

Neil Bailey, Director, *Environmental Management Act*

BC Ministry of Environment and Climate Change Strategy
Environmental Protection Division
Business Services Branch
PO Box 9377 Stn Prov Govt
Victoria, BC, V8W 9M1

October 2, 2019

Dear Neil Bailey,

Reference: Trans Mountain Pipeline ULC Westridge Marine Terminal (Wastewater Permit #3678)—Major Amendment Final Application for Phase 3 Works

Please find attached a pre-application form (Attachment 1), final application (Attachment 2), discharge factor forms (Attachment 3), and Technical Assessment Report (Attachment 4) for a major amendment of Trans Mountain Pipeline ULC's (Trans Mountain) Wastewater Discharge Permit #3678 for proposed Phase 3 construction at the Westridge Marine Terminal for review by the Director, *Environmental Management Act* (EMA), Ministry of Environment and Climate Change

The Westridge Marine Terminal expansion involves three Phases of construction activities and a final operational phase, and a series of permit amendments are required. A Major Amendment of Permit #3678 under the Waste Discharge Regulation and Public Notification Regulation (Section 1.2) of the EMA is requested for Phase 3 as a series of additional water quality parameters are being proposed and four new discharge locations are required. This application addresses the permit amendment requirements to support Phase 3 activities including the treatment of stormwater, concrete wastewater, hydrostatic test water and groundwater seepage and water from tunnel construction activities.

There are no additional changes in Authorized Works as a result of Phase 3 activities.

Westridge Marine Terminal Expansion Scope

The Westridge Marine Terminal expansion involves three Phases of construction activities and a final operational phase as described in Table 1.

Table 1 Westridge Marine Terminal Expansion Phases

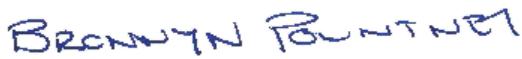
Phase	Description	Schedule	Proposed Permitting Requirement	Status
Phase 1	Early site works (outside of the permitted discharge area covered by Permit #3678) that do not require treatment of stormwater.	Q3 2019	Information Update	Letter submitted to BC ENV August 17, 2017
Phase 2	Early construction activities (outside of the permitted discharge area covered by Permit #3678) that require treatment of stormwater	Q3 2019 to Q1 2020	New Approval	Received August 14, 2018—Approval #109085
Phase 3	General construction activities for the Westridge Marine Terminal expansion that require relocation of the eastern outfall and the addition of discharge from outside of the existing permitted area, as well as treatment of stormwater, concrete wastewater, hydrostatic testwater, groundwater seepage and water from tunnel construction activities under the existing waste discharge Permit #3678 at Westridge Marine Terminal	Q1 2020 to Q1 2023*	Major Amendment to Permit #3678	As per this application
Phase 4	Operational activities under Permit #3678	Scheduled for operation by Q2 2022*	Major Amendment to Permit #3678	Pre-application in progress – targeting Q2 2020 submission
* The schedule of Phases 3 and 4 overlap - two berths will be operational (Phase 4) prior to the completion of the third berth (Phase 3).				

Closure

This letter and its attachments were prepared on behalf of Trans Mountain as an application for a Major Amendment of Permit #3678 for Phase 3 construction activities. If you have any questions or comments, please contact the undersigned.

Regards,

Trans Mountain



Bronwyn Pountney
Permitting Specialist
Trans Mountain Expansion Project
Phone: 403-514-6726
Bronwyn_Pountney@transmountain.com

Stantec Consulting Ltd.

**Lucy
Harrison**

Digitally signed by
Lucy Harrison
Date: 2019.10.02
17:44:18 -07'00'

Lucy Harrison
Regulatory Lead | Project Manager
Phone: (604) 412-3206
Lucy.Harrison@stantec.com

Attachments: 1) Amendment Pre-Application Form
2) Amendment Final Application Form
3) Discharge Factor Forms
4) Technical Assessment Report
5) Information Requirements Table - Westridge Phase 3

cc. Pam Hayward, Stantec Consulting Ltd.
Mike Christian, Kiewit/Ledcor TMEP Partnership
Aman Oberoi, Kiewit/Ledcor TMEP Partnership

ATTACHMENT 1

Amendment Pre-Application Form

PRELIMINARY Application for an Authorization AMENDMENT

for authorization to discharge waste under the *Environmental Management Act*

Permit, Approval or Operational Certificate

FORM REFERENCE CODE: EPD-EMA-04.3

INSTRUCTIONS:

The amendment application process is comprised of multiple steps that require the submission of a preliminary application and fee, followed by meetings with Ministry staff, and submission of a final application. **This form may be used for submission of a Preliminary Application to amend a Permit, Approval or Operational Certificate.**

Before completing this application form, please review the following:

- Waste Discharge Regulation under the *Environmental Management Act* at www.bclaws.ca; and,
- Ministry information and guidance documents that will assist in understanding the registration process and any other documents that may be required at <http://www2.gov.bc.ca/gov/content?id=0876E90DA4744A449423D35EB4E09785>.

It is preferred that this form is completed using a computer or typewriter. If completing this form by hand, please PRINT clearly.

Mandatory fields are marked with an asterisk (*). Please ensure all required fields are completed or the application form may not be accepted.

Once the preliminary application has been submitted, the amendment application will be screened for completeness before the applicant is contacted to proceed through the Preliminary Application Phase.

A Tracking Number will be assigned to your request. Both the Authorization Number and Tracking Number should be referenced on all further documents submitted to support the amendment application request.

Under *Environmental Management Act*, a person is prohibited from introducing waste into the environment without authorization. Submitting an application to discharge is NOT an authorization to discharge.

This application form can be submitted to the Ministry of Environment & Climate Change Strategy by email (preferred), by mail or by courier.

There is an application fee of \$400.00 for Permits and Operational Certificates that is due upon submission. There is no application fee for Approvals, however additional variable discharge fees may be required. See section 9 for payment.

Mail or Email	Courier
Environmental Protection Division Business Services PO Box 9377 Stn Prov Govt Victoria, BC V8W 9M6 Email: PermitAdministration.VictoriaEPD@gov.bc.ca	Ministry of Environment & Climate Change Strategy Environmental Protection Division Business Services 3rd Floor, 525 Superior Street Victoria BC V8V 1T7

Section 1: Purpose of Application

*Authorization Type (check one)	<input checked="" type="checkbox"/> Permit Amendment <input type="checkbox"/> Approval Amendment <input type="checkbox"/> Operational Certificate Amendment	1
*Authorization Number	3678	2
*Discharge type (check one)	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse	3
* Amendment Type as defined in the <i>Environmental Management Act</i> <i>Public Notification Regulation</i>	<input checked="" type="checkbox"/> Significant amendment <input type="checkbox"/> Minor amendment	4
Amendment changes requested	<input checked="" type="checkbox"/> Change to discharge location, quantity or quality <i>Discharge Factor Amendment Form EPD-EMA-06 required</i> <input type="checkbox"/> Other clause changes <i>Clause Change Form EPD-EMA-07 required</i> <i>For name/address changes and transfers use form EPD.EMA-A2</i> <i>For cancellations, use form EPD.EMA-A3</i>	5
*Additional amendment request information	<i>e.g. to discharge air emissions from x number of stacks at a sawmill.</i> See cover letter. A Supporting Materials Package has been developed to assist BC ENV with their review of this Permit Amendment application. The supporting materials package includes sub-phase descriptions and figures, and photos that provide examples of each sub-phase activity. See Attachment 3.	6
Is an exemption from the Preliminary Application Phase¹ requested?	<input type="checkbox"/> Yes (<i>attach letter with rationale</i>) <input checked="" type="checkbox"/> No	7

¹ This request for an exemption option is intended for applicants that have previous experience with permitting under the *Environmental Management Act* and do not require a meeting with the Ministry to clarify requirements. If you are requesting to bypass the Preliminary Application Phase, ensure all components of the Amendment Application Form (EPD-EMA-05) have also been completed. Please note that requests may not always be granted. Incomplete applications may be returned if they don't meet Ministry requirements and the application fee may not be refunded.

Section 2: Applicant Information (“the Applicant”)

This must be the name of the company or person seeking authorization, NOT an Agent acting on their behalf.

*Applicant Type	<input checked="" type="checkbox"/> Business <input type="checkbox"/> Individual <input type="checkbox"/> Government			1
*Company Legal Name <i>as registered with the BC Registrar of Companies</i>	Trans Mountain Pipeline ULC			2
OR * Individual’s Full Legal Name				3
Doing Business As <i>if applicable</i>				4
Incorporation Number <i>as registered with the BC Registrar of Companies (if applicable)</i>	A0070893			5
*Contact Numbers <i>e.g. (999) 999-9999</i>	Phone 1-403-514-6590	Mobile		6
*Email Address <i>generic company email address</i>	info@transmountain.com			7
*Are there changes to the Legal, Mailing and Billing Addresses?	<input type="checkbox"/> Yes and changes are indicated below <input checked="" type="checkbox"/> No changes to the existing addresses for this authorization (proceed to next section)			8
*Legal Address <i>as registered with BC Registrar of Companies</i>	Unit # / Street			9
	City	Province	Postal Code	10
*Mailing Address <i>if different from above</i>	<input type="checkbox"/> Same as Legal Address			11
	Unit # / Street			12
	City	Province	Postal Code	13
*Billing Address <i>if different from above</i>	<input type="checkbox"/> Same as Mailing Address <input type="checkbox"/> Same as Legal Address			14
	Unit # / Street			15
	City	Province	Postal Code	16
Billing Email Address <i>if different than above</i>				17

Section 3: Applicant's Contact for Technical Information

Name of the person the Ministry can contact regarding the technical details of this application that is NOT the Agent.

Contact's Last Name	Pountney			1
Contact's First Name	Bronwyn			2
Contact's Title	Permitting Specialist			3
Mailing Address	<input type="checkbox"/> Mailing address is the same as Section 2 above			4
	Unit # / Street 2700, 300-5 Avenue SW			5
	City Calgary	Province AB	Postal Code T2P 5J2	6
Contact Numbers e.g. (999) 999-9999	Phone 1-403-514-6726	Mobile 1-587-830-3549		7
Email Address	bronwyn_pountney@transmountain.com			8

Section 4: Authorized Agent (“the Agent”)

The Applicant may authorize an Agent to deal with the Ministry directly on future aspects of this application. This section must be completed in full if an Agent is used. An Agent is a person who is not an employee of the Applicant.

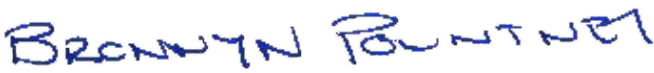
Agent's Company Legal Name <i>as registered with the BC Registrar of Companies</i>	Stantec Consulting Ltd.			1
Doing Business As <i>if different than above</i>				2
Agent's Last Name	Harrison			3
Agent's First Name	Lucy			4
Agent's Title	Environmental Planner			5
Mailing Address	Unit # / Street 500-4730 Kingsway			6
	City Burnaby	Province BC	Postal Code V5H 0C6	7
Contact Numbers <i>e.g. (999) 999-9999</i>	Phone 604-412-3206	Mobile 604-417-5241		8
Email Address	lucy.harrison@stantec.com			9

In this section:

“Applicant” means the applicant as identified in section 2 of this registration form;

“Agent” means the Agent as identified in section 4 of this registration form.

I/we (the Applicant) hereby authorize the above-named Agent to deal with the Ministry directly on all aspects of this registration. I/we (the Applicant) understand and agree with the terms and conditions in Section 8 of this application form.

Applicant's Full Name <i>NOT the Agent</i>	Bronwyn Pountney	10
Date signed	December 10, 2018	11
Signature of the Applicant		12

Section 5: Facility Location and Operator Information

Please confirm the following information regarding the facility

Facility Location <i>approximate centre of the site</i> <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.2881	Longitude (e.g., 116.8177) W -122.9547	1
Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input checked="" type="checkbox"/> Google Earth <input type="checkbox"/> Other (specify):		2
Either Legal Land Description or PID/PIN/Crown File Number is required.			
Legal Land Description (Lot/Block/Plan)	Lot 186 PL: 38021 DL: 217 LD: 37 New Westminster Group 1		3
PID/PIN/Crown File No.	PID 008-448-922		4
Facility Address	<i>Street / City / Province / Postal Code</i> <i>OR if no civic address, describe location (e.g. 3 km north of Sechelt, BC, on Highway 101)</i> Westridge Marine Terminal, 7065 Bayview Drive, Burnaby, BC <input checked="" type="checkbox"/> No change required		5
Is appropriate zoning in place for this facility?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If no, state why:		6
Facility Operator Contact First and Last Name	Mike Droppo		7
Facility Operator Title	Manager, Environment, Facilities		8
Facility Operator Contact Numbers <i>e.g. (999) 999-9999</i>	Phone 1-403-514-6537	Mobile 1-403-630-0161	9
Facility Operator Email Address	Mike_Droppo@kindermorgan.com		10

Section 6: Legal Land Owner of Facility (if not applicant)

*The Legal Land Owner of the facility is the Applicant.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	1
<i>*If the Applicant is not the Legal Land Owner:</i>		
Is this federal or provincial Crown land?	<input type="checkbox"/> Yes <input type="checkbox"/> No	2
Is the Legal Land Owner aware of the proposed application to discharge waste?	<input type="checkbox"/> Yes <input type="checkbox"/> No	3
Has the Legal Land Owner received a copy of this application?	<input type="checkbox"/> Yes <input type="checkbox"/> No	4
Legal Land Owner First and Last Name		
Legal Land Owner Contact Numbers <i>e.g. (999) 999-9999</i>	Phone:	Mobile:
Legal Land Owner Email Address		

Section 7: Checklist of Additional Information Required

Please note that if the following required information is not submitted with your Preliminary Application, the application may not be accepted as complete.

	Check box if included
DRAFT Discharge Factor Amendment Form (Form EPD-EMA-06)	<input checked="" type="checkbox"/> Included
<i>If requesting Preliminary Application Exemption Rationale Letter</i>	<input type="checkbox"/> Included

Documents Required LATER in the amendment application process

These documents are not needed at this time for the Preliminary Application Phase; however, they will be required for the Final Application Package. Applicants are strongly encouraged to submit drafts of these documents prior to any meetings with the Ministry.

	Included?
Information Requirements Table (IRT) <i>Draft only</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Clause Amendment Form (Form EPD-EMA-07)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Site Plan (Form EPD-EMA-09)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Environmental Protection Notice <i>Draft only</i>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Additional project background information	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Section 8: Declaration and Signature

Please carefully read the following before placing your signature.

By completing this Application for an authorization, the Applicant understands and agrees with the following terms and conditions:

1. In this section:

“Applicant” means the applicant as identified in section 2 of this application form;

“Authorization” means the permit, approval, operational certificate, or amended permit, approval, operational certificate, sought pursuant to this application;

“Director” means any statutory decision maker under EMA;

“EMA” means the *Environmental Management Act*, S.B.C. 2003, c. 53, as amended or replaced from time to time;

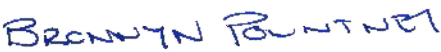
“FOIPPA” means the *Freedom of Information and Protection of Privacy Act*, R.S.B.C. 1996, c. 165, as amended or replaced from time to time;

“Province” means Her Majesty the Queen in Right of British Columbia;

“Regulatory Document” means:

- a) this application form,
- b) any document that the Applicant submits or causes to be provided submitted to the Province or the Director in support of this application, and
- c) any document that the Applicant submitted or causes to be submitted to the Director or the Province pursuant to
 - i. the Authorization;
 - ii. any regulation made under EMA that regulates the facility described above or the discharge of waste from that facility; or
 - iii. any order issued under EMA directed against the Applicant that is related to the facility described above or the discharge of waste from that facility.

2. In consideration of the Province receiving this application, subject to paragraph 3, the Applicant hereby irrevocably authorizes the Province to publish on the B.C. government website the entirety of any Regulatory Document.
3. Despite paragraph 2, if the Applicant clearly identifies on the face of a Regulatory Document that the Regulatory Document, or clearly identified portions of it, are confidential and provides in writing with the document a rationale for why the document or portion thereof could not be disclosed under FOIPPA, the Applicant does not consent to the Province publishing the document or any portion of it if, in the opinion of the Director, the document or portion could not be disclosed under FOIPPA, if it were subject to a request under section 5 of FOIPPA.
4. In consideration of the Province receiving this application, the Applicant agrees that it will indemnify and save harmless the Province and the Province’s employees and agents from any claim for infringement of copyright or other intellectual property rights that the Province or any of the Province’s employees or agents may sustain, incur, suffer or be put to at any time that arise from the publication of a Regulatory Document.
5. The Applicant certifies that the information provided in this registration form is true, complete and accurate, and acknowledges that the submission of insufficient information may result in this registration being returned causing delays in the registration review process.

*Name of Applicant or Agent (print)	*Signature of Applicant or Agent	*Date
Bronwyn Pountney		December 10, 2018

Section 9: Payment of Fees

PART A: Fee Calculation

Applicable fees	<p>The application fee is \$400 CDN for Permits and Operational Certificates. No PST or GST required.</p> <p>For Approvals, there is no application fee, however additional variable discharge fees may be required.</p>	1
*Amount submitted	\$ 400.00	2

PART B: Fee transmittal

<input checked="" type="checkbox"/> I would like a call-back to pay by credit card. <input type="checkbox"/> * DO NOT SEND CREDIT CARD INFORMATION VIA EMAIL *	<p>Please note there is currently no electronic payment system for credit card transactions. Please complete the following to arrange for a call-back to collect credit card payment information.</p>		1
	Name of cardholder	Amanda Szlepka	
	Phone number	(403) 514-6626 (999) 999-9999	
<input type="checkbox"/> <input type="checkbox"/> I am submitting my cheque or money order via mail/courier.	<p>Cheques or money orders not received within 10 business days may result in your application being returned as incomplete.</p> <p>In addition to submitting this application form electronically, please send a printed copy along with your cheque or money order.</p> <p><i>Mail:</i> Environmental Protection Division Business Services PO Box 9377 Stn Prov Govt Victoria, BC V8W 9M6</p> <p><i>Courier:</i> Ministry of Environment & Climate Change Strategy Environmental Protection Division Business Services 3rd Floor, 525 Superior Street Victoria BC V8V 1T7</p>		2
<input type="checkbox"/> <input type="checkbox"/> I have questions about the application fees and would like a call-back for consultation.	Name		3
	Phone number	(999) 999-9999	

ATTACHMENT 2

Amendment Final Application Form

FINAL Application Form for an Authorization AMENDMENT

for authorization to discharge waste under the *Environmental Management Act*

Permit, Approval, or Operational Certificate

FORM REFERENCE CODE: EPD-EMA-05.2

INSTRUCTIONS:

The amendment application process comprises of multi-steps that requires submission of a preliminary application and fee, followed by meetings with Ministry staff, and submission of a final application. **This form may be used for submission of a Final Application to amend a Permit, Approval or Operational Certificate.**

Before completing this application form, please review the following:

- Waste Discharge Regulation under the *Environmental Management Act* at www.bclaws.ca; and,
- Ministry information and guidance documents that will assist in understanding the registration process and any other documents that may be required at <http://www2.gov.bc.ca/gov/content?id=0876E90DA4744A449423D35EB4E09785>.

It is preferred that this form is completed using a computer or typewriter. If completing this form by hand, please PRINT clearly.

Mandatory fields are marked with an asterisk (*). Please ensure all required fields are completed or the application form may not be accepted.

Once the Final Application has been submitted, the application will be screened for completeness before proceeding through the Screening Phase.

A Tracking Number has been assigned to your request. Both the Authorization number and the Tracking Number should be referenced on all further documents submitted to support the amendment application request.

Under *Environmental Management Act*, a person is prohibited from introducing waste into the environment without authorization. Submitting an application to discharge is NOT an authorization to discharge.

This application form can be submitted to the Ministry by email (preferred), mail or by courier.

Mail or Email	Courier
Environmental Protection Division Business Services PO Box 9377 Stn Prov Govt Victoria, BC V8W 9M6 Email: PermitAdministration.VictoriaEPD@gov.bc.ca	Ministry of Environment & Climate Change Strategy Environmental Protection Division Business Services 3rd Floor, 525 Superior Street Victoria, BC V8V 0C5

Section 1: Application Information

*Tracking Number	378470	1
*Authorization Number	3678	2
*Applicant Name	Trans Mountain Pipeline ULC	3
*Facility Name	Westridge Marine Terminal	4
*Name of person completing this application	Lucy Harrison	5
*The person submitting this application is	<input type="checkbox"/> The Applicant as named on the Preliminary Application for Amendment Form, Section 2 <input checked="" type="checkbox"/> The Agent, as named on the Preliminary Application for Amendment Form, Section 4	6

The Application Package must include the following components or the application may be returned. Please refer to the guidance documents or contact the Ministry for further information on these requirements.

	Included	Not required / applicable	Submitted with Preliminary Application
Application Instruction Document (AID)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Information Requirements Table (IRT)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technical Assessment Report	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consultation Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discharge Factor Amendment Form (Form EPD-EMA-06)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clause Amendment Form (Form EPD-EMA-07)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Site Plan Form (Form EPD-EMA-09)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Location Map Form (Form EPD-EMA-08)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section 2: Declaration and Signature

Please carefully read the following before placing your signature.

By completing this Application for an authorization, the Applicant understands and agrees with the following terms and conditions:

1. In this section:

“Applicant” means the applicant as identified in section 2 of this application form;

“Authorization” means the permit, approval, operational certificate, or amended permit, approval, operational certificate, sought pursuant to this application;

“Director” means any statutory decision maker under EMA;

“EMA” means the *Environmental Management Act*, S.B.C. 2003, c. 53, as amended or replaced from time to time;

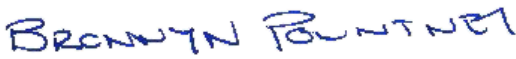
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“Province” means Her Majesty the Queen in Right of British Columbia;

“Regulatory Document” means:

- a) this application form,
- b) any document that the Applicant submits or causes to be provided submitted to the Province or the Director in support of this application, and
- c) any document that the Applicant submitted or causes to be submitted to the Director or the Province pursuant to
 - i. the Authorization;
 - ii. any regulation made under EMA that regulates the facility described above or the discharge of waste from that facility; or
 - iii. any order issued under EMA directed against the Applicant that is related to the facility described above or the discharge of waste from that facility.

- 2. In consideration of the Province receiving this application, subject to paragraph 3, the Applicant hereby irrevocably authorizes the Province to publish on the B.C. government website the entirety of any Regulatory Document.
- 3. Despite paragraph 2, if the Applicant clearly identifies on the face of a Regulatory Document that the Regulatory Document, or clearly identified portions of it, are confidential and provides in writing with the document a rationale for why the document or portion thereof could not be disclosed under FOIPPA, the Applicant does not consent to the Province publishing the document or any portion of it if, in the opinion of the Director, the document or portion could not be disclosed under FOIPPA, if it were subject to a request under section 5 of FOIPPA.
- 4. In consideration of the Province receiving this application, the Applicant agrees that it will indemnify and save harmless the Province and the Province’s employees and agents from any claim for infringement of copyright or other intellectual property rights that the Province or any of the Province’s employees or agents may sustain, incur, suffer or be put to at any time that arise from the publication of a Regulatory Document.
- 5. The Applicant certifies that the information provided in this registration form is true, complete and accurate, and acknowledges that the submission of insufficient information may result in this registration being returned causing delays in the registration review process.

*Name of Applicant or Agent (print)	*Signature of Applicant or Agent	*Date
Bronwyn Pountney		2019-10-02

ATTACHMENT 3

Discharge Factor Forms

Discharge Factor Amendment Form

for an Authorization to discharge waste under the *Environmental Management Act*

AMENDMENT to Permit, Approval, or Operational Certificate

FORM REFERENCE CODE: EPD-EMA-06.2

INSTRUCTIONS:

The amendment application process is comprised of multiple steps that requires submission of a preliminary application and fee, followed by meetings with Ministry staff, and submission of a final application. **This form may be used in conjunction with the submission of a Preliminary Application to amend a Permit, Approval or Operational Certificate.**

Before completing this application form, please review the following:

- Waste Discharge Regulation under the *Environmental Management Act* at www.bclaws.ca; and,
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It is preferred that this form is completed using a computer or typewriter. If completing this form by hand, please PRINT clearly.

Mandatory fields are marked with an asterisk (*). Please ensure all required fields are completed or the application form may not be accepted.

Once the final application has been submitted, the application will be proceed through the Screening Phase to verify administrative and technical completeness.

A Tracking Number will be assigned to your request. Both the Authorization Number and Tracking Number should be referenced on all further documents submitted to support the amendment application request.

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This application form can be submitted to the Ministry by email (preferred), mail or by courier.

Mail or Email	Courier
Environmental Protection Division Business Services PO Box 9377 Stn Prov Govt Victoria, BC V8W 9M6 Email: PermitAdministration.VictoriaEPD@gov.bc.ca	Ministry of Environment & Climate Change Strategy Environmental Protection Division Business Services 3rd Floor, 525 Superior Street Victoria, BC V8V 0C5

Section 1: Application Information

*Authorization Number	3678	1
*Tracking Number	378470	2
*Applicant Name	Trans Mountain Pipeline ULC	3
*Facility Name	Westridge Marine Terminal	4
*Number of discharge points	6	7

A copy of Section 2 must be completed for each discharge point. I.e. If there are three points of discharge, there should be three copies of Section 2 completed and submitted.

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	West Water Treatment Plant		1
*This discharge point is	<input type="checkbox"/> Existing point of discharge <input checked="" type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	West WTP (Figure 4-1)		4
Additional description (if needed)	The compliance point is as water leaves the water treatment plant.		5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Active treatment includes a water treatment plant - see Phase 3 Technical Assessment Report for more details.		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	As water leaves the water treatment plant		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.288468	Longitude (e.g., 116.8177) W -122.956119	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input checked="" type="checkbox"/> Other (specify): GIS		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Change requested			2,180	m3/day				

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
Total suspended solids	n/a	75 mg/L
pH	n/a	7.0 - 8.7
Total extractable hydrocarbons	n/a	5 mg/L
Hydrostatic testing - dissolved iron	n/a	0.35 mg/L
Hydrostatic testing - propylene glycol	n/a	500 mg/L
Hydrostatic testing - total residual chlorine	n/a	0.003 mg/L

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	East Water Treatment Plan		1
*This discharge point is	<input type="checkbox"/> Existing point of discharge <input checked="" type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	East WTP (Figure 4-1)		4
Additional description (if needed)	The compliance point is as water leaves the water treatment plant.		5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Active treatment includes a water treatment plant - see Phase 3 Technical Assessment Report for more details.		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	As water leaves the water treatment plant		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.289483	Longitude (e.g., 116.8177) W -122.952034	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input checked="" type="checkbox"/> Other (specify): GIS		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Change requested			4,360	m3/day				

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
Total suspended solids	n/a	75 mg/L
pH	n/a	7.0 - 8.7
Total extractable hydrocarbons	n/a	5 mg/L
Hydrostatic testing - dissolved iron	n/a	0.35 mg/L
Hydrostatic testing - propylene glycol	n/a	500 mg/L
Hydrostatic testing - total residual chlorine	n/a	0.003 mg/L

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	Foreshore Water Treatment Plant		1
*This discharge point is	<input type="checkbox"/> Existing point of discharge <input checked="" type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	Foreshore WTP (Figure 4-1_		4
Additional description (if needed)	The compliance point is as water leaves the water treatment plant.		5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Active treatment includes a water treatment plant - see Phase 3 Technical Assessment Report for more details.		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	As water leaves the water treatment plant		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.289941	Longitude (e.g., 116.8177) W -122.953012	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input checked="" type="checkbox"/> Other (specify): GIS		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Change requested			1,090	m3/day				

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
Total suspended solids	n/a	75 mg/L
pH	n/a	7.0 - 8.7
Total extractable hydrocarbons	n/a	5 mg/L
Hydrostatic testing - dissolved iron	n/a	0.35 mg/L
Hydrostatic testing - propylene glycol	n/a	500 mg/L
Hydrostatic testing - total residual chlorine	n/a	0.003 mg/L

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	Foreshore CO2 Bubbler		1
*This discharge point is	<input type="checkbox"/> Existing point of discharge <input checked="" type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	Foreshore CO2 Bubbler (Figure 4-1)		4
Additional description (if needed)	The compliance point is as water leaves the water treatment plant.		5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Active treatment includes a CO2 bubbler - see Phase 3 Technical Assessment Report for more details.		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	As water leaves the CO2 bubbler.		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N Dependent on foreshore construction activities	Longitude (e.g., 116.8177) W Dependent on foreshore construction activities	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input type="checkbox"/> Other (specify): n/a		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Change requested			300	m3/day				

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
pH	n/a	7.0 - 8.7
Hydrostatic testing - Total extractable hyc ⁺	n/a	5 mg/L
Hydrostatic testing - Total residual chlorin ⁺	n/a	0.003 mg/L
Hydrostatic testing - Dissolved iron	n/a	0.35 mg/L
Hydrostatic testing - Propylene glycol	n/a	500 mg/L

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	West permitted discharge		1
*This discharge point is	<input checked="" type="checkbox"/> Existing point of discharge <input type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	E258155 (Figure 4-1)		4
Additional description (if needed)			5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Existing discharge		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	Exit of T-201 (E258155)		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.288449	Longitude (e.g., 116.8177) W -122.957330	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input checked="" type="checkbox"/> Other (specify): GIS		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	415	m3/day	n/a	n/a	n/a	n/a
Change requested			n/a					

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
Total extractable hydrocarbons	5 mg/L	n/a

Section 2: Discharge Details

*Discharge Name e.g. Planer Mill Cyclone #2	East permitted discharge		1
*This discharge point is	<input type="checkbox"/> Existing point of discharge <input checked="" type="checkbox"/> New point of discharge		2
*Discharge Type	<input type="checkbox"/> Air <input checked="" type="checkbox"/> Effluent <input type="checkbox"/> Refuse		3
*EMS ID (existing) OR Site ID (new as referenced on Site Map ¹) e.g. Site A	E213525 (Figure 4-1)		4
Additional description (if needed)			5
Proposed treatment method and equipment to be used e.g. UV Disinfection, baghouse	Existing discharge		6
Discharge location description e.g. end of pipe, landfill, stack #1, etc	Exit of T-202 (E213525)		7
*Discharge location position i.e. end of pipe coordinates <i>must be in decimal degree format to 4 decimal places</i>	Latitude (e.g., 49.8952) N 49.289635	Longitude (e.g., 116.8177) W -122.954261	8
*Source of Data	<input type="checkbox"/> GPS <input type="checkbox"/> Survey <input type="checkbox"/> Google Earth <input checked="" type="checkbox"/> Other (specify): GIS		9
If the Legal Land Description for the facility location is different than this discharge location			
Legal Land Description (Lot/Block/Plan) OR PID/PIN/Crown File No.	PID 008-448-922		10

¹ For each point of discharge, there must be a corresponding point displayed on a map using the Site Form (Form EPD-EMA-09).

*Table A: Proposed Flows

INSTRUCTIONS: Complete the maximum rate of discharge, and if applicable, the minimum, and/or average rate. Typically, only a maximum is needed. Include the duration of the discharge (e.g., hours/day) and the frequency of the discharge (e.g., days/week, days/month or days/year). Typically, a discharge may start when the authorization is issued and continues until the authorization is cancelled. If this discharge is to be time limited, this should be discussed at your pre-application meeting. All units are to be in System International (SI) metric units.

	Minimum Discharge Rate	Average Discharge Rate	Maximum Discharge Rate	Units (e.g. m ³ /day)	Duration	Duration Units (e.g. hrs/day)	Frequency	Frequency units (days/weeks)
Existing Authorized Limit	n/a	n/a	415	m3/day	n/a	n/a	n/a	n/a
Change requested			n/a					

*Table B: Proposed Contaminant Concentrations

INSTRUCTIONS: The contaminant data should be the characteristics of the waste when it enters the environment. Guidance on acceptable discharge quality may be found in applicable Provincial and Federal Regulations, Objectives, Guidelines, Criteria, Policies, Codes of Practice, Best Achievable Control Technology (BACT), Best Management Practices and, in some cases, draft documents.

Enter the contaminant and its maximum concentration and if applicable, the minimum, and/or average concentrations. All units are to be SI metric units. If the contaminant is to be discharged for a period less than the life of the authorization, enter the start and/or end dates. All air discharge rates are to be corrected to 20°C, 1 atmosphere pressure, and zero water vapour.

Parameter or Contaminant Name	EXISTING Authorized Limit and Units	AMENDMENT REQUESTED Limit and Units
Total extractable hydrocarbons	5 mg/L	n/a

ATTACHMENT 4

Technical Assessment Report



Attachment 3—Technical Assessment Report

Phase 3: Westridge Marine Terminal—
Request for a Major Amendment of an
Existing Permit

Ministry of Environment Application
Tracking #378470

October 2, 2019

Prepared for:

Trans Mountain Pipeline ULC

Prepared by:

Stantec Consulting Ltd.

TMC Doc No.:
01-13283-TW-WT00-EV-RPT-0007 R1

Sign-off Sheet

This document entitled Westridge Marine Terminal Technical Assessment Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Trans Mountain Pipeline ULC (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not consider any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

As per the Province of British Columbia, a Qualified Environmental Professional (QEP) is an "applied scientist or technologist who is registered and in good standing with an appropriate BC professional organization constituted under an Act. The QEP must be acting under that association's code of ethics, and subject to the organization's disciplinary action." A QEP can be a professional Biologist, Agrologist, Forester, Geoscientist, Engineer, or Technologist. The staff that contributed to this Report are considered QEPs since they are Registered Professional Biologists (R.P.Bio.) in good standing with the College of Applied Biology or professional engineers registered with the Association of Professional Engineers and Geoscientists of British Columbia (P.Eng.).

Hydrologic modelling was completed by Ali Naghibi, P.Eng. Ali is a licensed Water Resources Engineer with over 15 years of experience in hydrologic and hydraulic modelling studies, hydrology monitoring studies, water balance modelling, and water management plans.

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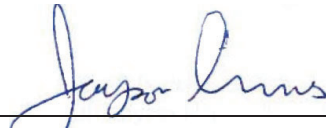
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WESTRIDGE MARINE TERMINAL TECHNICAL ASSESSMENT REPORT

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WESTRIDGE MARINE TERMINAL TECHNICAL ASSESSMENT REPORT

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Executive Summary

Trans Mountain Pipeline ULC (Trans Mountain) is seeking approval from the Director, *Environmental Management Act*, Ministry of Environment and Climate Change Strategy (BC ENV), for a Major Amendment to Westridge Marine Terminal (the “Terminal” or “Site”) Wastewater Permit #3678 (issued March 25, 2014). This Technical Assessment Report (TAR) has been developed for Phase 3 construction activities based on BC ENV’s March 13, 2019 email and its attachments addressed to Trans Mountain titled “2019-03-13 Application Instruction Document (AID) with Final Information Requirements Table (IRT) for WMT Phase 3”.

Westridge Marine Terminal currently handles crude oil and jet fuel. Oil is shipped from the Edmonton Terminal in Alberta through the Trans Mountain pipeline to the Burnaby Terminal, located south of Burnaby Mountain. From Burnaby Terminal, oil is distributed northwest to the Westridge Marine Terminal for direct loading onto vessels; no oil is stored at the Westridge Marine Terminal. Following completion of the Trans Mountain Expansion Project (TMEP), oil will be dispatched from Burnaby Terminal to Westridge Marine Terminal via three delivery lines through Burnaby Mountain tunnel directly to marine berths for loading onto tankers. Capacity of the TMEP will be expanded to 141,500 cubic metres per day (m³/d) [890,000 bbl/d]; up to 100,200 m³/d (630,000 bbl/d) of oil may be delivered to the Westridge Marine Terminal for loading and shipment.

Four phases of work are needed to complete construction activities at the Terminal—three construction phases and a final operational phase. Phase 3 construction activities include the following: manifold and pipe rack area construction, tunnel and substation construction and reclamation, and the installation of foreshore concrete foundations and an offshore superstructure to allow additional ships to dock at the Terminal. To support these activities, discharge from outside of the existing permitted area will be added, and stormwater, hydrostatic test water, wastewater from concrete curing activities, groundwater seepage and water from tunnel construction activities will require treatment.

Where construction activities could potentially impact the environment, an analysis was carried out to determine the scale of impact. Considering the implementation of erosion and sediment controls and management plans, site planting and restoration activities, the installation of three water treatment plants (WTPs) specifically designed for the Site and CO₂ bubblers, the potential impacts on the receiving environment are expected to be limited.

Based on Phase 3 construction activities, Trans Mountain proposes that the following amendments be made to Permit #3678:

- No change to the quantity and quality limits for the two existing discharges under Permit #3678—E258155 and E213525
- Addition of four compliance points (for a total of six), each with a daily discharge quantity dependent on the size of the contributing catchment for each WTP and/or CO₂ bubbler



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- Addition of the following water quality parameters depending on the construction activity or phase of construction:

Parameter	Proposed Limit
TSS	75 mg/L
pH	7.0–8.7
Total extractable hydrocarbons (TEH)	5 mg/L
Total residual chlorine ^{1, 2}	0.003 mg/L
Dissolved iron ¹	0.35 mg/L
Propylene glycol ¹	500 mg/L
NOTES: ¹ Only during hydrostatic testing ² Only when municipal water is used.	



Abbreviations

AID	Application Instruction Document
ARD	acid rock drainage
ARDMP	Acid Rock Drainage Management Plan
AWWQG	Approved/Working Water Quality Guidelines
bbl	oil barrels
BC	British Columbia
BC CSR	British Columbia Contaminated Site Regulations
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
BC MOE	British Columbia Ministry of Environment
BC OGC	BC Oil and Gas Commission
BC WQG	British Columbia Water Quality Guidelines
BCGS	British Columbia Geographic System
BPD	barrels per day
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CALA	Canadian Associated of Laboratory Accreditation
CCME	Canadian Council of the Ministers of the Environment
CCTV	closed-circuit television
CD	chart datum
CESF	chitosan enhanced sand filtration
COD	chemical oxygen demand
CP Rail	Canadian Pacific Railway
CPCN	Certificate of Public Convenience and Necessity
CRM	certified reference material
CSA	Canadian Standards Association
DFO	Fisheries and Oceans Canada
EAO	Environmental Assessment Office
ECCC	Environment and Climate Change Canada
EMA	<i>Environmental Management Act</i>



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EPBM	earth pressure balance machine
EPH	extractable petroleum hydrocarbons
EPP	Environmental Protection Plan
ESC	erosion and sediment control
GHAB	guided horizontal auger boring
GIC	Governor in Council
GPM	gallons per minute
HEPH	heavy extractable petroleum hydrocarbons
HSV L	headspace vapour level
IDF	intensity-duration frequency
IL	industrial
IRT	Information Requirements Table
ISQR	Interim Sediment Quality Guidelines
ISWRA	Intermediate Storm Water Retention Area
KLTP	Kiewit Ledcor Trans Mountain Partnership
LDCC	low density cellular concrete
LEPH	light extractable petroleum hydrocarbons
LTDL	less than detection limit
MSDS	Material Safety Data Sheet
NEB	National Energy Board
NP	neutralization potential
NPS	nominal pipe size
NTU	nephelometric turbidity unit
OWW	observation water wells
PAG	potentially acid generating
PAH	polycyclic aromatic hydrocarbons
PENO	probability of these events not occurring
PER	Project Environmental Review
PHC	petroleum hydrocarbon constituents
PLC	programmable logic controller



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QA/QC	quality assurance/quality control
QRS	Qualified Resource Specialist
RMSE	root mean square error
RMWRMP	Rock Mass and Waste Rock Management Plan
SCA	secondary containment areas
SFU	Simon Fraser University
SQG	Soil Quality Guidelines
TAR	Technical Assessment Report
TBM	tunnel boring machine
TCA	Tertiary Containment Area
TCLP	Toxicity Characteristic Leaching Procedure
TEH	total extractable hydrocarbons
TMEP	Trans Mountain Expansion Project
TOC	total organic carbon
TSS	total suspended solids
USDA	United States Department of Agriculture
VFPA	Vancouver Fraser Port Authority
VH	volatile hydrocarbons
VOC	volatile organic carbon
VPH	volatile petroleum hydrocarbons
WMT	Westridge Marine Terminal
WQG	Water Quality Guidelines
WTP	water treatment plant



WESTRIDGE MARINE TERMINAL TECHNICAL ASSESSMENT REPORT

Introduction
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1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) has an existing Waste Discharge Permit #3678 under the *Environmental Management Act* (EMA), from the Ministry of Environment and Climate Change Strategy (BC ENV) for Westridge Marine Terminal (the Terminal or Site) in Burnaby, British Columbia (BC). Permit #3678 authorizes Trans Mountain to discharge stormwater during operations from dyked tank areas (see Section 1.2.5 for more detail).

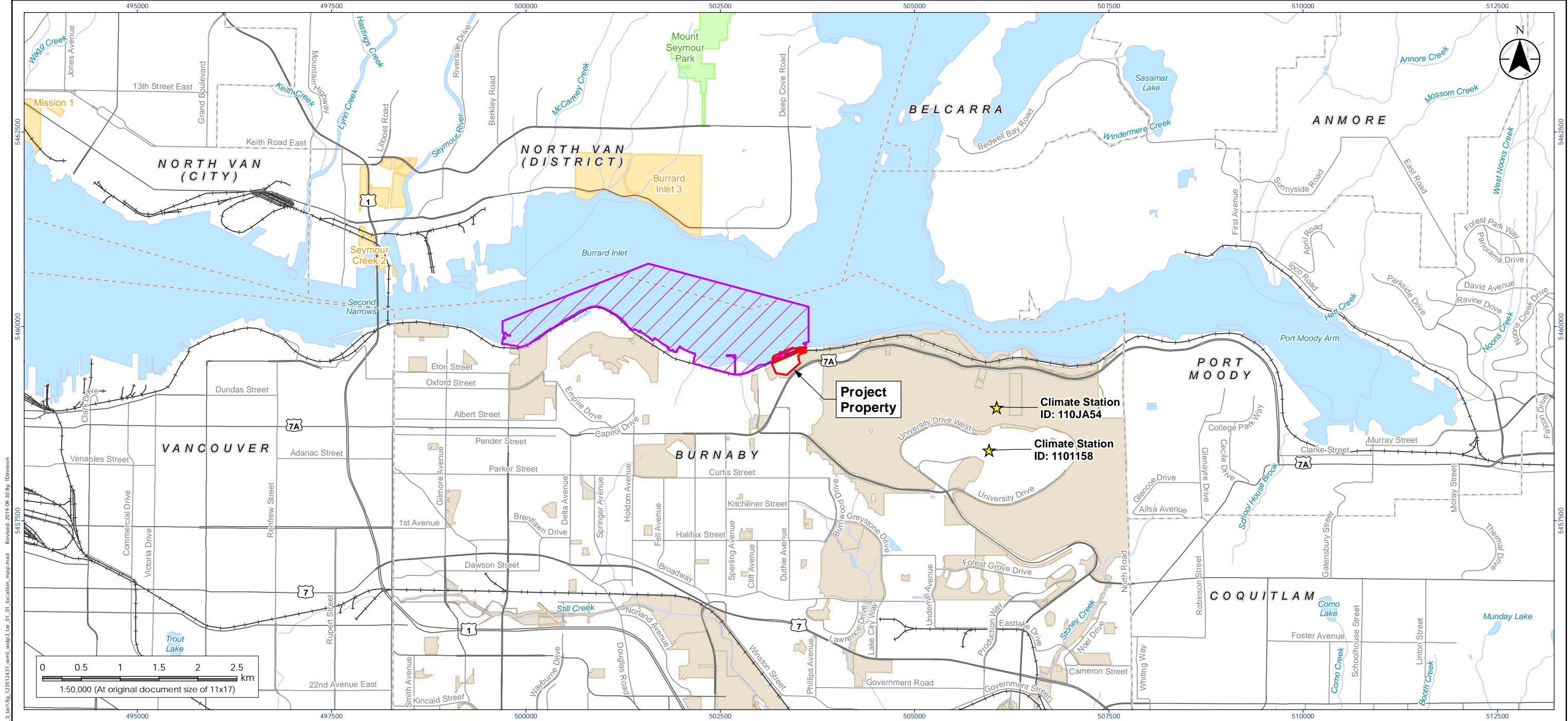
To support Phase 3 construction activities (the Works) at the Terminal as part of the Trans Mountain Expansion Project (TMEP or the Project), Trans Mountain is seeking a Major Amendment to Permit #3678 (the Permit amendment) from the Director of BC ENV (Figure 1-1) for the discharge of stormwater associated with construction activities (Application Tracking Number 378470). The Works include manifold and pipe rack construction, tunnel and substation construction, hydrostatic testing of facility piping and the tunnel, and the installation of foreshore concrete foundations and an offshore superstructure to allow additional ships to dock at the Terminal. Consequently, treatment of stormwater, wastewater from concrete curing activities, groundwater seepage and water from tunnel construction activities, and hydrostatic test water will be required.

This technical assessment report (TAR) was developed to support Trans Mountain's application for a Permit amendment and is based on BC ENV's March 13, 2019 email and its attachments addressed to Trans Mountain titled "2019-03-13 Application Instruction Document (AID) with Final Information Requirements Table (IRT) for WMT Phase 3".

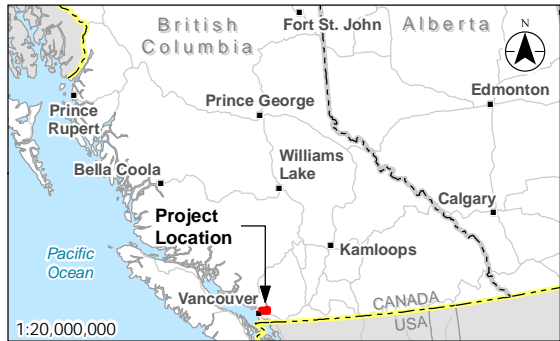
To facilitate review of Trans Mountain's application for a Major Amendment, the TAR follows guidance provided in the above-mentioned email and includes:

- Overview of the Trans Mountain Expansion Project and Westridge Marine Terminal (Sections 1.1 and 1.2)
- Description of the proposed changes to the Terminal during Phase 3 construction activities and associated mitigation measures (Section 2.0)
- Existing environmental conditions (Section 3.2)
- Analysis of potential impacts (Section 3.3)
- Proposed changes to Permit #3678 (Section 4.0)





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Revised: 2019-09-30 By: TDINNEEN
5457500
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5462500



Notes

1. Coordinate System: NAD 1983 BC Environment Albers
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
3. Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
4. This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

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- Highway
- Major Road
- Railway
- Watercourse
- Waterbody
- First Nations Reserve
- Park, Ecological Reserve, or Protected Area
- City of Burnaby Municipal Park
- ★ Climate Station
- ▭ Project Property Boundary
- ▨ Rockfish Conservation Area
- ▭ Municipal Boundary



Project Location NTS: 092G07 BCGS: 92G.026 UTM: 10U 503386 5459495	Project Number 123512431 Prepared by TDINNEEN 20190708 PM Review LHARRISON 20190927
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Client/Project Trans Mountain Pipeline ULC Trans Mountain Expansion Project Waste Discharge Phase 3 Technical Assessment Report	Project Contact Bronwyn Pountney 403-514-6726 Suite 2700, 300 5th Avenue SW, Calgary, AB, T2P 5J2
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Figure No. 1-1	Page No. 1 of 1	Doc No. 01-13283-TW-WT00-EV-RPT-0007
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Westridge Marine Terminal Location

1.1 TRANS MOUNTAIN EXPANSION PROJECT

1.1.1 Company Overview

The Trans Mountain Pipeline Company (Table 1-1) was established in 1951 to construct and operate the Trans Mountain Pipeline between Edmonton, Alberta and Burnaby, British Columbia. The pipeline and terminals began operation in 1953, creating a reliable energy supply for Canada and the United States. Since 1953 average daily throughput has been progressively increased from 150,000 barrels per day (BPD) to 300,000 BPD.

Table 1-1 Company Overview

Registered legal name	Trans Mountain Pipeline ULC
Incorporation Number	BC-XPO448710
Registered address of company	7065 Bayview Drive, Burnaby, BC V5A 4T3
Head office contact name and phone and fax numbers	Mike Droppo, Manager, Environment, Facilities, Trans Mountain Pipeline ULC Phone: 1-403-514-6537 Mobile: 1-403-630-0161 Email: Mike_Droppo@kindermorgan.com
Site office location and contact name, phone, fax numbers and email address	7065 Bayview Drive, Burnaby, BC V5A 4T3
Corporate Environmental Policy	Kinder Morgan's environment, health and safety policy is available here: ¹ https://www.kindermorgan.com/content/docs/ehs_policy_statement.pdf

1.1.2 Overall Project Approvals to Proceed

1.1.2.1 Federal and Provincial Certificates

Trans Mountain submitted a Facilities Application to the National Energy Board² (NEB) in December 2013 for the proposed Project. On November 29, 2016, the Governor in Council (GIC) concluded that the Project was in the public interest of Canada. A Certificate of Public Convenience and Necessity (CPCN) (OC-064) allowing the Project to proceed, subject to 157 Conditions, was issued on December 1, 2016.

On January 11, 2017, the British Columbia Environment Minister and Natural Gas Development Minister issued an Environmental Assessment Certificate (e17-01) to Trans Mountain for the BC portion of the Project, subject to 37 Conditions (the BC Environmental Assessment Office [EAO] Conditions). Although some of these conditions are applicable to the Westridge Marine Terminal, none are specifically related to

¹ Trans Mountain continues to adopt Kinder Morgan's environmental, health and safety policy despite its recent ownership change.

² On August 28, 2019, the *Canadian Energy Regulator Act* came into force. The *Canadian Energy Regulator Act* creates the new Canada Energy Regulator and repeals the *National Energy Board Act*.



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discharge of construction-impacted runoff water during the Works included in this application for a Permit amendment.

On August 30, 2018, the Federal Court of Appeal issued a decision to set aside the Governor in Council's approval of the TMEP, rendering the NEB Certificate of Public Convenience and Necessity (CPCN) OC-064 a nullity.³ Following the Federal Court of Appeal decision on August 30, 2018, the GIC directed the NEB to reconsider its previous recommendations. On February 22, 2019, the NEB issued its reconsideration report, in which it recommended the Project be approved subject to 156 conditions (150 conditions remain unchanged, six conditions were amended, and one condition was directed towards the Federal government). From October 2018 to June 2019, the Government of Canada undertook renewed Phase III consultations with affected Indigenous groups (more details can be found here: <https://www.canada.ca/en/campaign/trans-mountain/what-weve-done/previous-indigenous-consultations.html>). On June 13, 2019, the GIC issued its report on the Phase III consultations titled *Trans Mountain Expansion Project – Crown Consultation and Accommodation Report*. On June 18, 2019, the GIC approved the Project and directed the NEB to issue a CPCN to Trans Mountain. A new CPCN was issued for the TMEP on June 21, 2019.

1.1.2.2 Federal Permits

As part of the Project, the Westridge Marine Terminal (WMT or the Terminal) will require expansion, including construction of three new loading berths within an expanded water lot and infilling along the existing shoreline to accommodate new onshore infrastructure. On August 28, 2017 Vancouver Fraser Port Authority (VFPA) issued Project Permit 15-322 authorizing upgrades to the Westridge Marine Terminal on VFPA property.

On September 8, 2017 Trans Mountain received *Fisheries Act* Authorization No. 17-HPAC-00071, which authorizes the in-water works that are likely to result in the permanent alteration or destruction of intertidal and subtidal fish habitat. The Authorization includes a number of conditions related to mitigation, monitoring, and reporting. The Authorization does not stipulate a quantitative guideline for total suspended solids (TSS).

Trans Mountain commenced construction of the Westridge Marine Terminal Upgrades in September 2017.

Following the issuance of the new CPCN for TMEP, VFPA and Fisheries and Oceans Canada (DFO) informed Trans Mountain that the previously issued authorizations for the Westridge Marine Terminal expansion were nullified by the August 30, 2018 FCA decision. Trans Mountain re-applied for both the VFPA Project Permit and the *Fisheries Act* Authorizations for Westridge. The engineering and design of the facility as well as the environmental effects and proposed mitigations included in the permit applications remain materially the same as the original applications submitted to DFO and VFPA in 2017. DFO issued Authorization number 19-HPAC-0051 to Trans Mountain on September 12, 2019 and VFPA issued Project Permit 19-162 on September 27, 2019.

³ *Tsleil-Waututh Nation v Canada (Attorney General)*, 2018 FCA 153 ("*Tsleil-Waututh*"), para 768.



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The Westridge Marine Terminal Environmental Protection Plan (EPP) (CPCN Condition 81 of 156), applies to the Works at the Terminal for this Permit amendment (Appendix A). Key mitigation measures to address discharge of construction-impacted runoff water as stated in the Westridge Marine Terminal EPP (Appendix A) include:

- Prepare a site-specific Erosion and Sediment Control Plan (ESC) in compliance with regulatory requirements and submit to the Trans Mountain Environmental Inspector for review
- Detailed excavation and construction procedures that are undertaken in such a manner as to prevent sediment-laden runoff from the site of the work from directly entering natural drainage systems or marine environment
- Ensure that disturbed areas are kept dewatered with concentrated surface runoff either directed around work areas with interceptor ditches or temporarily contained within closed conduits
- Direct concentrated surface runoff to water conveyance and storage features (e.g., settling pond). Ensure that water contained in on-site settling ponds, or an approved equivalent, is treated and, where warranted, sampled prior to discharge
- Manage the potential for off-site migration of sediments through the installation of erosion and sediment control measures (e.g., coir logs, erosion control matting, sediment fence and crushed gravel) where indicated in the ESC. Ensure that surface runoff not collected into water conveyance and storage features passes through installed erosion and sediment control features prior to migration off-site.
- Regularly monitor erosion and sediment control measures in accordance with regulatory requirements and the ESC (i.e., a minimum of weekly during normal operations and daily during storm events). Initiate corrective measures or implement supplemental erosion and sediment control measures in areas where deficiencies are noted, in consultation with the Environmental Inspector.

A *Water Sustainability Act* Section 11 Permit for changes in and about a stream for the Terminal (see the sub-phase 3.2 description in Section 2.1.2) was issued by the BC Oil and Gas Commission (BC OGC) on May 1, 2018.

1.2 WESTRIDGE MARINE TERMINAL

1.2.1 Property Description and Location

The Terminal is located at 7065 Bayview Drive (Figure 1-1) in Burnaby, British Columbia. The Terminal is the western coastal loading and shipping facility for Trans Mountain. It was built in 1952, was put into operation in 1953. The Terminal exports crude oil products to California and Asia and distributes aviation jet fuel imported from Washington State refineries to Vancouver International Airport.

The Terminal is located on and above the southern shoreline of the Central Harbour in Burrard Inlet within VFPA jurisdiction. The Terminal is surrounded by lands zoned as a Park and Public Use District (zone code P3) within the City of Burnaby. The topography of the Terminal area is sloping from south (high) to the north (low) toward Burrard Inlet and the elevation ranges from approximately 30 metres (m) to 0 m above sea level (see Table 1-2 for location details).



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Table 1-2 Property Location Details

Criteria	Information
Location:	Latitude: 49.2881 Longitude: -122.9547
Legal Land Description (Lot/Block/Plan):	LOT: 186 PL: 38021 DL: 216 LD: 37 New Westminster Group 1
PID/PIN/Crown File No.:	PID 008-448-922
Facility:	Address: Westridge Marine Terminal, 7065 Bayview Drive, Burnaby, BC Operator: Mike Droppo, Manager, Environment, Facilities, Trans Mountain Pipeline ULC Phone: 1-403-514-6537 Mobile: 1-403-630-0161 Email: Mike_Droppo@kindermorgan.com

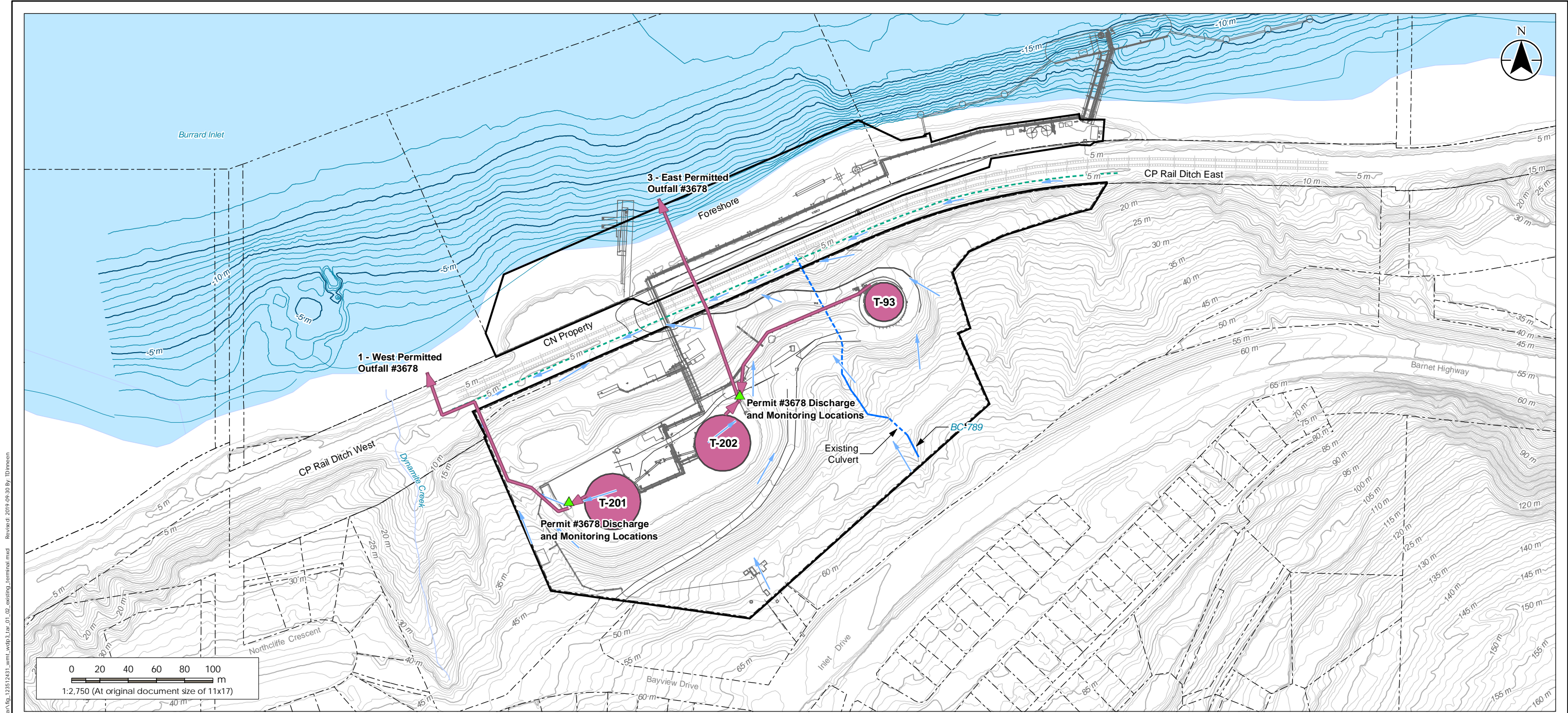
1.2.2 Existing Facilities Layout

Figure 1-2 provides the existing facilities layout of the Westridge Marine Terminal.

Westridge Marine Terminal currently handles crude oil and jet fuel. Three existing tanks are located at the terminal for storage of jet fuel, which is not part of TMEP. Jet fuel is received at the Terminal by vessel and is delivered to the Vancouver International Airport by Kinder Morgan's Jet Fuel pipeline.

Oil is shipped from the Edmonton Terminal in Alberta through the Trans Mountain pipeline to the Burnaby Terminal, located south of Burnaby Mountain. From Burnaby Terminal, oil is distributed northwest to the Westridge Marine Terminal for direct loading onto vessels; no oil is stored at the Westridge Marine Terminal. Currently, each month, an average of five tankers and three barges are loaded with crude oil and jet fuel is unloaded from one or two barges.





- Project Property Boundary
- Parcel Lot
- Existing Building/Facility
- Existing Road/Rail
- Topographic Contour (m)
- Bathymetric Contour (m)
- Watercourse
- Waterbody
- Compliance Monitoring Location
- Permit #3678 Outfall
- Drainage Direction
- Existing Watercourse
- Existing Culvert
- Existing CP Rail Ditch
- Permit #3678 Discharge Area

Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINNEEN 20190708
PM Review LHARRISON 20190927

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project
Waste Discharge Phase 3
Technical Assessment Report

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Bronwyn Pountney
403-514-6726
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Calgary, AB, T2P 5J2

Figure No. 1-2
Page No. 1 of 1
Doc No. 01-13283-TW-WT00-EV-RPT-0007

Westridge Marine Terminal - Existing Conditions

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1.2.3 Existing Water Management, Treatment and Discharges

The Westridge Marine Terminal area covers 6.2 hectares (ha) (“the Site”). The Site is characterized by forest, grassed areas, and current land uses including roads, industrial buildings, fence line and three jet fuel storage tanks. Each tank is within a dyked tank area for secondary containment. Discharge from the secondary containment is authorized by Permit #3678. Precipitation falling on impervious secondary containment areas is collected and passes through oil/water separators before discharging into Burrard Inlet via two permitted outfalls (Figure 1-2, Table 1-3). Runoff from tank T-93 (0.09 ha) and the east half of the T-201/T-202 secondary containment areas (0.44 ha) discharges to the east permitted outfall (E213525). Runoff from the west half of the T-201/T-202 secondary containment area (0.42 ha) discharges into the Burrard Inlet via the west permitted outfall (E258155).

Runoff generated on the Site in areas outside of the secondary containment areas drains to the Canadian Pacific Railway (CP Rail) ditch, or directly to the Burrard inlet through culverts under the CP Rail ditch. Runoff generally infiltrates to groundwater through flat, coarse-gravel ditches (railway ballast). During intense storm events where the ditch infiltration capacity is exceeded, runoff can reach two non-permitted outfalls (culverts) via sumps within the ditch, which discharge into Burrard Inlet (Figure 1-2, Table 1-3). These two outfalls were included as part of the Phase 2 Approval application (see Table 1-4), but for the purposes of this TAR will be referred to as “non-permitted”, i.e., not currently included as part of Permit #3678. A total of 2.92 ha of mostly forested land drains onto the Site from upslope, off Terminal areas.

Due to scheduling and permitting constraints, this TAR assumes that that some Phase 2 activities (under Approval #109085) may not have been completed by the time an amendment to Permit #3678 for Phase 3 activities is issued. These Phase 2 activities have been incorporated into the Phase 3 works described herein (refer to Phase 3.1—Manifold and Pipe Rack Area and Phase 3.2—Tunnel and Substation Area, described in Sections 2.1.1 and 2.1.2 respectively). The layout of the Terminal at the beginning of Phase 3 is assumed to be the same layout as at completion of Phase 1. Construction activities in Phase 3 will expand the discharge area included in Permit #3678.

Table 1-3 Marine Foreshore Outfall Locations

Outfall	Latitude N	Longitude W
West Permitted Outfall (Permit #3678—E258155)	49.288449	-122.957330
East Permitted Outfall (Permit #3678—E213525)	49.289635	-122.954261



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1.2.4 Planned Changes to Westridge Marine Terminal

Following completion of the TMEP, oil will be dispatched from Burnaby Terminal to Westridge Marine Terminal via three delivery lines through Burnaby Mountain tunnel directly to marine berths for loading onto tankers. Capacity of the Project will be expanded to 141,500 cubic metres per day (m^3/d) [890,000 bbl/d]; up to 100,200 m^3/d (630,000 bbl/d) of oil may be delivered to the Westridge Marine Terminal for loading and shipment. The Terminal will have a peak instantaneous loading rate of 4,630 m^3/h (30,000 bbl/h) for each berth and an average loading rate of 4,170 m^3/h (26,250 bbl/h). The number of tanker loadings of crude oil will increase to the equivalent of up to 34 loaded Aframax class tankers per month upon Project completion. The number of barge loadings is not expected to change and the number of barge unloadings is likely to decrease once alternate jet fuel receiving facilities have been commissioned (e.g., Vancouver Airport Fuel Delivery Project).

1.2.5 Environmental Management Act Submissions Related to Overall Terminal Expansion Activities

The Terminal has an existing Waste Discharge Permit #3678 (Appendix B) for effluent discharge from the dyked tank farm. The dyked tank farm is comprised of three jet fuel storage tanks, authorized works for the tank discharge, and two discharge locations (Figure 1-2). The Permit allows for a maximum annual average rate of discharge of 26 m^3 per day and a maximum rate of discharge of 415 m^3 per day from each of the two discharge locations (E213525 and E258155), with a maximum concentration of 5 mg/L of total extractable hydrocarbons (TEH).

Four Phases of work are needed to complete construction activities at the Terminal (Table 1-4). An information update letter for Phase 1 works was submitted to BC ENV on August 17, 2017 regarding planned early Site works to be completed on the eastern side of the Terminal, outside the permitted dyked tank farm, and as part of the planned expansion at the Terminal (Table 1-4).

Approval #109085 was issued by BC ENV on August 14, 2018 for Phase 2 activities outside of the permitted dyked tank farm: access road widening and tunnel portal excavation. The Approval allows for the following for 15 months from issue:

- East water treatment plant (WTP)
 - Maximum rate of discharge of 777,600 m^3 per year
 - Maximum daily rate of discharge of 4,320 m^3
 - Maximum concentration of 5 mg/L of TEH and 75 mg/L of TSS
- West WTP
 - Maximum rate of discharge of 388,800 m^3 per year
 - Maximum daily rate of discharge of 2,160 m^3
 - Maximum concentration of 5 mg/L of TEH and 75 mg/L of TSS



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A future permit amendment application for Phase 4 will be submitted to BC ENV. The amendment request will be for the final design and installation of new collection and treatment works for operation of the Terminal. Table 1-4 summarizes the four Phases and their EMA waste discharge permitting requirements (Table 1-4).

Table 1-4 Westridge Marine Terminal Expansion Phases

Phase	Description	Schedule	Permitting Requirement	Status
Phase 1	Early site works (outside of the permitted discharge area covered by Permit #3678) that do not require treatment of stormwater.	Q3 2019	Information Update	Letter submitted to BC ENV August 17, 2017
Phase 2	Early construction activities (outside of the permitted discharge area covered by Permit #3678) that require treatment of stormwater	Q3 2019 to Q1 2020	New Approval	Received August 14, 2018—Approval #109085
Phase 3	General construction activities for the Westridge Marine Terminal expansion that require relocation of the eastern outfall and the addition of discharge from outside of the existing permitted area, as well as treatment of stormwater, concrete wastewater, hydrostatic testwater, groundwater seepage and water from tunnel construction activities under the existing waste discharge Permit #3678 at Westridge Marine Terminal	Q1 2020 to Q1 2023¹	Major Amendment to Permit #3678	As per this application
Phase 4	Operational activities ² under Permit #3678	Scheduled for operation by Q2 2022*	Major Amendment to Permit #3678	Pre-application in progress – targeting Q2 2020 submission
¹ The schedule of Phases 3 and 4 overlap - two berths will be operational (Phase 4) prior to the completion of the third berth (Phase 3). ² The Best Achievable Technology for final build out can be found in Appendix C.				

1.2.6 Major Amendment Required for Phase 3 Works

This TAR addresses the Major Amendment requirements to support Phase 3, including changes to the number of discharges and associated compliance points, and water quality and water quantity limits (see Section 4.4 and Table 2-3 for more information).



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Phase 3 Works at the Terminal will take place in nine sub-phases (see Section 2.1). Each sub-phase includes site-specific mitigation measures and water treatment to avoid and limit potential environmental impacts on water quality, specifically total suspended solids (TSS) from construction contact water, runoff from concrete works (reflected by a change in pH) and additional water quality parameters related to hydrostatic testing: TEH, free residual chlorine, free total chlorine, dissolved iron and propylene glycol. Erosion and sediment control (ESC) and water treatment mitigation measures will be implemented as per the work in progress (Appendix D). Appendix E illustrates the activities that will occur during each sub-phase.

The notification of interested parties requirements are described in the Westridge Marine Terminal EPP and the Facilities EPP (NEB Conditions 78 and 81) and align with the Public Notification Regulation. Notifications will be made via various media including signage, publications and direct communications to federal, provincial and municipal governments and applicable regulatory agencies, Indigenous communities, stakeholders and the general public. These notifications will meet the requirements of the Public Notification Regulation.



2.0 PROPOSED CHANGES TO THE TERMINAL

2.1 DESCRIPTION OF THE WORKS AND ASSOCIATED MITIGATION MEASURES

The planned Phase 3 Works will take place in nine sub-phases as described in Appendix D and summarized below. The Works include the following activities: manifold and pipe rack area construction, tunnel and substation construction and reclamation, and the installation of foreshore concrete foundations and an offshore superstructure to allow additional ships to dock at the Terminal (see Figure 2-1 for visual representation of final build-out). Durations shown in Sections 2.1.1 to 2.1.8 are based on current anticipated schedules; however, durations may vary due to actual mobilization and weather conditions. See Section 4.4 for more information on Permit compliance points and the location of discharges to the marine environment.

Figures 3.1 to 3.6 in Appendix E, are conceptual maps of construction activities and associated ESC measures on the Terminal related to work phasing. The ESC Plan is considered a 'living document' and will be reviewed and updated as needed to address site-specific conditions.

Three WTP's are proposed for Phase 3 (West, East and Foreshore). The WTPs will be capable of treating runoff from a 10-year storm event, as per Section 3.3.1.4.



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Figure 2-1 Final Build-Out of Westridge Marine Terminal



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2.1.1 Phase 3.1—Manifold and Pipe Rack Area Construction

Phase 3.1 includes grubbing and excavation of manifold, pipe rack, and pipe bore pit areas, construction of shotcrete retaining walls and concrete foundations, preparation of pipe bore pit area for guided horizontal auger boring (GHAB) and hydrostatic testing of facility pipes. The approximate duration to complete Phase 3.1 work activities is nine months.

2.1.1.1 Description of Activities

- Grub and excavate pipe rack area to its final elevation and grade the work area
- Complete shotcrete retaining walls with soil anchors to secure cut slopes for pipe rack area
- Grub, strip and excavate pipe bore pit area and prepare area for GHAB
- Grub and excavate manifold area
- Removal of abandoned underground piping and installation of new utilities
- Bring manifold to rough grade in preparation for concrete foundations
- Construction of shotcrete retaining walls and installation of soil anchors for manifold area
- Complete concrete foundations for manifold and pipe rack area
- Hydrostatic testing of facility pipes

2.1.1.2 Erosion and Sediment Control Measures

- Install drainage ditch and check dams as required to the north of the excavation directing water towards the West WTP
- Apply cover to exposed areas where practicable
- Collect runoff and transmit to the West WTP
- Install sump pumps to pump storm water requiring treatment to West WTP
- The West WTP will be designed to allow for treatment of concrete wastewater
- Water will be discharged to a distribution and dissipation pipe along the crest of the CP Rail ditch
- Water that reaches Burrard Inlet will be released behind a turbidity curtain placed immediately around the outfall (Photo 2-1)
- There is potential for groundwater and tidal-influenced seepage into the bore pit. Construction operations will be sequenced based on hydrology limitations as to not exceed the capacity of the WTP.
- For mitigation measures related to concrete works see Section 2.1.9 and for hydrostatic testing see Section 2.1.10



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Photo 2-1 Example of Turbidity Curtain to be Installed Around the Outfall

2.1.2 Phase 3.2—Tunnel and Substation Area Construction

Phase 3.2 includes road widening and substation area construction, tunnel and tunnel portal construction, and hydrostatic testing of the tunnel delivery lines. The approximate duration to complete Phase 3.2 work activities is two years and more information is provided in Section 2.1.10.

2.1.2.1 Description of Activities

Road Widening and Substation Area Construction

- Grub work area adjacent to existing access road and excavate upslope to allow for widening the road surface
- Complete shotcrete retaining walls with soil anchors for upper road widening and substation area

Tunnel Portal Construction

- Divert the S6 watercourse around the east side of the tunnel portal area via a new culvert
- Install concrete secant piles and dewatering wells
- Grub, strip excavate and support tunnel portal area to final elevation
- Install concrete slabs and place gravel surface to finish tunnel portal area



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Tunnel Construction

- Set up and assemble Tunnel Boring Machine (TBM) as approved under NEB Condition 26
- Bore and stabilize tunnel with pre-cast segmental concrete liner
- Grout annulus between the pre-cast segmental concrete liner and tunnel wall excavation to limit/control groundwater seepage
- Install delivery pipelines within the tunnel
- Hydrostatic testing of delivery pipes
- Backfill tunnel with lightweight concrete

2.1.2.2 Erosion and Sediment Control Measures

- Set up settling pond and sump to collect stormwater surface drainage and tunnel seepage water
- Treat overflow water from the settling pond at the East WTP
- Treat used hydrostatic test water at the East WTP
- Install check dams in the drainage ditches to slow the velocity of water to and from the East WTP in order to settle large particles of sediment out of suspension.
- Discharge water from the East WTP directly to the storm drain
- Treated water that reaches Burrard Inlet will be released behind a turbidity curtain placed immediately around the outfall
- For mitigation measures related to concrete works see Section 2.1.9 and for hydrostatic testing see Section 2.1.10

2.1.3 Phase 3.3—Tunnel Reclamation

Phase 3.3 includes backfilling the tunnel portal area, restoration of the S6 drainage (as required), and hydroseeding. The approximate duration to complete Phase 3.3 work activities is three months.

2.1.3.1 Description of Activities

- Backfill and restore tunnel portal area
- Restore S6 drainage channel
- Spread topsoil and re-plant to stabilize the area

2.1.3.2 Erosion and Sediment Control Measures

- Install check dams in the drainage ditches to slow the velocity of water and allow for the settling out of large particles of sediment
- Treat stormwater in East WTP
- Install hydraulically-applied erosion control products (hydroseeding) and/or rolled erosion control products to protect slopes while reclamation plantings become established



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2.1.4 Phase 3.4.1—Foreshore Excavation

Phase 3.4.1 includes the excavation of the foreshore and pipe bore pit areas, guided horizontal auger boring (GHAB), and pipe installation. The approximate duration to complete Phase 3.4.1 work activities is three months.

2.1.4.1 Description of Activities

- Excavate the foreshore area prior to ground improvement
- Complete GHAB and pipe installation

2.1.4.2 Erosion and Sediment Control Measures

- Haul excavated material off-site
- Install Foreshore WTP and install water conveyance measures as required to control the flow of water to/from the Foreshore WTP
- Use a sump pump to divert the water from the excavated area to the Foreshore WTP
- Treated water from the Foreshore WTP will be released behind a turbidity curtain

2.1.5 Phase 3.4.1—Outfall Diversions

As part of Phase 3.4.1, discharge locations 3 and 4 (Figure 4-1) will be combined and diverted to discharge location 6 to allow for the development of the Foreshore (see Section 4.4 below).

2.1.5.1 Diversion of Discharge Location 4

A new stormwater piping system and a new outfall pipe to Burrard Inlet will be installed at discharge location 6 (Figure 4-1), and the existing outfall pipe associated with discharge location 4 will be removed by excavation and diverted to discharge location 6.

Description of Activities

- Install new, permanent stormwater piping system and connect to existing outfall at discharge location 6
- Install new outfall to Burrard Inlet
- Install temporary outfall diversion
- Excavate and remove existing outfall pipe associated with discharge location 4 and diverted to discharge location 6
- Tie new outfall pipe into new stormwater piping system

Erosion and Sediment Control Measures

- Install a turbidity curtain around location of the discharge location 6 outfall prior to construction and installation
- Install sump pumps as appropriate and divert contact water to the Foreshore WTP



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2.1.5.2 Diversion of Discharge Location 3

The existing outfall pipe associated with discharge location 3 (Figure 4-1) will be removed by excavation and the new stormwater piping will be connected to the new, permanent outfall pipe at discharge location 6 (installed as per Section 2.1.5.1 above).

Description of Activities

- Remove existing outfall pipe by excavation
- Divert existing permitted stormwater outfall to a new permanent outfall east of the cellular sheet pile wall (coffer cells; see Section 2.1.6)
- Install new/permanent storm water utilities and tie into previously installed utilities described under Phase 3.4.3

Erosion and Sediment Control Measures

- Control runoff entering excavation with field fit diversion, swales or water bars, as required
- Install sump pumps as appropriate and divert contact water to Foreshore WTP

2.1.6 Phase 3.4.2—Ground Improvement

Coffer cells (to be completed under a *Fisheries Act* authorization) are installed during Phase 3.4.2 to enclose the foreshore area. Ground improvement will be carried out in stages along the foreshore and will follow the progression of the cellular sheet pile wall installation (coffer cells) and placement of backfill behind and within the coffer cells. The proposed ESC measures and treatment of stormwater and construction wastewater will be consistent for all ground improvement work. The approximate duration to complete Phase 3.4.2 work activities is 8 to 10 months.

2.1.6.1 Description of Activities

- Lay out overlapping soil mixing column locations
- Auger soil columns using drill rigs and inject grout slurry to stabilize soil
- Once soil mixing inside the coffer cells has been completed, jet grouting will be completed inside the coffer cells, followed by soil mixing behind the cells
- As grout is injected into the ground, spoils are generated as existing material is mixed and displaced. This material will be removed from the Site and disposed of at an approved facility.

2.1.6.2 Erosion and Sediment Control Measures

- Install water conveyance measures as required to control the flow of water to/from the Foreshore WTP
- Install a soil perimeter berm on the south, east, and west sides of the ground improvement work area that connects with the northern sheet pile wall to contain excess soil cement slurry within the work area



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- Use a sump pump to divert the water from the soil mixing work area to the Foreshore WTP where turbid water will be able to settle and/or be treated
- Spoil materials will be sent to the spoils barge for disposal. The spoils barge will be removed as required for appropriate off-site disposal. Excess water collected on the spoils barge will be pumped to and treated in the Foreshore WTP as required.
- Spoils barges will have a sealed perimeter and be fenced such that spoil material and/or water runoff cannot leak from the barges
- Treated water from the Foreshore WTP will be released behind a turbidity curtain

2.1.7 Phase 3.5—Foreshore Concrete Foundations

Phase 3.5 includes formwork and concrete pouring of the foreshore foundation and management of curing water. The approximate duration to complete Phase 3.5 work activities is six months.

2.1.7.1 Description of Activities

- Install formwork for foreshore foundations
- Install rebar, mechanical inserts, anchor bolts, conduit and grounding, as required
- Pour concrete foundation pads
- Place curing blankets and plastic sheets over the concrete foundations to reduce the amount of curing water that is required
- Leave formwork in place until curing of slabs is complete

2.1.7.2 Erosion and Sediment Control Measures

- Set up a storage tank with a carbon dioxide bubbler system for treatment of concrete washwater or wastewater
- Set up sump pumps and hose connections to move curing water from the individual foundation sites to the storage tank
- Set up water conveyance structures (e.g., ditches, etc.) around disturbed areas to capture curing water runoff
- Treat curing water with CO₂ bubbler and settling tank, and discharge treated curing water behind a turbidity curtain
- For mitigation measures related to concrete works see Section 2.1.9

2.1.8 Phase 3.6—Offshore Superstructure

A cast in place concrete deck will be placed on top of the various loading platform and trestle structures. The concrete deck placement will take place as the piling foundation work is completed and as access to the structures is available via marine-based equipment. The approximate duration to complete Phase 3.6 work activities is 30 months.



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2.1.8.1 Description of Activities

- Install formwork for offshore superstructure
- Install rebar, mechanical inserts, anchor bolts, conduit and grounding, as required
- Pour concrete deck within formwork
- Place curing blankets and plastic sheets over the slabs to reduce the amount of curing water that is required

2.1.8.2 Erosion and Sediment Control Measures

- Storage tank will be set up on barge
- The amount of curing water required to be in contact with recently poured concrete will be reduced, by utilizing curing blankets that maintain moisture on concrete surface
- Leave formwork in place until curing of deck is complete
- At end of concrete curing period, pump excess curing water with high pH into the storage tank on the barge
- Move barge to the foreshore and pump water to foreshore storage tank set up with CO₂ bubbler
- Treat curing water with a CO₂ bubbler and settling tank and discharge treated curing water behind a turbidity curtain

2.1.9 Concrete Works

Concrete works will occur during all sub-phases throughout the year for the installation of concrete foundation, slabs, drilled shaft and concrete pilings, shotcrete retaining walls, soil mixing and jet grouting.

2.1.9.1 Concrete Curing Contact Water

Rainfall that has had contact with curing concrete will require treatment (“concrete curing contact water”). The volume of concrete curing contact water that may require treatment is presented in Table 2-1 with the assumption that curing takes up to seven days. Curing blankets (burlap) will be used to keep concrete moist during curing, for up to seven days after concrete is poured. The burlap will be moistened, as required. Water will not be constantly running during this process to limit runoff volume and keep it localized to the area.

Two rainfall scenarios were considered for concrete curing contact water volume estimations based on long-term daily precipitation data at the Burnaby Simon Fraser University climate station (Climate ID: 1101158):

1. Average climate condition: Mean value of the 7-day moving average rain depth regardless of month/season. This was calculated as 33 mm.
2. The 90-percentile high value of the 7-day moving average rain depth regardless of month/season. This was calculated as 86 mm. This value represents a wet condition.

Maximum daily surface area of concrete curing during sub-phases 3.5 and 3.6 will be 2,000 and 1,100 m², respectively (Table 2-1). Maximum volume of concrete curing contact water, which requires



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treatment within the 7-day curing period, during sub-phases 3.5 and 3.6 under the average and wet conditions are summarized in Table 2-1.

To mitigate risks of concrete water, pH will be actively treated and concrete washout (Section 2.4.6) and disposal areas will be set up (Section 2.1.9.2) to contain water and runoff.

Table 2-1 Total Concrete Curing Contact Water Volumes

Sub-Phase	Maximum Curing Surface Area (m ²)	Water Volume (m ³)	
		Average 7-Day Rain (33 mm)	90% Wet 7-Day Rain (86 mm)
Phase 3.5	2,000	66	172
Phase 3.6	1,100	36	95

2.1.9.2 Concrete Washout and Disposal Area

Wastewater and slurry resulting from washout of concrete pump trucks, tools and equipment will be contained and disposed of at a designated off-site facility. TMEP is anticipating a limited quantity of concrete washout water resulting from these activities.

The concrete washout facilities will be maintained in order to contain concrete waste generated from the washout activities. The designated concrete washout facility will be sealed with an impermeable plastic lining material to contain the concrete waste and washout water. Any excess concrete will be collected in lined dumpsters and will be disposed of off-site.

2.1.10 Tunnel Boring

The Burnaby Mountain Tunnel (the Tunnel; see Figure 2-2) will be 4.33 m in diameter containing three, 30 inch nominal pipe size (NPS) product lines which will transport product from Burnaby Terminal to Westridge Marine Terminal. The Tunnel Boring Machine (TBM) operations will start at a portal located at Westridge Terminal and tunnel boring will progress uphill towards Burnaby Terminal; water that is generated from the tunnel boring operations will drain down to Westridge Terminal and be treated at the East Water Treatment Plant (East WTP; see Section 2.1.2). Photo 2-2 provides a schematic of the tunnel alignment.



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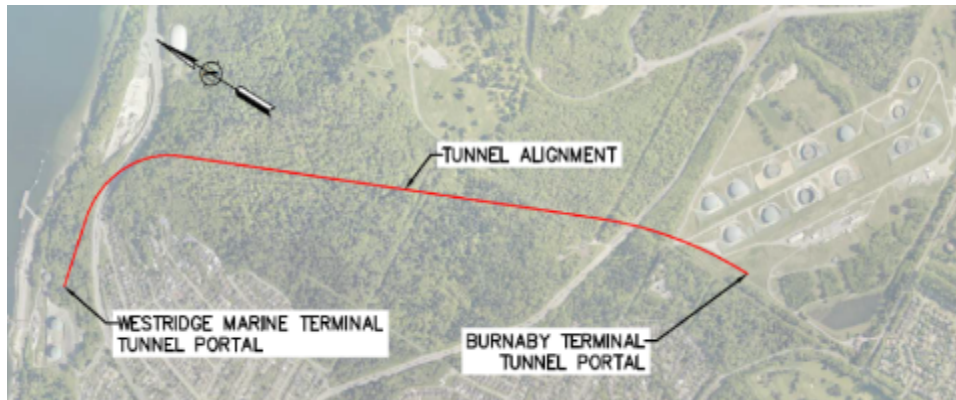


Figure 2-2 Burnaby Tunnel Alignment



Photo 2-2 Example of a Segmentally-Lined Tunnel

The Tunnel is excavated using a TBM (Photo 2-3). The TBM has a mechanical system on board that places curved precast concrete segments (Photo 2-4). These segments are used to line and support the bore (the tunnel excavated by the TBM). A typical truckload of “ready to use” segments is shown in Photo 2-4). As each precast segment is manufactured, a rubber gasket is anchored into a groove cast around the perimeter of the segment. During the tunneling operations the precast segments are installed and



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bolted together to secure the rubber gasket around the perimeter of the tunnel wall. As the TMB advances the annular space between the outside face of the precast segment and the tunnel wall is filled with a grout. Once the segments are in place, the result is a water-resistant tunnel liner.



Photo 2-3 Tunnel Boring Machine Main Drive



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Photo 2-4 Example Concrete Segments

The first 500 m of the tunnel length (from Westridge to Burnaby) is anticipated to be in soft earth at a depth of approximately 45 m, then following with 2,000 m of conglomerate rock at a depth no more than 140 m below ground surface. The TBM is specifically designed for the Project, will be a dual mode machine and has features specific for digging through soft earth and hard rock.

The first mode (soft soil) of TBM operation is called an Earth Pressure Balance Machine (EPBM or Closed Mode): it is used to excavate soil and do so in a manner that maintains external pressure (soil and water pressures) outside of the TBM. The pressure is regulated down to atmospheric through an enclosed screw conveyor. The revolutions per minute can be increased or decreased in this screw conveyor to increase or decrease the pressure in front of the TBM. The pressure immediately in front of the TBM and the pressure entering the screw are balanced, and therefore, with mitigation (being pressurized) no water flow occurs into the tunnel. At the end of this water-tight screw conveyor is a steel guillotine door that is hydraulically operated. Within seconds of any uncontrolled ingress of water and/or soil, the door can be closed, and the problem diagnosed and solved without the potential of prolonged uncontrolled water flow.

The second mode (conglomerate rock) of TBM is the Open Mode (or Single Shield). In this case the same screw conveyor is used to extract the material from the cutting face of the TBM, but not under pressure because the rock is self-supporting. However, all the same hardware and sealing systems remain to operate the machine in the pressurized mode. The TBM can be returned to pressurized mode in a matter



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of seconds to control unexpected groundwater inflows. Conservative geotechnical evaluations indicate a maximum unmitigated flush flow of approximately 600 L/min (Hatch et al. 2017) in an unlined tunnel condition. These conservative values have been used to support the hydrology modelling and the sizing of the East WTP (see Section 3.3.1.2).

Prior to the tunnel boring operations, a secant pile retaining wall will be constructed at the tunnel boring entry point to secure the cut slope. Dewatering wells will be installed adjacent to the secant pile wall to relieve the groundwater pressure. Groundwater volumes are not anticipated to be more than 4 L/min from any individual dewatering well. Based on geotechnical reports the conservative total volume related to the secant pile wall is expected to be up to 38 L/min. Additionally, approximately 75 L/min of water will be used to support tunnel construction activities.

The following materials will be used to support the tunnel construction:

- Soil Conditioning Foaming Agent will be injected inside the chamber of the cutter head. Note that the excavated material from the tunnel head will be taken offsite for disposal and no water from this operation will be sent to the WTP (see Appendix F).
- Bentonite will be injected into the shield area which acts as a lubricant between the tunnel shield and the earth.
- Grout will be injected to fill the gap between the tunnel liner precast segments and the soil (see Appendix F).

Material from tunnel boring activities will be disposed of off-site, at a permitted facility. Excavated material will be managed for potentially acid generating rock as described in Section 2.1.10.1.

2.1.10.1 Tunnel Boring Mitigation Measures

The main risk during tunnel boring activities is the unexpected release of groundwater. To mitigate a groundwater release, the TBM is designed to respond rapidly (normally within one minute) to a groundwater release; this would allow for the water treatment system to adequately store, treat, and discharge as flows are cut off and controlled by the tunnel boring machine. A series of operational mitigation measures are also available—these are described below.

Tunnel Boring Machine Mode

The EPBM mode regulates pressure so that groundwater flow into the tunnel does not occur. In the event groundwater is encountered in the rock section of the tunnel alignment during Open Mode, the TBM returns to EPBM mode and re-pressurizes the ground in front of the TBM. If the groundwater pressure remains below the operating rating of the machine, less than 5 bar, work can continue in EPBM mode. Should the sensors detect groundwater pressures above 5 bar, the computer on the TBM locks out the operation of the machine to protect the seals but the interior conditions of the tunnel will remain dry. To restart the excavation, the groundwater has to be cut off before the excavation can commence.



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Although the Tunnel construction method is not expected to lead to a significant discharge of groundwater, a number of design features of the TBM will further limit the release of groundwater:

- The TBM is state-of-the-art and custom fabricated for the conditions specific to the site. The TBM has a reinforced steel hull, similar to a submarine, that can handle external groundwater pressures up to 13 bar (similar to operating in water over 430 ft deep). The precast concrete segmental lining is erected inside of this steel hull, as the steel hull is a few inches larger than the concrete lining. Four rows of special seals keep the soil and groundwater from coming in between the steel hull and the concrete lining. Seals are continuously injected with a sealing compound during TBM advancement or when stopped if leakages occur.
- Selection of a watertight, erect as you go, precast concrete segmental lining
- Selection of segment gaskets to make watertight seal joints
- Success of the TBM seals is proven; the same seals were used at the Lake Mead Intake No. 3 tunnel⁴ which had higher external water pressures than Burnaby Mountain Tunnel.
- EPDM rubber gaskets have been in use in the tunneling industry since the 1950s, and the technology has progressed such that gasket materials and testing methods are extremely effective. Gaskets for the Tunnel will be designed and installed to achieve water tightness at 16 bars of groundwater pressure even with minor variations in erection tolerances.
- Procurement of a Closed Mode TBM designed to peak groundwater table elevations
- Procurement of accessories on the TBM that when implemented shut off all water flow in case of emergencies (larger flush flows than expected, loss of hydraulics, loss of electrical power)
- East WTP system with the capacity of 800 GPM ($= 50 \text{ L/s} = 3,000 \text{ L/min}$), along with a settlement pond of 225 m^3 receives contact water from the tunnel outflow (seepage and construction water), as well as groundwater withdrawals from the secant pile wall

Tunnel Boring Machine Operations

Furthermore, the following mitigation measures related to the operation of the TBM will also be implemented:

- Should any part of the WTP system fail, TBM advance is stopped and the guillotine door closed. The TBM sits idle, but since it is designed for such high-water pressures, repairs can be made to the treatment system while it is idle.
- The Contractor may choose to install redundant water treatment plants to maintain productivity, but in no case should a groundwater event “deluge” the treatment system.
- A water quality monitoring location upstream of the East WTP will be used to monitor tunnel water (see Appendix G). If, in this process, a previously unexpected contaminant is discovered for which the WTP is not effective, the TBM can be idled and sealed, the WTP stopped, and upgrades made to treatment systems to handle the previously unanticipated contaminant to assure regulatory compliance in discharge water. Once upgraded to treat for the new contaminant, tunneling can resume.

⁴ The Lake Mead tunnel, Southern Nevada Water Authority, 4,600 m in length and 200 m deep.



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Potentially Acid Generating Rock

Trans Mountain will consider, and implement where appropriate, the mitigation measures outlined in the Acid Rock Drainage Management Plan (ARDMP) ([Section 4.1 of Volume 6 of the Environmental Plans](#)), Burnaby Mountain Tunnel Environmental Protection Plan ([Volume 9 of the Environmental Plans](#)), and Burnaby Mountain Tunnel Option – Rock Mass and Waste Rock Management Plan (RMWRMP) ([Attachment 1 of the Environmental Plans](#)) during excavation and tunnel boring. These plans are designed as a reference for planning and subsequently determining the most appropriate site- and operation-specific measures to implement in order to avoid or limit acid rock drainage (ARD) when Potentially Acid Generating (PAG) rock is encountered.

Areas of ARD were identified by considering the following criteria:

- Areas where PAG bedrock occurs
- Areas of shallow or outcropped bedrock exposures
- Geochemical assessment of the Project
- Field verification Neutralization Potential (NP) fizz testing during construction

Testing within and around the Burnaby Mountain Tunnel indicates that acid generating rock, if encountered, will be at very low quantities. During the construction excavation process, daily samples will be taken from the excavated ground and analyzed in accordance with the RMWRMP for disposal classification. Non-PAG rock will be placed in engineered fills at the Burnaby Terminal or will be hauled to local permitted disposal facilities. Should unexpected PAG be encountered during construction, mitigation measures in the Field Changes Manual for Geohazard Mitigation and the ARDMP will be implemented. If PAG rock is encountered, appropriate mitigation will be implemented including the use of liners and covers, and will be permanently disposed of at the Burnaby Terminal or approved landfills. Where required, *Environmental Management Act* authorizations will be in place for receiving sites prior to relocation of PAG rock.

The Mitigation Decision Framework within the ARDMP will be followed when field sampling by a Qualified Resource Specialist (QRS) confirms ARD potential. The mitigation strategy will be based on the rock's acidity capacity and the amount of neutralizing capacity required to mitigate ARD potential. The disturbed materials will be classified into one of four categories (PennDOT 2016) for the construction phases of the Project and will be appropriately managed.

Monitoring, documenting and reporting of PAG rock will occur per the ARDMP, including the following activities:

- Drainage/Run-off Water Quality Monitoring
 - Water quality monitoring programs will be based on recommendations provided by a QRS and developed in collaboration with the Project Environmental team and Trans Mountain
- Excavation Monitoring: If PAG materials are encountered, the QRS will document items including, but not limited to:
 - Site characteristics
 - Areas being excavated or backfilled



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- Number of stockpiles, approximate volumes, and characterization of each
- Quantity and type of material being removed from the site
- Quantity and type of backfill being used in the excavation
- Photographic records throughout the excavation works
- Environmental concerns (i.e., spills onsite from equipment)
- Contamination in addition to what was anticipated
- Sampling conducted including the number of samples collected and the parameters analyzed
- **Material Tracking:** When PAG materials are removed from the site or clean, imported material is brought onto the site, the following information will be documented, or documents will be collected:
 - Tracking of PAG material stockpile locations including characterization of each stockpile and where the material in each stockpile originated from
 - Tracking and Environmental Inspector approval of clean imported soil, imported lime, and where these materials were being backfilled
 - Collection of waste transportation documentation (manifests, bill of lading, etc.) for each load of material transported offsite to an approved facility
 - Maintenance of a daily trucking log including:
 - o License plate of the truck(s)
 - o Approximate volume of material transported off/onsite
 - o Final material destination
 - o Record of the representative samples associated with each stockpile/load of material transported off-site

2.1.10.2 Installation of Delivery Lines

Delivery pipeline joints are delivered to the jobsite and assembled as joints in supports with three pipes arranged vertically. The pipes are pushed into the tunnel and welded according to procedures. The three delivery lines are then grouted into place, backfilling the void between the exterior of the pipelines and the interior of the tunnel, to create basically an impermeable backfill in the tunnel. After this, no further significant water treatment is expected. See Section 2.1.11 for more details on hydrostatic testing of delivery lines.

2.1.11 Hydrostatic Testing

Hydrostatic testing of the Westridge Delivery Lines (pipes running from Burnaby Terminal through the tunnel), manifold piping, loading lines and related facility piping will occur during Phase 3 and will be carried out in a manner that limits the volume of water used and aligns with the construction sub-phases.

2.1.11.1 Volume of Test Water Required and Water Source Location

It is anticipated that a total of 11,700 m³ of water will be required for hydrostatic testing of the Westridge Delivery Lines and facility piping.



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Westridge Delivery Lines

Trans Mountain intends to test the three delivery lines within Burnaby Mountain Tunnel (see Figure 2-2) twice—prior to and after the installation of backfill in the Burnaby Mountain Tunnel. To the extent possible, Trans Mountain intends to source the hydrostatic test water from Burnaby Terminal such as the Tertiary Containment Area (TCA) or the Intermediate Storm Water Retention Area (ISWRA); municipal water will be used as a secondary source.

Prior to the installation of tunnel backfill, each individual line will be hydrostatically tested. One single delivery line will require approximately 1,550 m³ of water during the testing operation, for a total volume requirement of approximately 4,650 m³ for all three lines. This process will take place again after the tunnel backfill is complete. In total, Trans Mountain will require approximately 9,300 m³ of water to complete the hydrostatic testing of the delivery lines.

Facility Piping

Hydrostatic testing of manifold piping, loading lines and related facility piping will take place in a manner that limits the volume of water used and aligns with the completion of appropriate construction activities at Westridge Marine Terminal. Based on the logical grouping of activities, facility piping will be hydrostatically tested across 11 different areas and approximately 2,400 m³ of water is anticipated to be used and discharged.

Trans Mountain intends to source hydrostatic test water from municipal water via fire hydrants located within the Westridge Marine Terminal fence line or from water trucks which have obtained water from municipal sources outside of the Terminal.

2.1.11.2 Potential Sources of Contamination

Potential sources of contaminants during hydrostatic testing include the following:

1. **Hydrostatic Testing:** Hydrostatic test water will come in to contact with potential contaminants associated with manufacturing and fabrication of the new pipes being tested. Potential contaminants may arise from the processes below:
 - a. **Manufacturing process:** The tanks and pipes will be constructed from carbon steel, which will be produced to CSA Group standards (formerly the Canadian Standards Association; CSA) unless substitution is allowed. The steel may contain mill scales and flash rusting (oxidation) associated with atmospheric exposure during transport and storage.
 - b. **Fabrication process:** Once the material has arrived at site from the manufacturer, it is assembled using an arc welding process, which produces welding slags that will be introduced to the internal surfaces of the pipes and tanks. The slag is mostly removed during the fabrication process through wire brush, grinding or sand blasting. Flash rusting of exposed steel surfaces will take place during storage on site prior to the hydrostatic test. Flash rust is a brown orange iron oxide that forms on the surface of the steel when unprotected.



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- c. **Hydrostatic testing:** During the hydrostatic testing, process water may take up contaminants through the corrosion reactions taking place between steel and water. The corrosion reactions inside of the pipes may introduce small amounts of soluble iron into the water. The amount of material dissolved into the water will depend on temperature at the time of the hydrostatic test, and the retention time of the water in the pipes. A mixture of water and propylene glycol⁵ may be used when there is a possibility of freezing.
2. **Municipal water:** Municipal water will be sourced from the Metro Vancouver water supply system. Metro Vancouver (Metro Vancouver 2018b) adds the following to drinking water supplies: lime (calcium hydroxide) or sodium carbonate to increase pH, ozone, and chlorine (fluoride is not added).

A summary table of potential contaminants is included in Table 2-2.

2.1.11.3 Review of Potentially Applicable Discharge Guidelines

Trans Mountain has reviewed the following codes and guidelines (see below) which it deems to potentially apply to discharge concentrations of parameters associated with hydrostatic testing water and these are summarized in Table 2-2. Selection of an appropriate exposure level for each guideline (i.e., long-term or continuous) is based on scientific knowledge and discussions with BC ENV. As water will not be discharged to ground, the Oil and Gas Waste Regulation does not apply to these activities.

Alberta Government Code of Practice for Release of Hydrostatic Test Water, 1999

Discharge quality of hydrostatic test water to surface water is not regulated provincially in BC or federally; however, the Province of Alberta has developed a code of practice (Alberta Government 1999) for hydrostatic testing of new and existing liquid or gas pipelines.⁶ This code of practice defines the requirements for release to receiving waters—hydrostatic test water (that has no additives) should be tested for TSS, free chlorine residual, pH, iron (dissolved), oil and grease; if additives are used, then the additive should be released at a non-toxic concentration (see Table 2-2 for more details).

BC Water Quality Guidelines (BC WQG)

BC ENV (2019) has developed province-wide ambient water quality guidelines for substances or physical attributes that are important in both fresh and marine surface waters of BC. The relevant WQGs, for discharge of hydrostatic water to a water body, include those for total residual chlorine, chloride, dissolved iron, pH and TSS.

⁵ Propylene glycol is a synthetic liquid substance that absorbs water and is used as a base for de-icing solutions or as an antifreeze. It is expected to degrade rapidly in water from biological processes and is not considered persistent in the environment. See Appendix F for the MSDS for this substance.

⁶ Although the Trans Mountain project is for the transport of oil, the manufacturing, fabrication and hydrostatic testing processes and, therefore, potential contaminants, are assumed to be similar.



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Canadian Council of the Ministers of the Environment (CCME) for Canadian Water Quality Guidelines for the Protection of Aquatic Life

In the absence of BC WQG, CCME's Canadian WQGs for the Protection of Aquatic Life (freshwater and/or marine) are typically reviewed. In this case, BC WQG were available for the anticipated parameters and found to be more conservative than the CCME Guidelines.



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Table 2-2 Potential Contaminants and Associated Guidelines and Limits for Discharge for Hydrostatic Test Water at Westridge Marine Terminal

	Provincial and Federal Guideline or Code of Practice			
	Discharge from Tanks and Facility Piping	Receiving Environment		Existing Discharge Permit
Potential Contaminant	Alberta Government Code of Practice for Release of Hydrostatic Test Water	Canadian Council of the Ministers of the Environment (CCME) for Canadian Water Quality Guidelines for the Protection of Aquatic Life	BC Water Quality Guidelines for Freshwater Aquatic Life and Marine and/or Estuarine Aquatic Life (BC WQG)	Permit #3678
Chlorine ^e	Free residual chlorine—0.1 mg/L	-	Total residual chlorine Freshwater—0.002 mg/L (average exposure continuous) <u>Marine—0.003 mg/L (average exposure continuous)</u>	-
Chloride (as Cl)	-	Freshwater - 120 mg/L (long-term)	Freshwater—150 mg/L (30-d average) Marine—activities should not cause Cl ⁻ to fluctuate more than 10% of the natural range	-
Hydrocarbons	No visible sheen	-	-	<u>5 mg/L^c</u>
Dissolved iron	1.0 mg/L	-	<u>Freshwater—0.35 mg/L</u>	-
Calcium hydroxide ^a	-	-	-	-
Sodium carbonate ^a	-	-	-	-
Ozone ^b	-	-	-	-
pH ^d	6–9.5	Freshwater—6.5–9 Marine—7.0–8.7	Freshwater—6.5–9 <u>Marine—7–8.7</u>	-
TSS	Less than or equal to 20 mg/L above ambient receiving water level	Dependent on background conditions	Dependent on background conditions	-



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Table 2-2 Potential Contaminants and Associated Guidelines and Limits for Discharge for Hydrostatic Test Water at Westridge Marine Terminal

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Potential Contaminant	Alberta Government Code of Practice for Release of Hydrostatic Test Water	Canadian Council of the Ministers of the Environment (CCME) for Canadian Water Quality Guidelines for the Protection of Aquatic Life	BC Water Quality Guidelines for Freshwater Aquatic Life and Marine and/or Estuarine Aquatic Life (BC WQG)	Permit #3678
Propylene glycol	Non-toxic concentration	500 mg/L (freshwater)	-	-
<p>a. Effects evaluated through change to pH</p> <p>b. A permit limit is not proposed for ozone as it is volatile and is assumed to have broken down quickly after water is treated.</p> <p>c. The existing permit limit for total extractable hydrocarbons (TEH) is included as a conservative measure of 'no visible sheen'</p> <p>d. The permit limit for pH is recommended to be the freshwater guideline, as it is assumed that considerable mixing will occur within the turbidity curtain in the marine environment (see Section 3.3.4).</p> <p>e. Monitoring for chlorine is proposed only if municipal water is used.</p> <p>- No limit mandated by the guideline</p> <p>Values in bold are recommended for inclusion in the amended Permit #3678</p> <p>NOTES:</p> <ul style="list-style-type: none"> If more than one guideline exists for a particular contaminant, the most conservative guideline was generally chosen (i.e., for chloride) Freshwater and marine CCME guidelines BCWQG have been provided where available In the case of pH, the BC WQG was selected as it is more suitable to ecological conditions in British Columbia In the case of TSS, although the Alberta Code of Practice and the CCME and BC WQG are background-dependent, Trans Mountain proposes 75 mg/L to align with the limit defined in the Land Development Guidelines for the Protection of Aquatic Habitat (Appleby and Scarratt 1989; DFO 1993; Birtwell et al. 2008). See Section 3.3.5 				



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2.1.11.4 Summary of Potential Contaminants

Table 2-2 summarizes the potential contaminants that may be present in the hydrostatic test water after use, and relevant limits based on the reviewed codes and guidelines. Trans Mountain proposes that the following additional water quality parameters be added to Permit #3678: pH (during all construction activities—to cover concrete works as described in Section 2.1.9) and total residual chlorine, (only when municipal water is being used), dissolved iron and propylene glycol.

when hydrostatic testing is taking place. Proposed concentration limits are identified in bold in the table. In the case of TSS, although the Alberta Code of Practice and the CCME and BC WQG are background-dependent, Trans Mountain proposes 75 mg/L to align with the limit defined in the Land Development Guidelines for the Protection of Aquatic Habitat (Appleby and Scarratt 1989; DFO 1993; Birtwell et al. 2008) (see Section 3.3.5).

The City of Burnaby maintains a water quality monitoring station, approximately 220 m from the boundary of Westridge Marine Terminal—BUR-530K (Burnaby Map 2019)—located in the Seymour water system. Average chloride measurements in the Seymour Water system in 2018 were 2.5 mg/L (range 2.2–3 mg/L) (Metro Vancouver 2018b); this is considerably lower than the 120 mg/L long-term chloride guideline (CCME 2019). Therefore, based on the low concentrations in municipal water, and preliminary guidance from BC ENV during a meeting in Prince George (July 9, 2019), TMEP proposes that chloride is not included as a permit limit for discharge, but that hydrostatic test water be tested for chloride prior to release from the delivery pipelines and facility piping to a WTP to confirm that concentrations are below 120 mg/L.

2.1.11.5 Mitigation Measures for Hydrostatic Testing

Westridge Delivery Lines and Facility Piping

Mitigation will be implemented as outlined in the [Burnaby Mountain Tunnel Environmental Protection Plan](#) and [Water Withdrawal and Discharge Management Plan](#).

Where possible, the water supply pumps will be located a minimum of 50 m away from surface water bodies or ditches that may lead directly into a waterbody. Pumps will be situated in a bermed or controlled area to prevent spills or any unplanned release of hydrostatic test water. Screens will also be installed on the water intakes from TCA or ISWRA to prevent juvenile amphibians from being entrained during water withdrawal.

There is existing vehicle access (paved/gravel road) to the water main at the north end of Burnaby Terminal. Water will be transported to the hydrostatic fill locations through pumps and hoses installed between hydrants and hydrostatic fill locations.



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Treatment of Potential Contaminants from Tank and Pipe Manufacture and Fabrication, Hydrostatic Testing and Municipal Water Use

Once a hydrostatic test is completed and the hydrostatic test water is to be discharged, a sample will be sent to an offsite testing facility approved to Canadian Association of Laboratory Accreditation (CALA) standards and tested permit limits. Pending the water quality results, the water will either be trucked offsite to be discharged at a Trans Mountain-approved facility as per Appendix E of Section 3.1 of the [Waste Management Plan](#) filed pursuant to Condition 78, or be disposed of onsite for additional treatment to waste discharge permit limits. Hydrostatic test water will only be released to WTPs during drier periods, such that the WTPs have the capacity to treat the test water. The release of hydrostatic test water will be continually monitored and controlled by pressure regulating valves, and discharge will be as per the discharge limits of Permit #3678.

Water treatment plants are equipped to allow installation of additional modules capable of treating contaminants resulting from hydrostatic testing activities (see Table 2-2 for potential contaminants and Section 2.4 for water treatment details).

2.2 POTENTIAL RISKS

Proposed construction works have three major potential risks: (a) adverse weather conditions which may potentially overwhelm planned water quality controls, management procedures and WTP designs, (b) accidental spills associated with construction activities and equipment, and (c) an inadvertent release of hydrostatic test water. These risks have the potential to cause an exceedance in permitted effluent water quality.

Potential risks will be managed through controls described throughout Section 2.0 and in the plans developed to be consistent with the NEB project approvals listed in Table 2-3. The Westridge Marine Terminal EPP outlines TMEP's contingency plans for adverse weather conditions and accidental spills. Controls, specifications, hydrologic assessment and WTPs have been designed, reviewed and signed off by Qualified Environmental Professionals and Professional Engineers for quality control and assurance.



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Table 2-3 Project Related Management and Environmental Protection Plans

Plan Topic	Plan Name	Plan Location
Environmental Protection Plan	Environmental Protection Plans Volume 4 – Westridge Marine Terminal EPP for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project Rev. 5 – NEB Condition 81	Appendix A
Erosion and Sediment Control	Westridge Marine Terminal – Clearing, Erosion, Sediment Control Plan – Phase 3	Appendix D
Effectiveness of ESC Measures	Trans Mountain Expansion Project - Construction Water Quality Monitoring Plan Phase 3	Appendix G
Hydrostatic Testing	Hydrostatic Test Plan—NEB Condition 113	Not yet submitted
Spills and Flooding	Trans Mountain Expansion Project - Kiewit Ledcor Trans Mountain Partnership (KLTP) Site Specific Emergency Response Plan Westridge Marine Terminal	LINK
Litter	Environmental Protection Plans Volume 6 – Environmental Management Plans Section 3.1 – Waste Management Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project – NEB Conditions 72, 78 and 81	LINK
Odour	Air Emissions Management Plan for Westridge Marine Terminal Trans Mountain Pipeline ULC Trans Mountain Expansion Project – NEB Condition 52	LINK
	Fugitive Emissions Management Plan for Westridge Marine Terminal Trans Mountain Pipeline ULC Trans Mountain Expansion Project - NEB Condition 53	LINK
Fire	Trans Mountain Expansion Project - Project Specific Safety Plans	LINK

2.3 EROSION AND SEDIMENT CONTROL

The primary objective of Trans Mountain's ESC Plan (Appendix D) is to isolate the proposed construction areas from areas that will be unaffected and prevent sediment from discharging into the environment. Isolation will be accomplished using ditches, sumps, pumps and culverts. The construction activities and associated ESC measures are illustrated in Appendix E and present the major ESC measures proposed. The ESC plan is considered a 'living document' and will be reviewed and updated as needed to address site-specific conditions.



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The proposed ESC features include proven in situ, conveyance and active treatments. These measures will be applied in a treatment-train approach to reduce the TSS generated by stormwater runoff in affected areas. The ESC features include:

- In situ treatments which prevent the generation of sediment from affected areas, including:
 - Coco matting, polymer tarps, hydroseeding
- Conveyance treatments slow the movement of runoff, allowing TSS settling to occur in designated locations:
 - Silt fences
 - Check dams and silt weirs
 - Drain/pump clean or non-contact water to vegetated areas as per the Oil and Gas Waste Regulations (OGWR; Province of British Columbia 2019)
- Cross ditching active treatments such as Chitosan flocculent socks to remove TSS from the water column

Erosion and sediment controls, site planting and restoration activities, and WTPs will be located downslope of proposed work areas to treat potential contact water and discharge clean water to the CP Rail ditch or through a culvert to Burrard Inlet; discharge of treated construction water to Burrard Inlet will be behind a turbidity curtain.

The Westridge Marine Terminal Construction Water Quality Monitoring Plan (Appendix G) describes in more detail additional monitoring that will be carried out to confirm that water treatment and ESC measures are appropriate and working effectively.

2.4 WATER TREATMENT

Water treatment plants (WTPs) and carbon dioxide (CO₂) bubblers will be installed on Site to manage water quality for compliance with the permit limits⁷.

2.4.1 Total Suspended Solids

The primary water treatment approach will use a Chitosan Enhanced Sand Filtration (CESF) system (see Figure 2-3, and Appendix I and Appendix J) as a mobile modular WTP designed specifically for the Westridge Marine Terminal. The CESF system is a rapid sand filter system which can achieve high hydraulic flow rates consistent with the hydrologic modelling results for the Westridge Marine Terminal and areas of construction. To meet the TSS permit levels, chitosan flocculent is added in increasing amounts as sediment loading (measured in nephelometric turbidity units (NTU)⁸) increases. This

⁷ Water treatment plants will be located within a perimeter security system which includes ½ inch mesh fence and a CCTV (closed-circuit television) camera system. The site will have 24/7 Security Guards. Once a WTP is operational, KLTP Westridge Onshore will have personnel onsite to monitor the operation of a WTP 24 hours a day.

⁸ A TSS-turbidity curve will be established for the Westridge Marine Terminal to allow for conversion of in situ turbidity measures to TSS for comparison to the compliance threshold. This will be submitted as a supplemental filing.



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flocculant removes suspended solids and impurities from water prior to filtration with specialty sand media in purpose-designed containment tanks. The system is broken down into specific treatment modules.

Chitosan is commonly used as a flocculent to treat stormwater run-off, dewatering water, groundwater, wastewater, process water and drinking water. Chitosan is a non-toxic and biodegradable organic polymer derived from chemical treatment of chitin from shrimp, prawn and crab shells (Kumar 2000). Although the rainbow trout LC_{50} in water for chitosan is 173 mg/L (Appendix H), the chitosan will be contained and diluted within the WTP, and managed through controls described in Sections 2.4.4 and 2.4.5 and Appendix D and plans and protocols that have been developed to be consistent with conditions of the NEB TMEP project approvals. As per Approval #109085 (August 14, 2018 for Westridge Marine Terminal Phase 2 activities), Trans Mountain proposes that the requirement for a weekly chitosan residual test also be included in the Permit issued for Phase 3.

2.4.2 Treatment of Contaminants from Hydrostatic Test Water and Municipal Water

Chlorine, dissolved iron and propylene glycol will be treated through the installation of additional modules in line with existing CESF units, downstream, so that additional treatment is conducted after sediment treatment is complete. Dissolved iron will be treated with an ion exchange module, total chlorine residual and propylene glycol will be adsorbed with activated carbon.

If other metals are present in hydrostatic test water, other modules will be added to the WTP. The exact metals treatment ion exchange process will depend on the particular type of metals, and the concentrations requiring treatment. Of note, the existing TSS/NTU treatment process can be effective in treating particulate metals. Bench top testing of water samples will be carried out to confirm and optimize field implementation of the exact treatment system.

The addition of treatment modules will not affect the discharge rate of the CESF unit. Additional modular treatment units will be sized appropriately with capacity to treat water at the maximum designed flow rate of the CESF unit. Increased contaminant concentrations may reduce the discharge flow rate for a given treatment process; to counteract this, the treatment process will be designed with contingency capacity and redundancy to provide a robust treatment system with the ability to maintain a design discharge flow rate in varying source water conditions.

2.4.3 Water Treatment Plant Configuration

The modular treatment system can be reconfigured for different flow and layout configurations (see Figure 2-3). A control module houses the electronics, and measuring and dosing equipment. This can be paired with a number of filter options depending on the flow requirements of construction and surficial material characteristics.

Each sand filter contains a base layer of support gravel under the main layer of filter medium. The filter medium is a specially designed, washed and graded filtration sand. Each sand pod has an electro-pneumatic back flush system that purges filtered particulate from the sand bed to discharge.



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The effectiveness of both the proposed Tervita WTPs and the CESF process is supported by other project case studies in British Columbia for recently completed and ongoing water management projects, including the Evergreen Line Rapid Transit Project, Kitimat LNG early works construction, and the John Hart Dam construction.

There are two approaches for measuring water quality and compliance with discharge quality permit limits:

- **CESF unit:** WTPs are fitted with in-line sensors that are connected to a computer (programmable logic controller; PLC) which is programmed to the discharge criteria. The system is set to not discharge water outside a set of given parameters for NTU and pH.
- **Custom criteria approach:** In the case that real-time sensors are not available or cost effective to implement, a test batch will be treated, and a water quality sample will be sent to a laboratory for testing to confirm the system efficacy. The test batch of water will be discharged following this initial laboratory testing.
 - After ongoing treatment and discharge begins, a pre-determined confirmatory testing and reporting regime will begin in parallel, to show that discharge criteria compliance is maintained
 - This procedure is generally carried out when treating metals due to real-time concentration data not being available

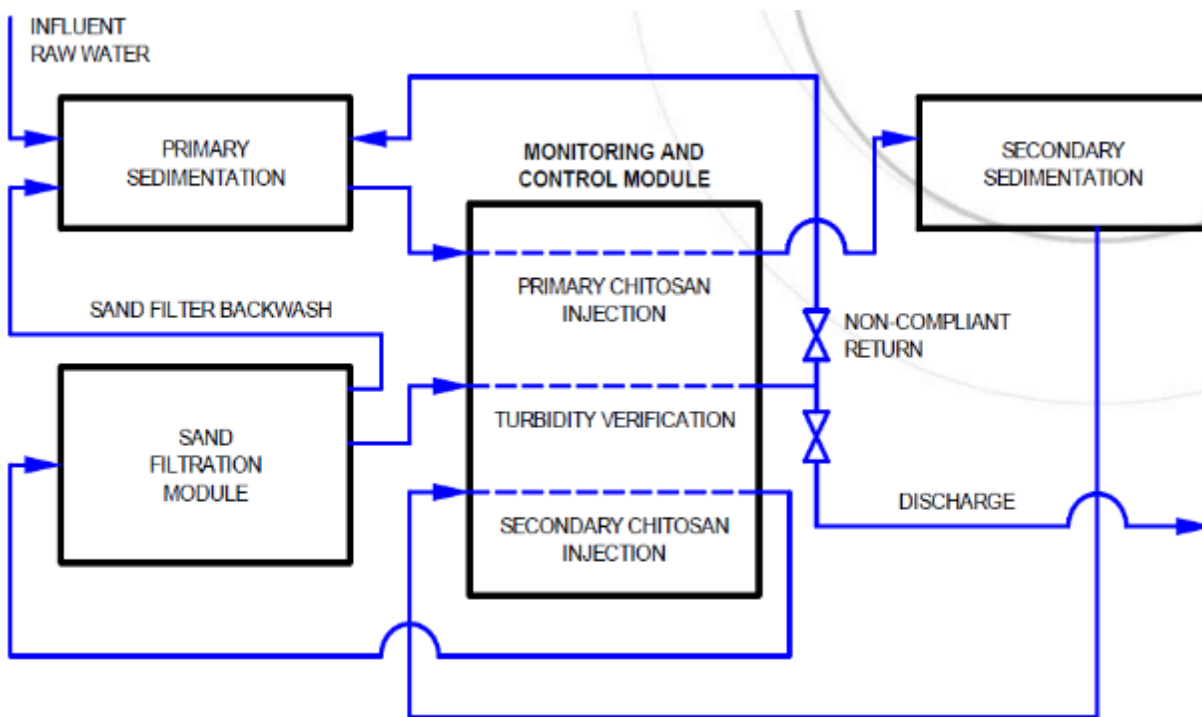


Figure 2-3 A Typical Chitosan Enhanced Sand Filtration Process Diagram



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2.4.4 General Operation of the Water Treatment Plant System

The general operation process for WTP systems is described below (see Appendix I for more detail).

2.4.4.1 Typical Process Summary

1. Stormwater is collected in an inlet surge tank
2. Stormwater is then pumped from the inlet surge tank, through the CESF unit, dosed with flocculant as required, and sent to secondary settling tanks
3. Stormwater from the settling tanks is then pumped back through the CESF unit, given an additional dose of flocculant if required and then is filtered through the sand filters
4. Stormwater from the sand filter is routed back through the CESF unit and tested every 15 minutes by a PLC for final compliance with the water quality requirements
5. PLC allows for remote monitoring of the system and data logging of key water parameters, such as flow rate, pH and turbidity. The PLC unit will automatically send customized alerts to designated person(s) of system parameters and alarms.
6. If stormwater meets project-specific water quality criteria, then the stormwater is sent to the discharge point
7. Any stormwater that does not meet the compliance requirements will be automatically re-circulated to the inlet surge tank for additional treatment
8. In addition to the automated monitoring systems, daily water sampling will take place during wetter periods to confirm automated monitoring results
9. If the WTPs capacity is reduced due to a large-scale storm event, Trans Mountain will add additional pre-treatment tanks, CESF control modules and sand filtration units as required. These additional modules will be stored on-site and added as needed based on weather forecasts.
10. Trans Mountain will also shut down construction activities if performance of the WTPs is impacted due to abnormal increases in TSS loadings
11. CESF unit removes only suspended solids; therefore, a reverse osmosis unit will be installed after the CESF unit to remove dissolved ions
12. Once water has been processed by the CESF (i.e., it meets the TSS water quality parameter) it will pass through a reverse osmosis unit and generate permeate (water that meets permit limits) and concentrate (contaminants removed from contact water)
13. Quality of the contact water is continuously monitored for parameters included in the Permit as per the active construction activities and only water that meets permit limits will be discharged
14. Any contact water that does not meet the water quality parameters will be returned for secondary treatment (recycled through the reverse osmosis unit a second time)
15. Concentrate will be collected and sent to an approved disposal facility

2.4.4.2 Backflush

Backflushing is the process by which water flow is reversed through the sand beds to expel the accumulated sediment on the top of the beds.

1. Sediment settles and accumulates in the tanks and is captured by the sand filters
2. Water flow is reversed through the sand filters to expel the accumulated sediment
3. Each sand pod is flushed one at a time while the rest of the pods in the filter continue to operate normally
4. Stormwater filtered from the active pods will fill the bottom header and a portion of it is forced upward through the pod that is being backflushed



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5. Backflush parameters are set from the control box which is fixed to the side of the sand filter. Flush duration, delay between switching pods, manual start and stop as well as power and breaker switches are all on the control box.
6. Backflush water will contain flocculant particles accumulated on the surface of the sand filter beds. These flocculant particles will settle rapidly in the detention structure due to their large size and density.
7. Backflush accumulated sediment is pumped back into the inlet surge tank

See Appendix I for more details.

2.4.4.3 Removal of Sediment from Settling Tanks

A flocculated sludge that forms at the bottom of the settling tanks will require periodic removal (see Appendix K). The quantity of the sludge produced will be dictated by the inlet TSS loading. This waste is composed of solids removed from the stormwater as well as the chitosan flocculent. The sludge from the bottom of the settling tanks will be removed using a vacuum truck for off-site disposal at an approved site.

Chitosan Flocculent

- Chitosan is a natural biopolymer derived from the structural material found in crustaceans. Chitosan is a long chain polymer and possesses a strong positive charge. Sediment particles typically are negatively charged. Chitosan flocculates (clump together into a large mass) these fine particles causing the sediment to settle, thereby clarifying the water.
- ChitoVan Chitosan Acetate (see Appendix H) is a high-quality industrial grade chitosan solution containing the acetate counter-ion and is available in 1% (CA100). ChitoVan CA is a clear viscous solution that is very stable (18-month or greater shelf life) in comparison to other flocculants that may degrade rapidly. CESF technology typically uses a chitosan acetate solution metered into a pipe to flocculate suspended solids prior to filtration.
- CESF stormwater treatment with ChitoVan CA100 has been thoroughly tested through the Washington Department of Ecology Technical Review Committee and was awarded a General Level Use Designation for batch, infiltration and flow-through to all receiving waters of the state. The rainbow trout LC₅₀ is greater than 10,000 mg/L.

2.4.4.4 Ion Exchange System

An ion exchange system will be used to remove dissolved iron. The system removes unwanted anions and cations by passing the water through a resin-packed column to adsorb the contaminants.

Contaminated water is sent through the column and contaminants are replaced with another similarly charged ion that is not a contaminant, such as sodium or hydroxide. After the exchange capacity of the resin has been met, the column will be returned to its original state by a regeneration process—a regeneration solution is run through the resin and contaminants are collected and disposed of in an approved manner.



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2.4.4.5 Activated Carbon

Free and total chlorine residual and propylene glycol will be treated with activated carbon. Activated carbon is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption or chemical reactions. Due to high reactivity of the free chlorine residual and a large surface area of activated carbon, there is a high affinity for a chemical reaction between the free chlorine and propylene glycol and the carbon structure of the activated carbon. When water with chlorine or propylene glycol pass through the carbon bed, they form a chemical bond with the fix media. When the capacity for adsorption has been reduced, the used carbon media will be disposed of in an approved manner.

2.4.4.6 Decommissioning of Water Treatment Plants

When a WTP is no longer needed on site (i.e., construction activities in a phase or area of the site are complete) the WTP will be decommissioned as per Appendix L.

2.4.5 Modular Construction of Various System Components and Potential Extra Capacity Addition

Below is a summary of modular construction of various system components, and examples of potential extra capacity additions.

2.4.5.1 Modular Components Available to Add Capacity

The performance of the WTPs will be monitored based on actual rainfalls during initial WTP commissioning. Plant sizing will be adjusted based on actual WTP performance. Monitoring of weather forecasts and seasonal needs will also take place. WTP components can be increased ahead of forecasted events and seasonal needs. Options for expansion and customization are described below.

- Tanks—additional tanks can be added in parallel and interconnected with header units and pumps to be sized accordingly
- Sand Filters—additional sand filters can be added in parallel to provide more filtration and flow capacity
- Pumps—additional pumps of various types can be added, or individual pumps can be upgraded, to increase pressure and flow
- CESF Head Unit—in the most demanding cases, multiple CESF systems can be arranged in parallel to share in the required treatment capacity

Tervita has a significant fleet of the above equipment in Richmond, British Columbia. Tervita has sized the initial capacity of the WTPs. With the addition of an extra retention tank, upsizing the pumps, or additional flocculant or sandpot systems, additional treatment capacity can be achieved (see Figure 2-3 for typical CESF process diagram).



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2.4.5.2 Capacity of Water Treatment Plants to Handle Storm Events

The safety factor for control of TSS and turbidity from stormwater runoff during construction activities at the Terminal has been defined by a series of predictive modelling results, on-site water management protocols and redundant mitigation measures and systems including:

1. Predictive hydrologic modelling which has been used to design the filtration capacity of individual WTPs for each area of construction activity
2. Active and ongoing site restoration activities for each construction area
3. Erosion and sediment controls managed and maintained, specific for each construction area (silt fences, cross ditching, hay and gravel berms, covering exposed soils, local re-circulation sumps, dispersion to vegetated areas, soil stabilization, vegetated buffers
4. Pollution prevention measures including designed, monitored and managed collection sumps, intake tanks and WTP specified for each construction area, including additional WTP modules stored on site
5. Active and real time monitoring at each WTP, and across the Site
6. Active weather forecasting for rainfall events
7. Prohibited discharges

The WTPs have been sized to handle a 10-year return storm (Section 3.3.1.1). The East, West, and Foreshore WTPs will have capacity to treat 800 GPM (0.050 m³/s), 400 GPM (0.025 m³/s), and 200 GPM (0.013 m³/s) of runoff, respectively.

2.4.6 pH Treatment

Concrete curing contact water can have a high pH; treatment to 6.5–9.0 is required prior to discharge to the receiving environment. Process water dissolves calcium hydroxide and other alkalis that are present in fresh and hardened concrete, elevating process water pH. A common method to treat high pH water is with the use of CO₂ gas. When added to process water, CO₂ forms carbonic acid, a weak acid that reacts with calcium hydroxide to precipitate calcium carbonate. Before water is discharged, both precipitate and suspended solids must be removed by settling or filtering operations. Increasing the flow of CO₂ to the holding tank will further reduce the process-water's pH level. When pH levels reach 7 or 8, the precipitated calcium carbonate dissolves and the process water can be released to the environment.

The pH treatment of affected water will be completed in two stages. During the first stage, concrete wastewater will be periodically pumped to the on-site CO₂ bubbler/settling tank to treat for pH and TSS (see Photo 2-5). CO₂ cylinders will be placed next to the settling tank and will be fitted with perforated diffuser hoses. The hoses will lay on the bottom of the containment pond with the flow of CO₂ adjusted by hand at the cylinder regulator. During the second stage of water treatment, CO₂ gas will be used again to control pH in the WTP. CO₂ will be injected inline (i.e., into the flow of water); the injection of CO₂ will not impact the discharge rate of the WTP.



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Water that leaves the WTP(s) will be monitored and controlled with a pH electrode probe (e.g., +GF+ Signet). In a WTP, water will be measured three times for pH; first as part of the pre-treatment, second as part of the influent treatment, and the third time prior to discharge. At the third monitoring point (prior to discharge), if water does not meet the discharge limits a solenoid valve will close preventing any discharge water from leaving the WTP. That water would be recirculated back into the WTP for further treatment and monitoring. When water meets the discharge limits, the water will be released to the receiving environment through existing drainage infrastructure or to the CP Rail ditch. pH will be monitored at specific locations after release from the WTPs as per Appendix G.



Photo 2-5 **Example of Water Treatment Plant CO₂ Bubbling Component**

2.5 MANAGEMENT SYSTEMS AND CONTINGENCY PROTOCOLS

Environmental management of the Site during construction, adverse weather conditions and/or spill incidents, as well as contingency measures are described in Appendix B of the Westridge EPP (Appendix A). The EPP describes a series of protocols and steps to identify adverse weather conditions in advance of them occurring, and responses beyond planned site-specific mitigation measures, to avoid and limit potential effects to the receiving environment. The EPP describes spill response related to construction activities. Ongoing Terminal operations and construction activities will be managed and monitored to verify that hydrocarbons are not added to Site drainage and/or runoff and are not discharging from the site. WTPs will be actively managed to maintain compliance with Permit levels.



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The following is a list of mitigation measures to respond to adverse weather conditions:

- As per the EPP, daily weather forecast review (Appendix A)
- With a forecasted adverse weather event, WTP technician staffing will be scheduled to assist with WTP performance management and monitoring during the event; water samples will be collected as per the Westridge Marine Terminal Construction Water Quality Monitoring Plan—Phase 3 (Appendix G)
- If an adverse weather and rainfall event is forecast to result in accumulations of precipitation that reach WTP capacity (e.g., for a 10-year storm event), construction activities will be shut down and ESC measures implemented to control stormwater turbidity levels ahead of storm events
- Water can be pumped back from the west sump within the CP Rail ditch to the West WTP if water quality discharge from the WTP exceeds the Permit limits
- If an extreme rainfall event is forecast (i.e., greater than the capacity of the WTPs), a bypass authorization may be sought from BC ENV for temporary discharge of excess water to the most upslope of vegetated/coco mat area



3.0 IMPACT ASSESSMENT

3.1 INTRODUCTION

Phase 3 construction activities could potentially impact aspects of the environment. Section 3.2 provides a summary of the existing conditions for the Terminal (climate, hydrology, hydrogeology, oceanography and marine sediments, marine and freshwater water quality, soil quality, aquatic resources, vegetation, wildlife and wildlife habitat, and human use and protected areas). Where construction activities could potentially impact the environment, an analysis is carried out to determine the scale of the impact and in some cases new mitigation measures are proposed (see Section 3.3) above those proposed in the EPP (Appendix A).

3.2 EXISTING ENVIRONMENTAL CONDITIONS

3.2.1 Climate

The Terminal is in the Fraser Lowland Ecosection within the Lower Mainland Ecoregion, an area of high rainfall, with precipitation increasing towards the Coast Mountains and Cascade ranges. Pacific air can stall in this region bringing rain or snow to the adjacent mountains. Infrequently, arctic air moving through the area can bring winter storms with cold temperatures and snow, with the minimum temperature recorded at the weather station at Simon Fraser University (SFU) (Climate ID: 1101158) of -19.4°C (December 2, 1968) (ECCC 2016). Hot, dry air from the south can bring warm, very dry conditions in the summer, with a maximum temperature recorded at SFU of 34.5°C (September 3, 1988). Daily average maximum temperatures are highest in July and August at approximately 21°C, with daily average minimums lowest in December and January at approximately 1°C. Average precipitation recorded at the monitoring station at SFU between 1981 and 2010 is 2,010 mm per year, including 89.3 cm of snowfall.

Daily climate data at the nearby SFU climate station (ID: 1101158) is available online. An Intensity-Duration-Frequency (IDF) curve has been published by ECCC for their climate station on Burnaby Mountain (Burnaby Mountain BCHA, Climate ID: 110JA54) (i.e., the closest station to the Terminal with an IDF curve, see Appendix M).

Daily precipitation totals at the SFU climate station (ID: 1101158) were compared to the IDF return period rainfall depths at the Burnaby Mountain station (ID: 110JA54) for historical context (Figure 3-1). These two climate stations are both located on Burnaby Mountain, and have therefore recorded the same general meteorological conditions. Unlike SFU climate station (ID: 1101158) data, daily data for the Burnaby Mountain station (ID: 110JA54) are not available online; therefore, they cannot be independently checked or updated with more recent data.

The storms used in this analysis are shown in Table 3-1, with the full IDF curve provided in Appendix M.



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Table 3-1 Intensity-Duration-Frequency Return Period Rainfall Amounts, Burnaby Mountain BCHA (110JA54)

24-Hour Storm Return Period	Total Rainfall (mm)
2-Year	79.6
5-Year	103.0
10-Year	118.6
100-Year	167.3

The industry-standard storm duration of 24 hours and return period storms in Table 3-1 are based on the following rationale. The two-year event was selected based on professional judgement, experience with similar projects/ developments, and to generate inflows expected to be treated by the various WTPs proposed in different phases of the Works. The 10-year and 100-year events were selected as large storm events; these targets are typically used by the City of Burnaby for sizing their minor and major stormwater systems, respectively. Return period storms are inversely related to their probability of exceedance. Therefore, the 2-year, 5-year, 10-year and 100-year events have a 50%, 20%, 10% and 1% probability of being exceeded in a given year.

Figure 3-1 presents the reported daily precipitation data over the 53-year period of record at the SFU weather station (ID: 1101158; 1965–2018, 17,416 data points). Also presented in Figure 3-1 are the Burnaby Mountain (Climate ID: 110JA54) rainfall depths for 2-, 5-, 10-, 25-, 50- and 100-year 24-hour return periods based on the IDF curve (Table 3-1). The 100-year 24-hour return period rainfall (167.3 mm) was exceeded once (January 1968), the 10-year 24-hour storm period rainfall (118.6 mm) was exceeded twice (January 1968 and October 2003), the 5-year 24-hour storm period rainfall (103 mm) was exceeded three times (twice in January 1968 and once in October 2003), and the 2-year 24-hour storm period rainfall (79.6 mm) was exceeded 21 times during the period of record. Daily precipitation values exceeded the 2-year, but not the 5-year return period values 18 times over the 53-year period of record. The remainder of the daily precipitation totals (more than 17,000 data points) were below the 2-year storm return period value for rainfall. In the last 10 years, (2009 to 2018) the 2-year 24-hour return period rainfall was exceeded once at the SFU weather station (November 3, 2014; 84.2 mm). This was the highest reported daily precipitation during this period.



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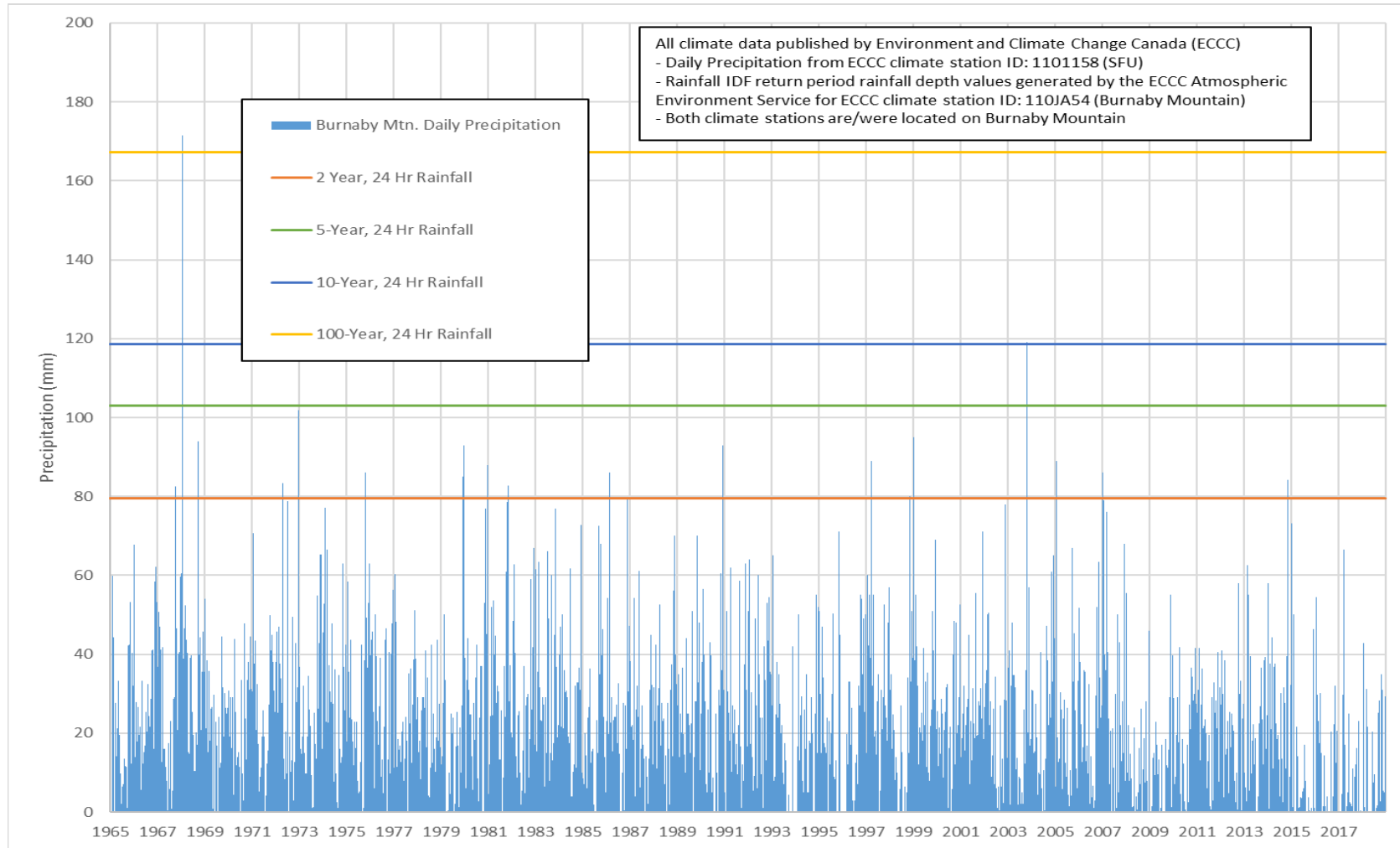


Figure 3-1 Average Daily Precipitation at Westridge Marine Terminal Over the Last 53 Years



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3.2.2 Hydrology

The Westridge Marine Terminal is located on the lower slopes of a north-facing hillside and extends to the Burrard Inlet shoreline (Figure 1-1). The elevations of the Project area range from approximately 58 m at the top of the property down to -6 m in the waters of Burrard Inlet. Aside from the relatively flat foreshore, most of the property is steeply sloped (approximately 26% gradient) (Appendix D).

Existing drainage for the Westridge Marine Terminal directs surface runoff into Burrard Inlet (Figure 1-2). A drainage ditch, filled with coarse-gravel (railway ballast), runs parallel to the CP Rail tracks on the south side of the tracks that is only seasonally wetted. A manmade ditch on the west side of the property boundary also runs north to the same east-west vegetated drainage ditch. Another small watercourse (non-fish bearing stream; BC-789) crosses onto the property on the south side from Inlet Drive directly south of the Tunnel portal area (Section 2.1.2) and flows north across the site (Appendix D). This drainage is then culverted under the site to Burrard Inlet (Figure 1-2).

To demonstrate the hydrologic regime of these onsite drainages, average daily discharge rates from the Burnaby Terminal, which is hydro-climatically similar to the Westridge Marine Terminal, are shown in Figure 3-2. High rainfall-driven flows are seen during the high precipitation period of November to March, while very low flows are observed during the dry period of summer (July to September).



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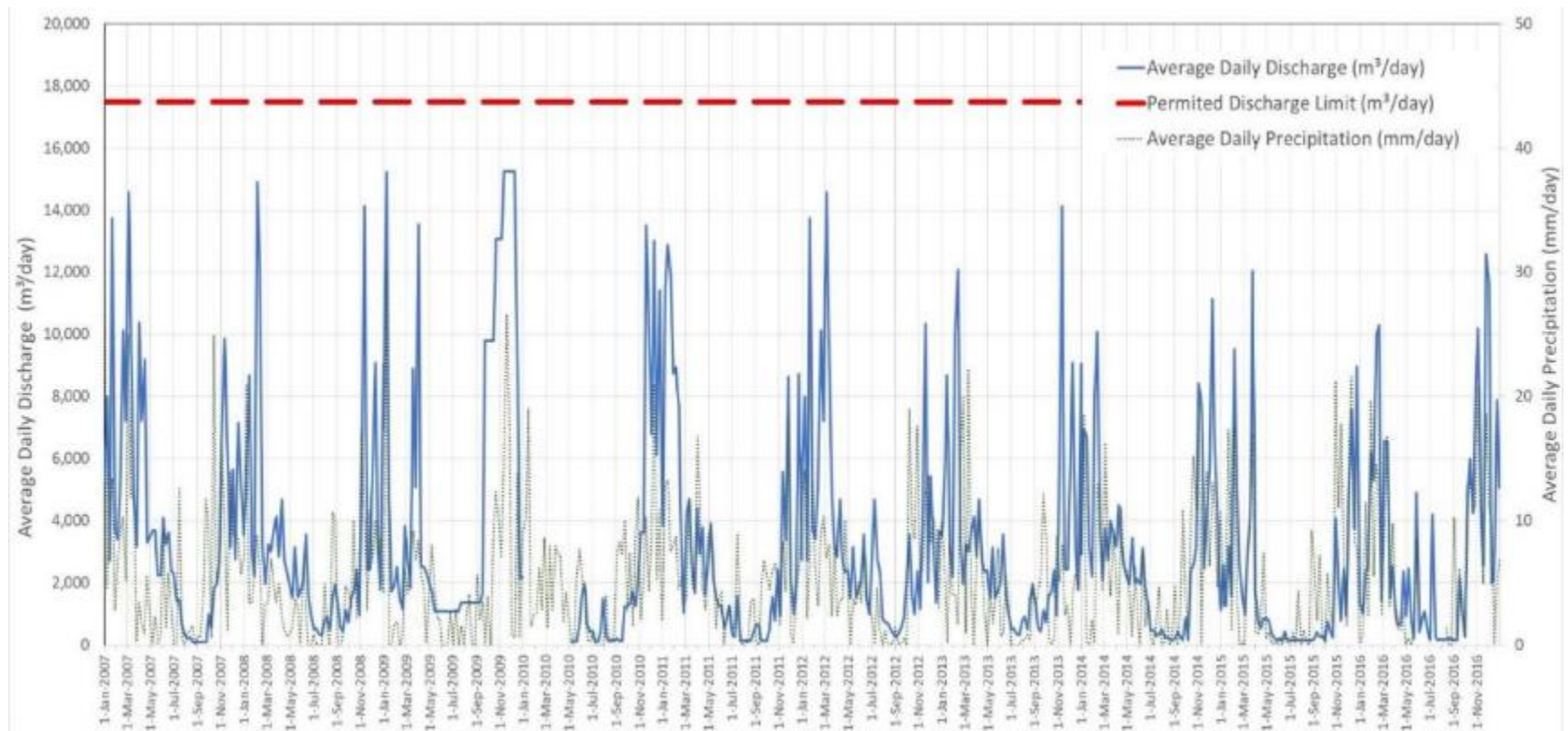


Figure 3-2 Average Daily Discharge and Average Daily Precipitation at Burnaby Terminal from 2007 to 2016



3.2.3 Hydrogeology

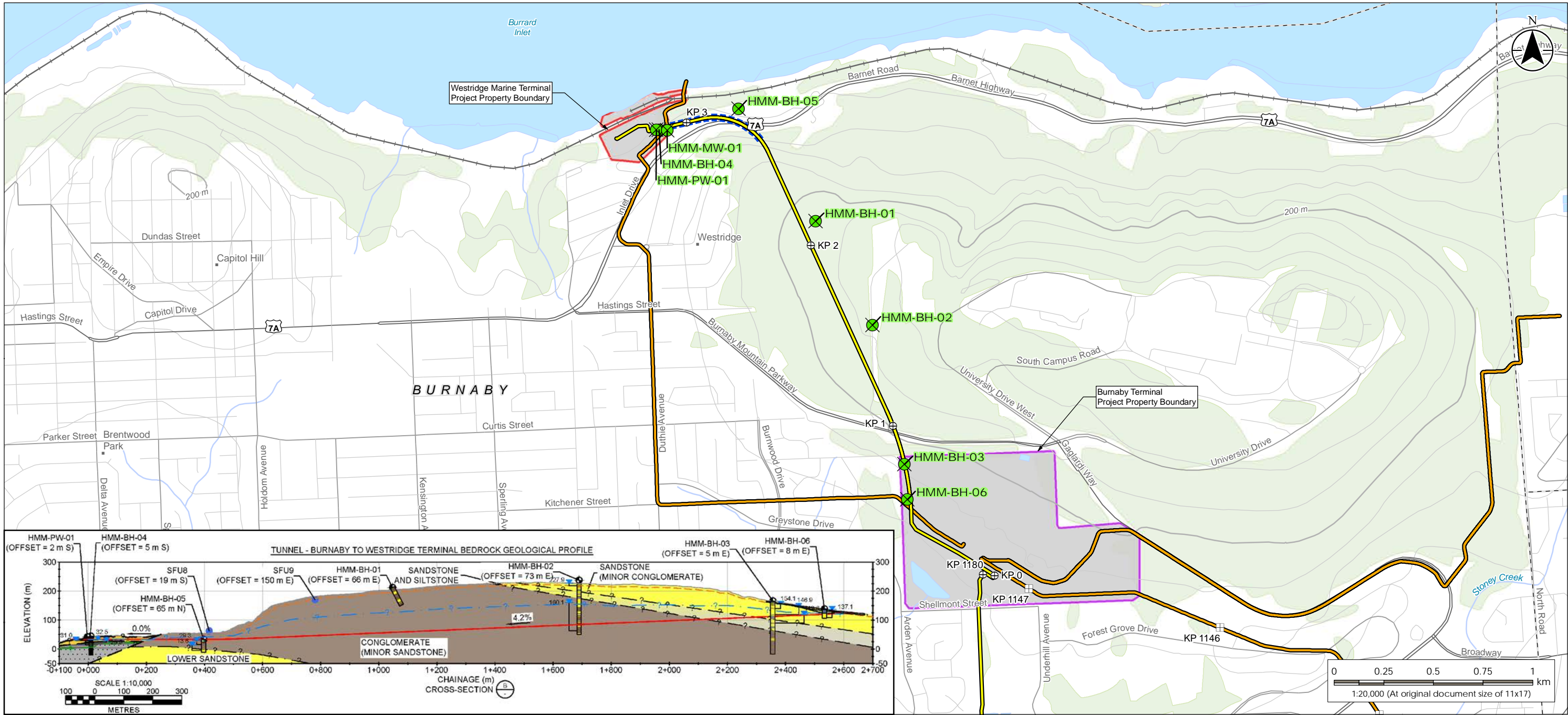
3.2.3.1 Baseline Study Design

Groundwater-related data were collected from geotechnical boreholes at Westridge Marine Terminal and Burnaby Terminal in 2014 and 2015 through previous technical studies to support design of the Project (BGC 2015a, 2015b; Hatch et al. 2017), specifically the tunnel alignment. To increase confidence in the numerical flow model and to provide additional temporal data for baseline conditions, TMEP carried out an additional monitoring/sampling event during the high groundwater season (Spring 2019; Appendix N). These data were used to confirm existing groundwater elevations and trends. The resulting compiled baseline data therefore covers several years starting in 2014, with data collected during both high and low groundwater conditions.

Specific groundwater monitoring and sampling locations are presented in Figure 3-3.



S:\1232\projects\123512431\Figures\Reports\Westridge_marine_terminal_waste_discharge_phase_3\map\fig_123512431_wm_twp_3.tar_03_groundwater_map.mxd
Revised: 2019-09-30 By: TDineen



Notes

- Coordinate System: NAD 1983 BC Environment Albers
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project; Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
- This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

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- Highway
- Major Road
- Local Street
- Railway
- Topographic Contour (m)
- Watercourse
- Waterbody
- Wooded Area
- Burnaby Terminal Project Property Boundary
- Westridge Marine Terminal Project Property Boundary
- Municipal Boundary
- Existing Trans Mountain Pipeline Kilometre Post
- Existing Trans Mountain Pipeline Centreline
- Proposed TMEP Pipeline Kilometre Post
- Proposed TMEP Pipeline Centreline
- Phase I and II Site Investigation
 - Borehole
 - Seepage Mapping (Approx. Location)



Location Information
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINEEN on 20190726
PM Review LHARRISON 20190927

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project

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Suite 2700, 300 5th Avenue SW,
Calgary, AB, T2P 5J2

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Westridge Marine Terminal – Groundwater Quality Sampling Locations Plan and Profile View

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The following reports documenting hydrogeological baseline conditions for the Project were reviewed:

1. BGC Engineering Inc. (2015a), 2014 Westridge Tunnel Investigation Site Data Report—report includes geotechnical borehole logs and completion, water quality during drilling, groundwater quality, packer testing and groundwater level monitoring, along the tunnel alignment
2. BGC Engineering Inc. (2015b), Mountain Tunnel Phase II Site Investigation: Westridge Marine Terminal—aquifer test including groundwater level monitoring and quality, three new borehole logs and completions, from chainage 0+000 to 0+200 along proposed tunnel alignment
3. Hatch, Mott and MacDonald (May 2017). Inflow during Construction—Rates and Impact—Hydrogeological Modelling Report, Burnaby Mountain Tunnel
4. Stantec, (June 2019), Westridge Marine Terminal—Hydrogeology Baseline Sampling Program (Appendix N)

3.2.3.2 Groundwater Quantity

A hydrogeological baseline field program was completed on May 28 and 29, 2019, to supplement and confirm the results of the previous studies listed in Section 3.2.3.1. The 2019 field scope of work included the following tasks:

- Collecting groundwater samples at available, existing monitoring well locations
- Downloading data from level-loggers and baro-loggers (where available)
- Preparing a groundwater seepage at-surface map (including flow measurements if applicable) along the tunnel alignment section north of Burnaby Mountain

Conceptual Hydrogeological Model

The Conceptual Hydrogeological Model (Hatch et al. 2017) along the Project footprint concluded the following:

- Aquifer geometry: two bedrock units with higher hydraulic conductivity on top, and lower hydraulic conductivity below; gently dipping according to stratigraphy
- Groundwater flow regime: recharge is from Burnaby Mountain, groundwater flow resistance is controlled by hydraulic conductivity, downward vertical hydraulic gradient, and discharge performance, with Burrard Inlet being the regional discharge area
- Spatial recharge depends on urban development, topography, and wet area distribution; there is no temporal variation (annual average used) but tunnel inflow will vary depending on open segment position during construction
- Surface water bodies are groundwater discharge locations (e.g., Burrard Inlet) rather than sources of recharge
- Local groundwater abstraction is deemed insignificant because there are presumably no other groundwater users based on available registry.
- No large groundwater-related development is present within the domain.
- Recharge and discharge are based on local geology within two basins: the Brunette River basin and the Burrard Inlet basin. Average annual precipitation rates are applied to both areas. Calculated recharge is considered maximum discharge to surface water bodies. The tunnel discharge estimate is based on an analytical solution applied to individual sections of tunnel wall.



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Geology

Geological units are divided into three hydrogeological units:

- Unconsolidated material: referring regionally to the Quadra Sands
- Weathered bedrock in the form of shallow bedrock: will be intercepted by the tunnel alignment at two interfaces, between bedrock and unconsolidated material (i.e., both portals)
- Unweathered bedrock in the form of deep bedrock: the greater portion of the tunnel alignment intercepts this unit

The tunnel alignment (from west to east) will intercept unconsolidated material followed by the weathered bedrock units at the Westridge Marine Terminal portal for approximately 200 m, and then will enter bedrock for approximately 2,200 m prior to intercepting weathered bedrock and unconsolidated material for the last 200 m at the Burnaby Terminal portal. Refer to the boreholes logs in the reports in Appendix N.

Figure 3-4 shows the bedrock geological profile and chainage in metres along the pipeline alignment (BGC 2015b).

Detailed methods and quality assurance/quality control (QA/QC) procedures are outlined in the reports in Appendix N.



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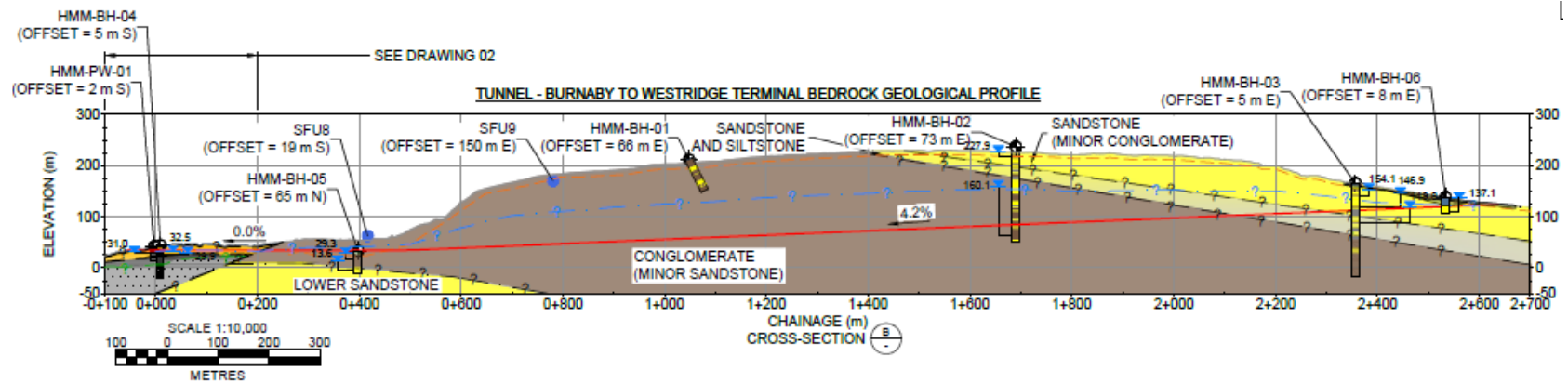


Figure 3-4 Tunnel—Burnaby to Westridge Marine Terminal Bedrock Geological Profile



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Hydraulic Conductivity

The hydraulic conductivity of the bedrock along the proposed tunnel alignment varies from 2.7×10^{-9} to 2.9×10^{-5} m/s. Higher conductivities (2.3×10^{-6} to 2.9×10^{-5} m/s) were calculated in highly- to moderately-weathered bedrock in HMM-BH-05 compared to conductivities in the unweathered bedrock (BGC 2015a). In the unweathered material, hydraulic conductivity ranges from 2.7×10^{-9} to 1.4×10^{-7} m/s (BGC 2015a). Bedrock hydraulic conductivity decreases significantly with depth (Hatch et al. 2017). The longest stretch of the tunnel, north of the Burnaby Terminal, will intercept the unweathered bedrock unit.

Analyses were conducted to estimate hydraulic conductivity and transmissivity of the Quadra Sands (i.e., unconsolidated material hydrogeological unit). Hydraulic conductivity analyses yielded a geometric mean of 8.2×10^{-7} m/s with values ranging between 6.1×10^{-7} to 1.1×10^{-6} m/s. Transmissivity results varied between 4.6×10^{-6} and 8.2×10^{-6} m²/s with a geometric mean of 6.1×10^{-6} m²/s (BGC 2015b). The Quadra Sands unit, comprised of two interlayered material types (i.e., medium to fine sand and silt to clayey silt) is approximately 25 m thick at the Westridge Marine Terminal, encountered between 40.5 to 15.5 m asl. The approximate depth of the tunnel alignment is within this unit (Hatch et al. 2017).

Aquifer storativity is estimated to 3.2×10^{-4} (BGC 2015b). This value is representative of semi-confined aquifer and is consistent with the hydrogeological setting.

Groundwater Level Data

Groundwater level data were collected at seven different sites (HMM-PW-01, HMM-BH-04 (2 levels), HMM-MW-01 (2 levels), HMM-BH-05 (2 levels), HMM-BH-02 (2 levels), HMM-BH-03 (4 levels) and HMM-BH-06) along the tunnel alignment during the geotechnical drilling program (fall of 2014) as well as near the Westridge Marine Terminal proposed tunnel portal during an aquifer test in fall of 2015. In 2019, data collected from wells equipped with pressure transducers and dataloggers (HMM-PW-01, HMM-BH-04 (2 levels) and HMM-MW-01D (i.e., deep)) were downloaded. See Figure 3-3 for monitoring locations.

Groundwater level measurements typically characterize hydrogeologic variables at appropriate spatial and temporal scales. By collecting data during high water conditions in 2019, compared with data collected in fall of 2014 and 2015 (low groundwater level conditions), a review of seasonal variations was covered. It was assumed that if water levels remained consistent at available observation water wells (OWW) in 2014, 2015 and 2019, then general water levels remained spatially and temporally consistent along the Project footprint.

Groundwater levels fluctuated by 0.84 to 1.86 m between 2014 and 2019: those values are consistent with seasonal fluctuations (Figure 3-5; Appendix N). The data show that groundwater levels have remained relatively stable since 2014; as such, the numerical groundwater flow model predictions are still considered valid.



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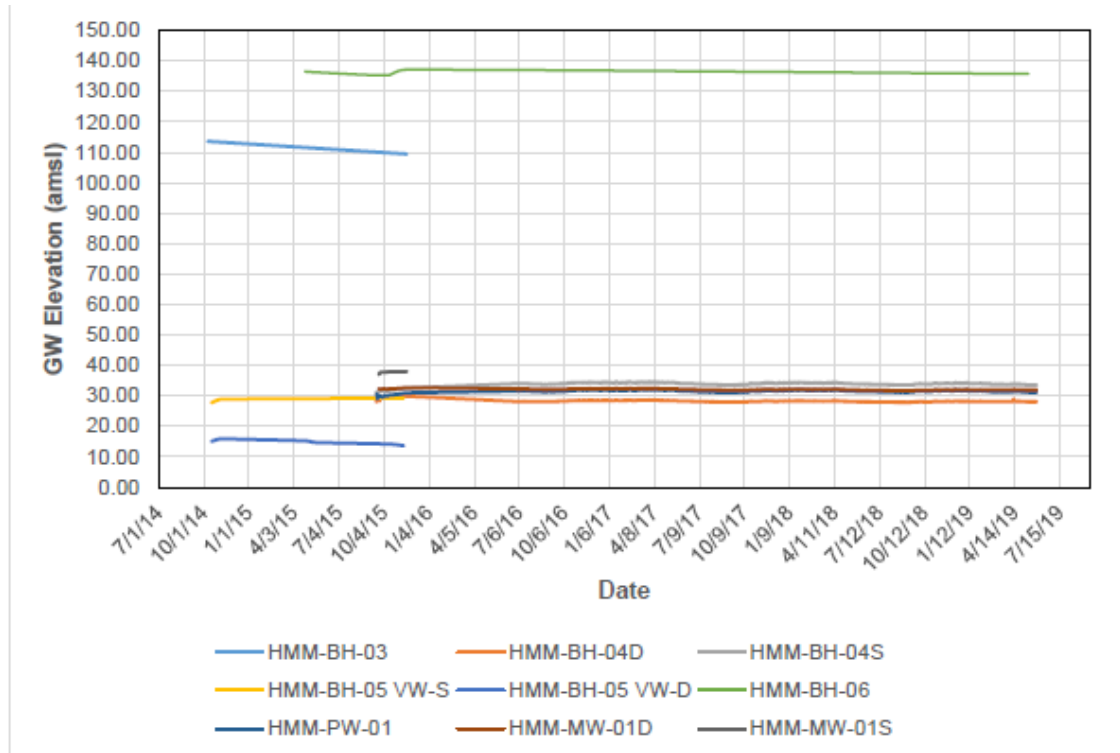


Figure 3-5 Tunnel Alignment Groundwater Level Observations

Based on the available data (i.e., groundwater level data is available only along a linear alignment), a contour map of groundwater flow cannot be presented. However, based on knowledge of the hydrogeology of the area, in general, groundwater is expected to flow towards Burrard Inlet to the north. Figure 3-5 presents depth to groundwater and horizontal hydraulic gradient (4.2%) along the proposed tunnel alignment sloping north, towards Burrard Inlet.

Predicted Tunnel Groundwater Inflows

During tunnel boring activities (directed from Westridge Marine Terminal), gravity will convey potential groundwater seepage to the Westridge Marine Terminal, where it will be collected and treated before being discharged to Burrard Inlet.

Simulation runs using a numerical groundwater flow model were used for this purpose. The following Figure 3-6 illustrates the relationship between the simulated heads at specific locations along the alignment compared to the observed water levels (see Figure 3-3 for locations of observation water wells).



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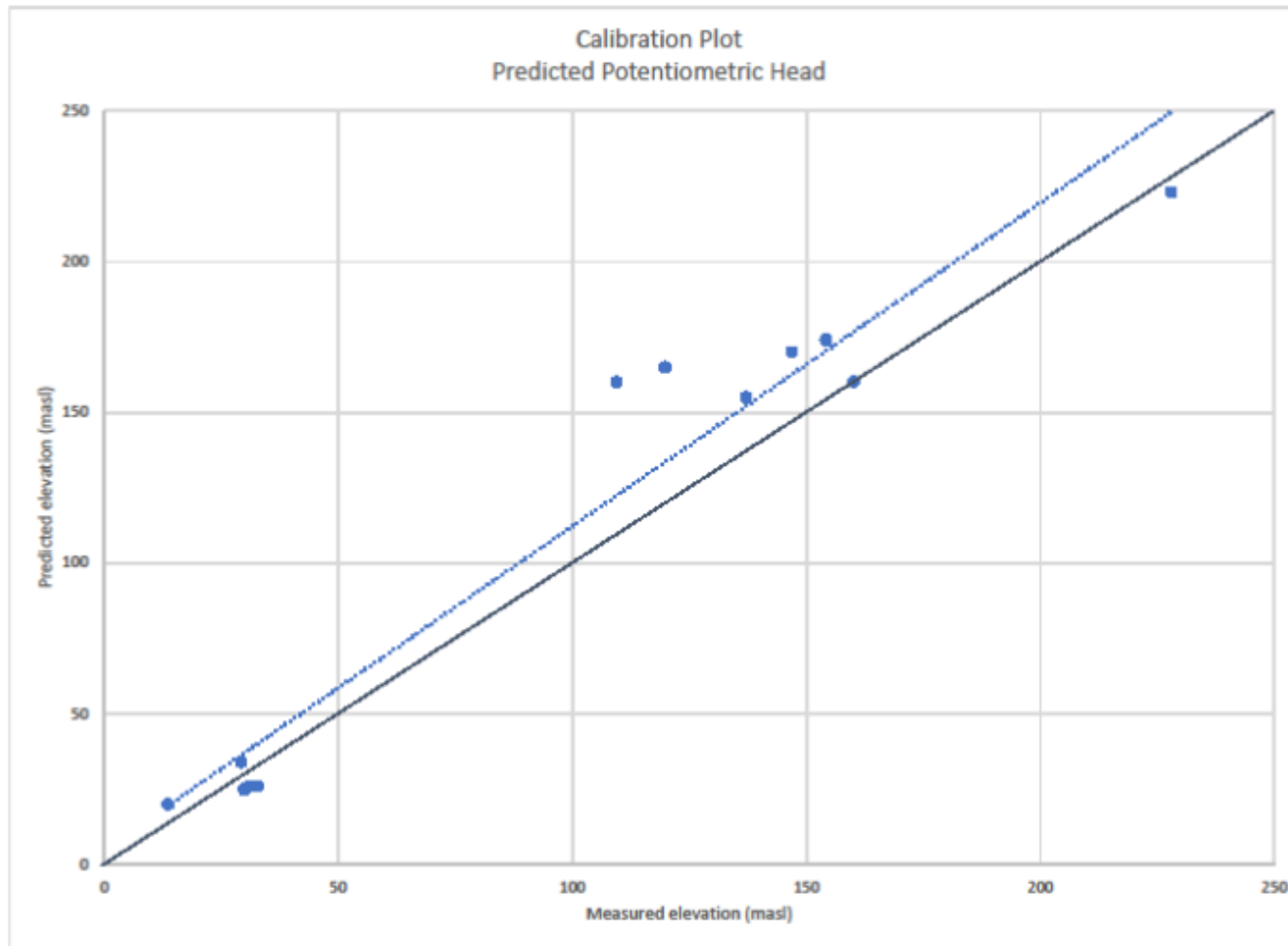


Figure 3-6 Calibration Plot—Potentiometric Head (Hatch et al. 2017)



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The normalized Root Mean Square Error (RMSE) for the observed water well groundwater elevations is estimated at 12.4%. The calibrated model is sufficient to predict potentiometric heads and inflow rates with sufficient accuracy.

The sensitivity analysis indicates that the sensitivity of simulated potentiometric heads to aquifer recharge rates and hydraulic conductivities is good, except near constant-head boundaries. The use of non-unique parameter values (hydraulic conductivities and recharge rates) will obtain hydraulic head distributions in the same range. Because of site-specific hydraulic conductivity measurements and estimated discharge rates based on field observations, it is assumed that tunnel inflow could be predicted with enough confidence to use the groundwater flow model. Because of uncertainties affecting some parameters that are not site-specific measured, conservative values need to be chosen for these parameters for use in prediction scenarios. Furthermore, the model was sufficiently well calibrated to proceed with predictive modelling. The resulting groundwater inflow along the tunnel alignment is summarized in Table 3-2.

Table 3-2 Predicted Tunnel Inflows during Tunneling (Hatch et al. 2017)

Approximate Days Elapsed since Start of Tunneling in Open Mode	Tunnel Reference Point Chainage (m)	Predicted Average Seepage Rate during this Interval (L/s)	Predicted Cumulative Inflow by the End of this Interval (m ³)
0 to 5	210–270	0.3	130
5 to 10	270–330	0.4	290
10 to 15	330–395	1	710
15 to 20	395–460	0.8	1,060
20 to 30	460–590	0.5	1,520
30 to 40	590–710	0.007	1,530
40 to 165	710–2,270	0.015	1,690
165 to 170	2,270–2,330	0.03	1,700
170 to 176	2,330–2,410	1.1	2,270
176 to 180	2,410–2,440	1.5	2,740
180 to 185	2,440–2,520	1.2	3,270
185 to 190	2,520–2,600	0.9	3,700
190 to 193	2,600–end	0.7	3,830

The maximum flow rate is anticipated at the start of the boring (between 0+200 and 0+600 m) due to higher horizontal hydraulic conductivities (unconsolidated material and weathered bedrock hydrogeological units). Variations in inflow rate is related to the transition into different hydraulic conductivity hydrogeological unit as boring progresses.



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Cumulative inflows were obtained by multiplying the extracted inflow rates for each stress period by the stress period's duration (Table 3-2). As indicated in the table, the cumulative inflow is predicted to be less than 4,000 m³. Conservative model outputs indicate a maximum flush flow (unmitigated flows) of 600 L/min (Hatch et al. 2017), and this has been incorporated into hydrology modelling, and subsequently, the sizing of WTPs (see Section 3.3.1).

Potential Uncertainties

It is possible that, during tunnel boring, a fractured bedrock area could be intercepted, producing a higher instant inflow rate for a short period of time. The effects of these singular inflows would be temporary: the tunnel walls will be sealed as the tunneling progresses.

Water Seepage - Springs

On May 29, 2019 a groundwater seepage assessment was completed along a portion of the tunnel alignment (Appendix N). The assessment was completed from the Westridge Marine Terminal to a location approximately 100 m east of Barnet Highway (Figure 3-7). Field staff walked the tunnel alignment route and mapped locations of surface water and shallow groundwater. Shallow groundwater was noted by the presence of hydrophilic vegetation or visibly wet soil. Surface water was present as small streams that cross over the tunnel alignment. These streams are assumed to originate as a groundwater seep upgradient of the alignment.

An estimate of flow rate was performed at each seep; rates varied from barely measurable traces up to 0.5 L/s, with some of them showing dry conditions at times. It is possible that the flow in these streams could be temporarily impacted during tunnel construction; however, no post construction impacts are likely once the pre-cast segments have been installed.

Overall, surface seepage of groundwater along the first section of the tunnel alignment, near the Westridge Marine Terminal, may be temporarily affected by tunnel construction, but should revert to pre-construction conditions after the tunnel walls have been plastered and sealed.



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3.2.3.3 Groundwater Quality

Groundwater quality samples were collected during low groundwater conditions at two different OWWs: Westridge Marine Terminal in 2015 (HMM-PW-01) and at Burnaby Terminal (HMM-BH-03) in 2014. Groundwater quality sampling events completed in 2014 and 2015 focused on low water conditions. These reports are summarized in Appendix N.

The 2019 Groundwater Sampling Program (Appendix N) was completed on May 28 and 29, 2019, at five wells located at three locations at the Westridge Marine Terminal. The 2019 sampling event was planned to coincide with high water conditions to assess seasonal variations. The main objective of the groundwater quality sampling program was to establish baseline conditions to allow for the design of effective treatment of inflow water during construction.

The BC Ministry of Environment Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016) recommends the minimum period of record for a groundwater quality baseline study be comprised of one year of quarterly data; however, Stantec determined that if 2019 (high level conditions data) water quality results were similar to 2014/2015 water quality results, this could be sufficient to characterize seasonal variations. Note that during the 2019 sampling event, groundwater was only sampled / analyzed at the following locations: HMM-PW-01, HMM-MW-01 (2 levels) and HMM-BH-04 (2 levels) as some previously identified wells were no longer in existence. It is assumed that the sampling results are representative of groundwater conditions in general, in the area between the Westridge and Burnaby Terminals.

Sampling Methods

The 2019 field sampling program was conducted in accordance with the BC Field Sampling Manual (BC MOE 2013). Groundwater was analyzed for in situ temperature, pH, dissolved oxygen, specific conductivity, and turbidity, and samples were submitted to the ALS laboratories (ALS is an accredited laboratory with the CALA) in Burnaby, BC for analysis of:

- Routine parameters: conductivity, total dissolved solids, pH, true colour, hardness, turbidity
- Nutrients (NO₂, NO₃, TKN, o-PO₄)
- Metals (total and dissolved)
- Total organic carbon (TOC)
- Chemical oxygen demand (COD)
- Volatile organic carbon (VOC)
- Hydrocarbons: extractable petroleum hydrocarbons (EPH) (C10-19; C19-32), F2-F4, light/heavy extractable petroleum hydrocarbons (LEPH/HEPH)
- Polycyclic aromatic hydrocarbons (PAHs)
- Methane
- Phenols (4AAP)



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Samples were collected from monitoring wells HMM-PW-01, HMM-MW-01S, HMM-MW-01D, HMM-BH-04S and HMM-BH-04D, with a duplicate sample collected at HMM-PW-01 to meet the quality assurance and quality control (QA/QC) objectives as outlined in the BC Field Sampling Manual (BC MOE 2013). See Appendix N for detailed methods and QA/QC protocols and results.

Applicable Guidelines

Sample results were compared to the BC approved and working WQG (BC WQG 2018) for marine aquatic life and the CCME Water Quality Guidelines for Marine Aquatic Life (CCME 2019). Full laboratory results screened against guidelines and QA/QC results are provided in Appendix N. Laboratory certificates are also found in Appendix N.

Initial Groundwater Quality Results

The initial groundwater quality results used to assess the existing groundwater condition in the area between Westridge Marine Terminal and Burnaby Terminal consisted of the groundwater samples collected in 2014, 2015, and 2019. Elevated total metal concentrations were mainly observed in samples from HMM-MW-01D, HMM-BH-04S (both collected in 2019), and HMM-BH-03 (collected in 2014), which are characterized by high turbidity levels (165 to 3740 NTU). Table 3-3 summarizes the initial groundwater quality results for parameters that exceed WQGs in one or more samples or are relevant to identification of samples containing elevated sediment levels; applicable water quality guidelines are included in the table.



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Table 3-3 Summary Table of Initial Groundwater Quality Results

Analyte	Units	BC Approved Water Quality Guideline	BC Working Water Quality Guideline	CCME	HMM-PW-01	HMM-PW-01	HMM-PW-01	HMM-MW-01-S	HMM-MW-01-D	HMM-BH-03	HMM-BH-04-S	HMM-BH-04-D	HMM-BH-06
		MAL	MAL	MAL	(BGC)	(BGC)	(Stantec)	(Stantec)	(Stantec)	(Waterline)	(Stantec)	(Stantec)	(SNC Lavalin)
Date Sample Collected					10/7/2015	10/8/2015	5/28/2019	5/28/2019	5/28/2019	10/11/2014	5/28/2019	5/28/2019	5/23/2019
Turbidity	NTU	-	-	-	1.25	0.54	1.93	11.70	165	3740	177	8.52	2.73
Aluminum (Al)-Total	mg/L	-	-	-	0.1480	0.0586	0.0917	0.0778	10.0000	45.7000	9.2500	0.6370	0.0492
Aluminum (Al)-Dissolved	mg/L	-	-	-	0.0109	0.0097	0.0023	0.0081	0.0024	0.4010	0.0023	0.0039	0.0037
Arsenic (As)-Total	mg/L	0.0125	-	0.0125	0.0095	0.0098	0.0128	0.0130	0.0202	0.0115	0.0067	0.0115	0.0018
Arsenic (As)-Dissolved	mg/L	-	-	-	0.0093	0.0095	0.0107	0.0127	0.0159	0.0014	0.0052	0.0113	0.0018
Cadmium (Cd)-Total	mg/L	-	0.00012	0.00012	<0.000005	<0.000005	<0.000005	0.000010	0.000461	0.001430	0.000076	0.000010	0.000007
Cadmium (Cd)-Dissolved	mg/L	-	-	-	0.000010	<0.000005	<0.000005	0.000010	<0.000005	0.000026	<0.000005	<0.000005	<0.000005
Chromium (Cr)-Total	mg/L	-	-	-	0.00094	0.00066	0.00083	0.00590	0.03300	0.11000	0.01640	0.00149	0.00027
Chromium (Cr)-Dissolved	mg/L	-	-	-	0.00043	0.00029	0.00032	0.00110	0.00030	0.00120	<0.00010	<0.00010	0.00018
Copper (Cu)-Total	mg/L	0.002	-	-	<0.0005	<0.0005	<0.0005	<0.0005	0.02070	0.15200	0.02150	0.00204	0.00072
Copper (Cu)-Dissolved	mg/L	-	-	-	0.0014	<0.0005	<0.0002	<0.0002	<0.0002	0.0021	<0.0002	<0.0002	0.0002
Iron (Fe)-Total	mg/L	-	-	-	0.043	<0.03	0.436	0.091	12.700	0.027	10.700	0.661	0.058
Iron (Fe)-Dissolved	mg/L	-	-	-	<0.03	<0.03	<0.01	0.01	<0.01	0.53	<0.01	<0.01	<0.01
Lead (Pb)-Total	mg/L	0.002	-	-	0.00052	0.00029	0.00009	<0.00005	0.00335	0.02720	0.00238	0.00021	0.00009
Lead (Pb)-Dissolved	mg/L	-	-	-	0.00039	0.00024	<0.00005	<0.00005	<0.00005	0.00026	<0.00005	<0.00005	<0.000050
Manganese (Mn)-Total	mg/L	-	0.1	-	0.0221	0.0220	0.8110	0.0287	0.2680	1.5000	0.2440	0.0375	0.0101
Manganese (Mn)-Dissolved	mg/L	-	-	-	0.0219	0.0211	0.0045	0.0252	0.0207	0.3500	0.0194	0.0191	0.0069
Nickel (Ni)-Total	mg/L	-	0.0083	-	0.00078	0.00061	0.00089	0.00387	0.02450	0.07390	0.01750	0.00164	0.00059
Nickel (Ni)-Dissolved	mg/L	-	-	-	0.00083	0.00057	<0.00050	0.00113	0.00229	0.01800	<0.00050	<0.00050	0.00051
Zinc (Zn)-Total	mg/L	0.01	-	-	0.0073	0.0068	<0.0030	<0.0030	0.0428	0.3110	0.0277	<0.0030	<0.0030
Zinc (Zn)-Dissolved	mg/L	-	-	-	0.0093	0.0060	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	-	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0024	<0.0010	<0.0010	<0.0010
EPH C19-C32	mg/L	-	-	-	<0.25	<0.25	<0.25	<0.25	<0.25	0.31	<0.25	<0.25	<0.25



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Screening of Groundwater Quality Data

A screening of the groundwater quality data was performed to identify samples that represent the existing groundwater condition for incorporation into the baseline assessment. In the screening, turbidity, total aluminum, and total iron concentrations in the samples were reviewed to identify the presence of sediment, and three samples (from wells HMM-MW-01-D, HMM-BH-03, HMM-BH-04-S) were excluded from the baseline assessment due to high turbidity levels (165 to 3740 NTU). Review of sampling records indicated that sample from HMM-BH-03 was collected after an insufficient quantity of water (2.2 well volumes) was removed, resulting in sampling of disturbed groundwater. Field notes also confirmed the presence of sediment in samples from HMM-MW-01-D and HMM-BH-04-S. A summary of groundwater quality data after screening for sediment presence and WQG exceedances is presented in Table 3-4.



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Table 3-4 Summary of Groundwater Quality Results and Exceedances

Analyte	Units	BC Approved Water Quality Guideline	BC Working Water Quality Guideline	CCME	HMM-PW-01	HMM-PW-01	HMM-PW-01	HMM-MW-01-S	HMM-BH-04-D	HMM-BH-06
		MAL	MAL	MAL	(BGC)	(BGC)	(Stantec)	(Stantec)	(Stantec)	(SNC Lavalin)
Date Sample Collected					10/7/2015	10/8/2015	5/28/2019	5/28/2019	5/28/2019	5/23/2019
Turbidity	NTU	-	-	-	1.25	0.54	1.93	11.70	8.52	2.73
Arsenic (As)-Total	mg/L	0.0125	-	0.0125	0.0095	0.0098	0.0128	0.0130	0.0115	0.0018
Arsenic (As)-Dissolved	mg/L	-	-	-	0.0093	0.0095	0.0107	0.0127	0.0113	0.0018
Copper (Cu)-Total	mg/L	0.002	-	-	<0.0005	<0.0005	<0.0005	<0.0005	0.00204	0.00072
Copper (Cu)-Dissolved	mg/L	-	-	-	0.0014	<0.0005	<0.0002	<0.0002	<0.0002	0.0002
Manganese (Mn)-Total	mg/L	-	0.1	-	0.0221	0.0220	0.8110	0.0287	0.0375	0.0101
Manganese (Mn)-Dissolved	mg/L	-	-	-	0.0219	0.0211	0.0045	0.0252	0.0191	0.0069



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Conclusion

As shown in Table 3-4, the water quality results of undisturbed groundwater samples collected in the area between the Westridge Marine Terminal and Burnaby Terminal indicate average total concentrations of metal species were below applicable BC WQGs.

- Maximum total concentrations were marginally above applicable BC WQGs for total arsenic and total copper; also, the maximum dissolved arsenic concentration was higher than applicable WQG for total arsenic.
- The total manganese maximum concentration of 0.811 mg/L was eight times the BC WQG (0.1 mg/L). This value is considered an outlier, given that this one value was notably higher than the other samples collected, including those affected by elevated turbidity. The maximum dissolved manganese concentration in that sample was 0.0045 mg/L.
- Arsenic and copper concentrations appear to be naturally elevated in groundwater, with some samples marginally exceeding their WQGs. The maximum total arsenic concentration was 4% higher than the WQG, and the sample contained 97% dissolved arsenic. The maximum total copper concentration was 2% higher than the WQG and the sample contained non-detectable dissolved copper. No toxicity concerns for these concentrations of metals are identified if groundwater is discharged to the marine environment.

3.2.4 Oceanography and Marine Sediment Quality

Marine currents vary throughout Burrard Inlet, with the highest current velocities occurring at locations where the inlet narrows at First and Second narrows, constricting water movement, and at the outflows of large rivers. Currents in most of Burrard Inlet range from 0.3 to 1 m/s (Nijman 1990). The Terminal is located in a broad section of Burrard Inlet (Central Harbour) with no large river outflows nearby (Figure 1-1). Currents in the vicinity of the Terminal are tied to the ebb and flood tides with observed currents generally less than 0.2 m/s and predicted maximum currents of 0.41 m/s during a flood tide (EBA 2013). The inner portions of Burrard Inlet are sheltered from prevailing winds and generally have limited fetch (length along water over which wind blows in a particular direction). At the Westridge Marine Terminal location, currents typically have two primary directions, west-southwest and east-northeast, which correspond to the shoreline angle; however, some relatively strong currents (0.5 m/s) have also been recorded in a southward direction towards the Terminal, particularly at mid-depths (EBA 2013).

Data on wave heights in Burrard Inlet are limited. Waves around the Westridge Marine Terminal are generally small, which makes measurement difficult; however, modelled data predicts small wave heights in Burrard Inlet (EBA 2013). Maximum wave heights in English Bay (off West Vancouver in a more exposed location) were below 0.61 m 90% of the time during one year of monitoring (Thomson 1981). Given the more sheltered location of the Terminal in Central Harbour, wave heights in this area will be lower than those measured in English Bay.

The waters near the Terminal are circulated relative to tidal currents, tide cycles and with freshwater input from the Seymour River and tidal exchange and currents in and out of the Second Narrows (BIEAP-FREMP 2012). Ambient water quality, while generally considered good, is affected by release of



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contaminants from multiple industrial and municipal outfalls, discharge points and uncontrolled sources within the Central Harbour, including municipal stormwater outfalls (BIEAP-FREMP 2012), vessels, marinas and permitted industrial discharge.

Surface water salinity in Burrard Inlet typically ranges from 20–25 parts per thousand (ppt) during the winter to less than 10 ppt during the summer consistent with input from freshwater sources creating a less saline lens in the Central Harbour. In deeper waters of the Central Harbour, salinity is typically 29–30 ppt consistent with a marine environment (deYoung and Pond 1988, Nijman 1990). Deep water temperatures in Burrard Inlet show less fluctuation over the year than in shallower waters; however, estuarine and tidal flow at First and Second narrows can result in greater levels of vertical ocean mixing within the water column in these areas (Nijman 1990). Sampling at the Westridge Marine Terminal in May 2013 reported salinity levels ranging from 15 to 26 ppt (Trans Mountain 2013).

Marine sediment quality data has been collected historically by several sources as well as during the Trans Mountain environmental assessment baseline studies; sediment quality data were also collected and published in 2002 as part of the Burrard Inlet Environmental Action Program (BIEAP 2002). Sediment quality in 2002 exceeded BC sediment quality thresholds at a number of Burrard Inlet sites, including Central Harbour (MWLAP 2004) marine sediments for copper, lead, cadmium, mercury, zinc, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl.

Sediment quality sampling was conducted in May 2013 as part of the Trans Mountain environmental assessment baseline studies (Trans Mountain 2013). Results from the analysis of sediment samples indicated that mercury exceeded the CCME Interim Sediment Quality Guidelines (ISQG) in 14 of 53 samples in the Westridge Marine Terminal area. Analyses also indicated that arsenic, cadmium, copper and lead levels exceeded the ISQGs in multiple samples around the Terminal area. Metals were concentrated in the top 0.5 m of sediment cores and generally decreased with depth in the sediment, with the exception of zinc, chromium and copper, which had higher concentrations in samples below 1 m in sediment cores. Sediment metals collected in 2013 were compared to the results of the 2002 Burrard Inlet sediment objectives monitoring program (BC MWLAP 2004) and indicated similar sediment metal concentrations between sampling periods for arsenic, cadmium, copper, and lead.

3.2.5 Marine and Freshwater Water Quality

Consistent water quality monitoring data is not available within the past decade for the Central Harbour of Burrard Inlet; however, historical water quality data from Burrard Inlet are available from 2002 when water quality data were collected, and objectives published as part of the Burrard Inlet Environmental Action Program (BIEAP 2002). Water quality exceeded BC WQG thresholds at a number of Burrard Inlet sites, including Central Harbour for suspended solids, copper, and dissolved oxygen (MWLAP 2004).

Marine water samples were collected in 2013 by Trans Mountain as part of the Trans Mountain environmental assessment baseline studies (Trans Mountain 2013). Samples were collected at 1 m below the surface and 1 m above the bottom during flood and ebb tides. Salinity was consistent with marine water sample results from 2002 (BIEAP 2002) and indicated a large range in seasonal freshwater input. Metal concentrations in 2013 were lower than the BC WQG and CCME water quality guidelines for



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the protection of marine life (BC WQG 2018; CCME 2019), except for zinc in shallow waters (Trans Mountain 2013). Hydrocarbons were below detection limits.

Baseline water quality monitoring sampling for the Terminal was conducted between February 2018 and August 2019 (two trips in February 2018, two trips in March 2018, four trips in May 2019, one trip in July 2019, and three trips in August 2019) which included sampling to characterize freshwater water quality entering the Terminal, changes within the Terminal, and marine water quality in the immediate vicinity of the Terminal.

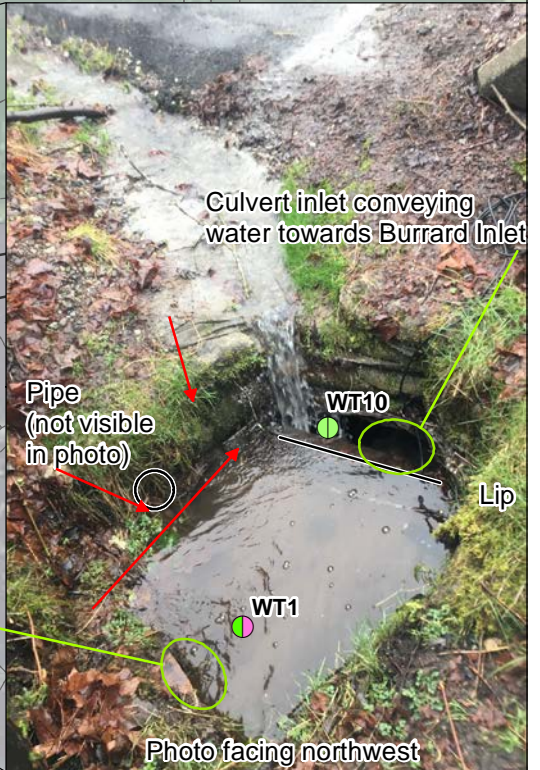
Sampling included both freshwater and marine locations selected to characterize both impacted and unimpacted water quality conditions found within and around the WMT. Rationale for sampling location selection (locations WT1 to WT11) is described in the Westridge Marine Terminal—Water Quality Results (Appendix O) and shown in Figure 3-8. Detailed methods, results including summary statistics for all sampling dates and locations, and quality control results are also presented in Appendix O. Ten locations were sampled in 2018 (seven freshwater and three marine) and eight locations in 2019 (six freshwater and two marine [surface and deep]). In 2018 only surface marine samples were collected, while deep samples (1 m above the seabed) were also collected in 2019.

In situ measurements were taken for temperature, pH, dissolved oxygen, specific conductivity, and turbidity at all sample locations. Samples were transported to ALS laboratories for analysis of general chemistry (pH, specific conductivity, hardness, total suspended solids, turbidity), total metals, dissolved metals, and hydrocarbons. Nutrient results (total ammonia, nitrate, nitrite, and total phosphorus) were below CCME WQG and BC WQG in both 2018 and 2019 samples.

In situ results from all sampling trips in both years for freshwater locations indicated dissolved oxygen concentrations between 3.9 to 76.8 mg/L, conductivity between 11 to 4052 $\mu\text{S}/\text{cm}$, pH between 6.5 and 10.4 and turbidity of 0.01 to 1385 NTU. Dissolved oxygen and conductivity did not show obvious seasonal trends. TSS concentrations were generally below 100 mg/L except during sporadic events in March 2018. Compared to freshwater sites, marine sampling results showed similar dissolved oxygen concentrations from 7.9 to 13.3 mg/L, higher conductivity from 10,600 $\mu\text{S}/\text{cm}$ (near a freshwater outfall) to 41,846 $\mu\text{S}/\text{cm}$, similar pH between 7.2 and 9.9, and lower turbidity of 0.38 to 4.05 NTU. Temperature ranges were similar in both marine and freshwater samples ranging from 4.6 (freshwater) and 10.5 (marine) degrees centigrade in February to 18.3 degrees centigrade in August (freshwater).



S:\1232\projects\123512431\figures\reports\westridge_marine_terminal_waste_discharge_phase_3\map\fig_123512431_wmt_wdp3.tar_03_08_baseine_water_quality_sampling_locations.mxd Revised: 2019-09-30 By: TDinneen



- Highway
 - Local Street
 - Railway
 - Watercourse
 - High Water Coastline
 - Low Water Coastline
 - Existing Building/Facility
 - Burnaby Park Inventory
 - Legal Parcel
 - Project Property Boundary
- Permit #3678 Discharge and Monitoring Location
 - Permit #3678 Outfall
 - Non-Permitted Outfall
 - Existing Watercourse
 - Existing Culvert
 - Permit #3678 Discharge Area

- Baseline Water Quality Sampling
- Sampled in 2018 and 2019
 - Sampled in 2018, Not Sampled in 2019
 - Not Sampled in 2018, Sampled in 2019

*WT10 samples from 3 water sources:
- BC-789,
- Drainage from west
- Runoff from road



Location Information
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503370 5459515

Project Number 123512431
Prepared by TDINNEEN 20190708
PM Review LHARRISON 20190927

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project

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2018 and 2019 Baseline Water Quality Sampling Locations for the Westridge Terminal

Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project, Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
- This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

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Summaries of analytical results including (where applicable) exceedances of CCME and BC WQG for freshwater and marine samples are provided below. Full results can be found in Appendix O.

Freshwater:

- Total aluminum exceeded the CCME guideline (0.1 mg/L) at all sites in February and March 2018. All locations except WT3 and one sampling occurrence at WT8 exceeded the CCME guideline in May 2019. Locations WT8 and WT10 exceeded the CCME guideline in July 2019. All locations except WT3, WT11 and one WT8 occurrence exceeded the CCME guideline in August 2019. Dissolved aluminum exceeded the BC guideline frequently at sites WT1, WT8, WT9 and WT10.
- Frequent exceedances of the CCME and BC WQG for total copper at most sites for all except the August 2019 sampling periods, and exceedances of total iron guidelines at most sites for all sampling periods.
- Occasional exceedances of CCME/BC WQG for total arsenic guidelines, CCME total cadmium guideline, the BC WQG for total cobalt guideline and the BC WQG total manganese guideline, particularly arsenic and cobalt at WT2 in March 2018 and WT4 in February 2018, and arsenic at WT2 and WT3 in August 2019.
- Hydrocarbon concentrations were below detection limit in all samples, with the exception of WT2 on Trip 3, where F3 and F4 hydrocarbons were above the detection limit of 0.3 mg/L, with values of 1.06 and 1.97 mg/L respectively.

Marine:

- BC WQG guideline for boron was exceeded in all samples as expected as boron levels are commonly above the BC WQG guideline in marine waters (CCME 2019)
- One sample from WT5-deep exceeded the BC WQG for total zinc guideline in May 2019
- Hydrocarbon concentrations were below detection limits in all samples

The metal concentrations that exceeded CCME or BC WQG generally occurred at reference areas (WT4, WT8) and around the Terminal, suggesting naturally elevated levels that are not the result of Project activities. The elevated turbidity, and associated high total metal concentrations, recorded at WT2 on March 13, 2018 are likely associated with low flow causing higher levels of sediment in the water sample as the water flows out of the concrete wall at this site. Corresponding dissolved metal levels were low at WT2 on subsequent trips indicating the majority of metal present was bound to particles rather than in the more bioavailable dissolved form and that metals concentrations had rapidly returned to more typical conditions.

3.2.6 Soil Quality

3.2.6.1 Soil

The surficial geology of the existing onshore Terminal area is characterized by Pleistocene Vashon Drift and Capilano Sediments (Armstrong and Hickock 1979). The Vashon Drift sediments (V_a , V_b) are overlain by the moderately high runoff potential Capilano Sediments (C_d) which are sometimes mantled by gravels.



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Vashon Drift (V_a , V_b) is a till composed of glaciofluvial, glaciolacustrine and ice-contact deposits:

- V_a , lodgement till (with sandy-loam matrix with clay content of 0% to 20%) and minor flow till containing lenses and interbeds of glaciolacustrine laminated stony silt
- V_b , glaciofluvial sandy gravel and gravelly sand outwash and ice-contact deposits (clay content < 10%)

Capilano Sediments (C_a to C_d) are raised marine, deltaic and fluvial deposits:

- C_d , marine and glaciomarine stony (including till-like deposits) to stone-less silt loam (clay content 0% to 30%) to clay loam (clay content 27% to 40%) with minor sand and silt normally less than 3 m thick but up to 30 m thick, containing marine shells. These deposits thicken from west to east.

Armstrong and Hickock (1979) describe the area encompassing the entire Site as a uniform mix of glacial drift:

- Lodgement and minor flow till, lenses and interbeds of sub-stratified glaciofluvial sand to gravel, and lenses and interbeds of glaciolacustrine laminated stony silt up to 25 m thick but in most places less than 8 m thick
- Overlain by glaciomarine and marine deposits similar to C_d normally less than 3 m but in places up to 10 m thick
- Marine derived lag gravel normally less than 1 m thick containing marine shell casts has been found mantling till and glaciomarine deposits up to 175 m above sea level. Above 175 m above sea level till is mantled by bouldery gravel that may be in part ablation till, in part colluvium, and in part marine shore in origin.

The above descriptions of clay content are derived from the United States Department of Agriculture Soil Texture Triangle (USDA 2018) cross-referenced with the description of soils (Armstrong and Hickock 1979).

3.2.6.2 Baseline Soil Quality

Trans Mountain undertook a soil quality baseline assessment in 2019 to gather observational data related to the soil quality in support of a possible Permit amendment. Additional soil analytical data collected from the previously-completed 2017 Phase II Environmental Site Assessment was also used to supplement the data collected in 2019. The Soil Quality Baseline Assessment Report (Appendix P) provides a summary of the analytical results of relevant soil sample data collected from 2017 and soil analytical testing completed on soil samples from fifteen boreholes advanced in 2019 from the following three proposed construction areas:

1. Foreshore Excavation Area
2. Manifold and Piperack Area
3. Tunnel and Substation Area



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The leachable characteristics of the soil data were also assessed to determine the potential for impacts to surrounding surface water bodies. A copy of the Soil Quality Baseline Report is provided in Appendix P for further information.

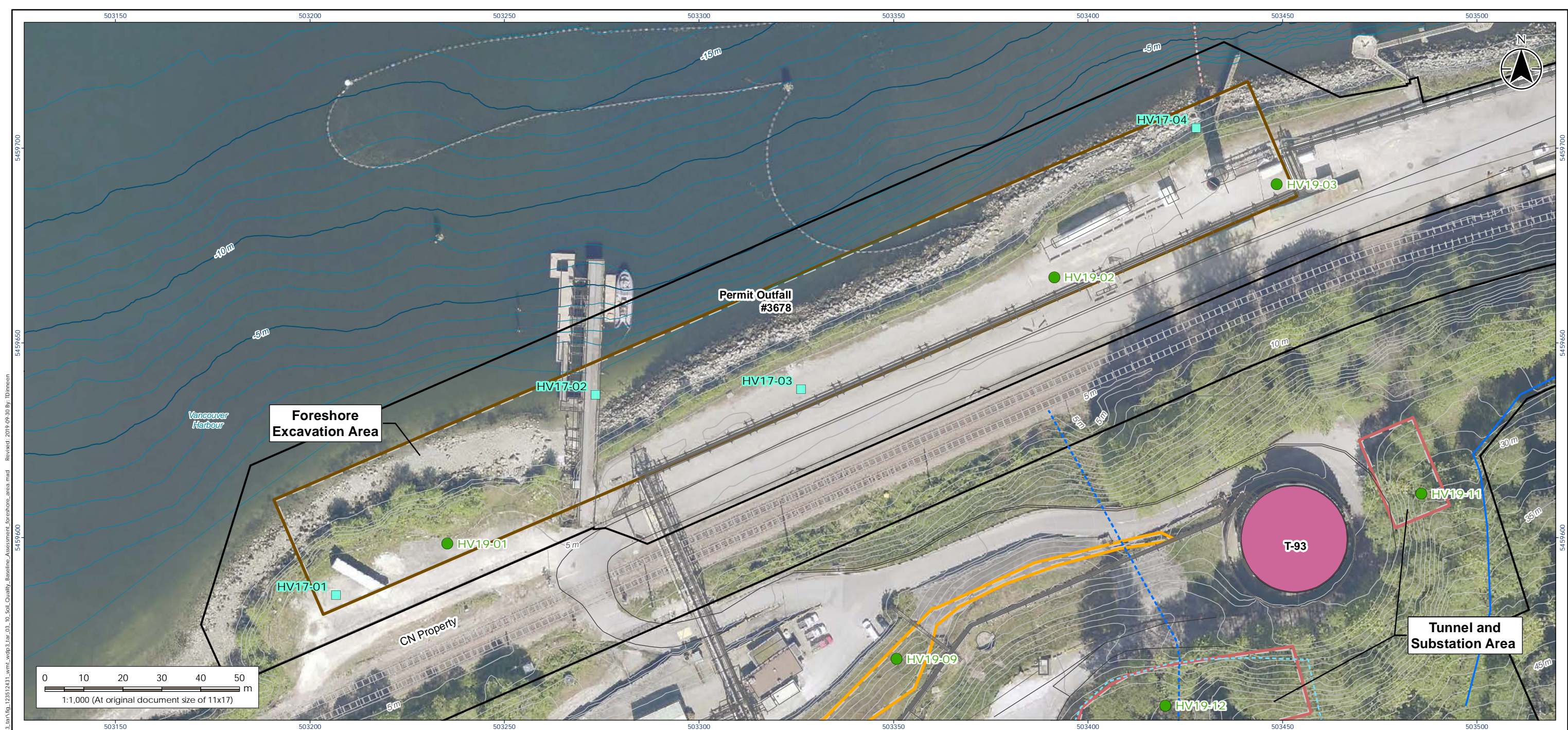
3.2.6.3 Methodology

Nineteen locations were investigated as part of the soil quality baseline assessment. The sample site names and rationale for selection are provide in Table 3-5. The sample site locations are presented in Figure 3-9 and Figure 3-10.

Table 3-5 Sample Location Rationale

Area	Borehole ID	Rationale
Foreshore Excavation Area	HV17-01* HV17-02* HV17-03* HV17-04* HV19-01 HV19-02 HV19-03	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Foreshore Excavation Area.
Manifold and Piperack Area	HV19-04 HV19-05 HV19-06a HV19-06c HV19-07a HV19-07b HV19-07c HV19-08 HV19-09 HV19-10	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Manifold and Piperack Area. Boreholes HV19-06a, -06b and -06c, -07a and -07c were positioned in two cross-sectional lines across the slope to collect samples from varying depths.
Tunnel and Substation Area	HV19-11 HV19-12 HV19-13 HV19-14 HV19-15	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Tunnel and Substation area.
NOTES: * = These boreholes were advanced during the Stantec 2017 Limited Phase II Environmental Site Assessment		





Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
- This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

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- Project Property Boundary
- Watercourse
- Topographic Contour (m)
- Bathymetric Contour (m)
- Existing Building/Facility
- Existing Road/Rail
- Permit #3678 Discharge Area
- Existing Watercourse
- Existing Culvert

- Hydrovac Location/Soil Sampling Site
 - Previously Advanced Hydrovac Location/Soil Sampling Site
- Excavation Area**
- Manifold Area and Pipe Rack Area (Phase 3.1)
 - Tunnel Portal and Substation Area (Phase 3.2)
 - Foreshore (Phase 3.4.1)



Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINNEEN 20190708
PM Review LHARRISON 20190927

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project

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Westridge Marine Terminal – Soil Quality Baseline Assessment - Sampling Sites in Foreshore Excavation Area

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Analytical services for the 2019 assessment were provided by ALS laboratories. The soil samples collected for the assessment were submitted to ALS for analysis of one or more of the following:

- Flashpoint
- pH
- Grain Size
- Metals
- Toxicity characteristic leaching procedure (TCLP) metals
- TCLP PAHs
- TCLP VOCs
- Volatile hydrocarbons (VH)
- Volatile petroleum hydrocarbons (VPH)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- x LEPH/HEPH
- PAH
- CCME petroleum hydrocarbon constituents (PHC) fractions F1–F4

Observations

The headspace vapour level (HSVL) concentrations were measured in all soil samples during the field investigation. The HSVLs ranged from less than detection limit (LTDL) of the instrument to 150 parts per million by volume (ppmv).

The soil stratigraphy was generally observed to be a sandy silt fill (which varied significantly in depth) overlying a poorly graded sandy silt/silty sand with gravel. This was consistent with the surficial geology described above in Section 3.2.6.1.

Groundwater was encountered at approximately 2.5 m below ground surface (mbgs) in boreholes in the foreshore excavation area (Figure 3-10) and was generally not encountered in other locations with the exception of HV19-06C in the manifold and piperack area where groundwater was encountered at 1.0 mbgs and at HV19-11 and HV19-12 in the tunnel and substation area where groundwater was encountered at 2.0 mbgs and 2.5 mbgs respectively.

Analytical Results

As noted above, soil samples were collected and submitted to ALS for the analysis of metals, PHCs and PAHs. The analytical results from submitted soil samples in 2017 and 2019 were compared to the CCME and BC CSR Industrial (IL) soil guidelines and/or standards. Please refer to Section 2.0 – Regulatory of the Soil Quality Baseline Assessment Report in Appendix P for a detailed discussion of the applicable guidelines and standards for the Terminal.

The concentrations of analyzed parameters from soil samples were within the applicable regulatory limits except for pH values in multiple samples in 2019 and the concentration of arsenic in a sample in 2017.



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The reported pH values of samples in 2019 were outside the acceptable range (6.0–8.0) for CCME and the soil sample obtained from HV17-4 in the Foreshore Excavation Area in 2017 arsenic exceeded the CCME guideline and BC CSR standard.

In addition to the standard soil analysis, Stantec also requested that ALS complete TCLP analysis of select soil samples for metals, PAHs and BTEX. The intention of this analysis was to provide a conservative assessment of the leachability of potential contaminants, from soil to surface water, across the Terminal. This is a conservative approach as TCLP analysis is used to simulate leaching in a landfill (i.e., under acidic conditions).

The results of the TCLP analysis were summarized and compared to the CCME and the BC WQGs to further evaluate whether leachable concentrations would exceed the WQGs for freshwater and marine aquatic life. The TCLP results indicate that the concentration of various metal parameters exceeded the applicable CCME and BC WQGs. The PAH and BTEX TCLP results were reported to be less than the CCME and/or BC WQGs.

When comparing TCLP to the CCME and BC WQGs, the detection limits of several metal parameters were raised to levels that are above the guidelines. As a result, this assessment was unable to determine if the leachable concentrations for these parameters were above or below the applicable WQGs for these parameters where they were reported as non-detectable (below detection limit). However, the soil analytical results for those same parameters, with the exception of arsenic within the Foreshore Excavation Area, were reported to be within the applicable soil standards and guidelines. Based on these soil results, the TCLP results for these analytes (summarized below in Table 3-5), with the exception of arsenic in the Foreshore Excavation Area, are not considered to be of concern.

The complete analytical results are summarized in the tables presented in Appendix P. These tables provide a comparison of the reported analytical data to the applicable standards and/or guidelines.



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Table 3-6 provides a summary of the analytical parameters in soil that exceeded the indicated criteria within each construction area:

Table 3-6 Summary of Soil Quality Baseline Assessment Analytical Results that Exceeded an Applicable Standard and/or Guideline

Standard/Guideline Exceeded	Construction Area		
	Foreshore Excavation Area	Manifold and Piperack Area	Tunnel and Substation Area
CCME SQG	pH, arsenic	pH	no samples analyzed exceeded
BC CSR Soil Standards	arsenic	no samples analyzed exceeded	no samples analyzed exceeded
CCME WQG (Leachate)	Cadmium*, copper*, iron*	Cadmium*, copper*, iron*, lead*	Cadmium*, copper*, iron*
BC WQG (Leachate)	copper, iron	Copper, lead	Copper, iron
NOTES: * - For these parameters the detection limit for TCLP analysis were raised to levels that are above the CCME and BC CSR WQGs			

Quality Assurance and Quality Control

A detailed review of sampling data was completed by Stantec to confirm that the data presented is reliable and applicable to support conclusions and this application. A review of the field methodologies indicated that they were consistent with those considered acceptable based on Stantec standard operating procedures and current regulatory requirements.

New soil samples collected during the program were submitted to ALS. As conveyed by the laboratory, method blanks, control standards samples, certified reference material (CRM) standards, method spikes, replicates, duplicates and instrument blanks are routinely analyzed as part of their QA/QC programs.

Sample integrity and reliability was checked by submitting field replicates. Whenever possible, BC ENV guidance regarding the minimum number of quality control samples was followed for blind field duplicate submissions.

The QA/QC program for analytical laboratory results included:

- Review of actual versus recommended sample holding times
- Review of sample temperature reported by the laboratory upon sample receipt
- Assessment of laboratory implemented QA/QC program (e.g., review of laboratory replicates, laboratory spike summaries, etc.)
- Assessment of sample collection methodologies and laboratory reliability using calculated relative percent differences (RPDs) between numbered and blind field duplicate/replicate samples



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The samples collected from the Terminal were submitted to a CALA-accredited laboratory that uses BC ENV and CCME recognized methods to conduct laboratory analyses. The quality of the data set was reviewed for holding time, temperature, laboratory quality assurance and control results, and field protocols for proper sample collection. The data set derived from the sampling program was considered representative of the Terminal conditions. Based on the results of the QA/QC Program, the data set was considered reliable for the purposes of this assessment.

Conclusions

Based on the results from soil quality baseline assessment completed at Westridge Marine Terminal, Stantec concludes that the concentration of arsenic present in soil obtained at the Foreshore Excavation Area is greater than the applicable CSR and CCME IL standard and guideline respectively (see commentary in Section 3.3.4 regarding leachate tests. Imported fill in this area is the most likely source of these exceedances as there were no on-site activities identified that would contribute to this arsenic exceedance. The concentration of arsenic in samples obtained from the remaining areas were reported to be less than the applicable standard and/or guideline.

The remaining metal parameter concentrations were reported to be below the applicable standards and/or guidelines for samples submitted from all three areas.

In addition to arsenic, the obtained pH values were outside the CCME acceptable range of pH 6-8 in soil samples obtained from all three areas.

The concentration of PHCs, PAHs and VOCs in soil samples submitted and analyzed were reported to be below the applicable standards and guidelines in all three areas.

The analytical results of the completed TCLP analysis indicate that cadmium, copper, iron and lead in samples obtained from all three areas had elevated detection limits above the CCME and BC WQGs; however, as analysis of soil samples reported concentrations that were less than the soil quality standards and guidelines it was concluded that this presented no overall concern. The TCLP results for cadmium, copper and iron were reported to be greater than the WQGs in the Foreshore Excavation Area and the Tunnel and Substation Area, while cadmium, copper, iron and lead were reported to be greater than the WQGs in the Manifold and Piperack area.

There were no data gaps identified in the completion of this section of the report.

3.2.7 Aquatics Resources

3.2.7.1 Freshwater Fish and Fish Habitat

There is no known freshwater fish-bearing habitat within the Terminal area. The nearest fish-bearing habitat is downstream of the Terminal in the marine environment of Burrard Inlet. There is one non-fish bearing freshwater watercourse within the Terminal (BC-789); however, there is no fish access between Burrard Inlet and the watercourse due to the steep culvert gradient from the ocean, and an impassable sump located downstream of the Terminal in the CP Rail ditch.



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Dynamite Creek is located approximately 35 m from the western edge of the Terminal and is the nearest freshwater drainage outside the Terminal. Dynamite Creek is a steep gradient small ephemeral watercourse. The lower reach of the watercourse is confined and piped under the CP Rail tracks to Burrard Inlet. No records of fish habitat or fish presence have been identified.

The unnamed non-fish bearing watercourse BC-789 flows north across the Terminal through a combination of open channel and culverted sections and then discharges into Burrard Inlet. Within the Terminal, the watercourse crosses the southern fence line and flows downhill as an open channel for approximately 20 m before entering a culvert, which directs flow northwest for approximately 15 m, before passing through a 53 m long, open channel through a treed area. This 53 m open channel is located at the centre of the proposed tunnel portal construction area. BC-789 then flows through a 15 m long culvert under the Terminal access road where it briefly daylights again (approximately 1 m), before entering a final culvert which conveys flows north, under the Terminal, to a discharge point north of the CP Rail tracks along the Burrard Inlet shoreline. The 53 m section of open channel is subject to planned construction works and a *Water Sustainability Act* section 11 permit for changes in and about a stream was received on May 1, 2018.

3.2.7.2 Marine Fish and Fish Habitat

Burrard Inlet has a surface area of 11,300 ha and 190 kilometres (km) of shoreline (BIEAP-FREMP 2012). The inlet is approximately 50 km long from west to east, ranging between 0.5 and 3 km in width. Water depths reach 220 m in the deep basin of Indian Arm (Stacey et al. 2002). The Central Harbour, where the Terminal is located, is shallower, with maximum depth to 65 m. The mean tide within Burrard Inlet is 3 m. The physical seabed at the Terminal has a moderate slope and reaches approximately -17 m chart datum (CD) within 50 to 100 m of the shoreline. Beyond 100 m the seabed has a small bench that extends approximately 200 m and then continues to deepen, although less steeply, with a decrease of approximately 1 m for every 25 to 50 m.

A survey of intertidal habitat at the Terminal was conducted from August 18 to 19, 2012 (Stantec 2013). The intertidal zone is dominated by coarse substrate types, particularly boulder and cobble rip rap. Two shore types were identified in the intertidal zone: man-made rock ramps and rock cliffs. A total of 17 marine invertebrate species and eight marine algae species were identified. The most common sessile invertebrate species were common acorn barnacles (*Balanus glandulus*) and blue mussels (*Mytilus sp.*), and the most common motile invertebrate species were periwinkles (*Littorina sp.*) and limpets. The most common algae species were rockweed (*Fucus gardneri*), Turkish washcloth (various genera), and green rope (*Acrosiphonia coalita*).

A camera-mounted remotely-operated vehicle was used to survey subtidal habitat in and around the Terminal from September 17 to 20, 2012 (Stantec 2013). The substrate observed consisted almost entirely of soft bottom (silt, mud, sand) with traces of broken shells and wood debris. A small section of steeply-sloping rip rap was identified inshore of the existing berth. A total of 32 species of fish and invertebrates were observed, including 8 species of arthropod, 7 species of echinoderm, 9 species of fish, 4 species of cnidarian, 3 species of mollusk, and 1 species of tunicate. The dominant invertebrate species include Dungeness crab (*Metacarcinus magister*), sunflower stars (*Pycnopodia helianthoides*), ochre



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stars (*Pisaster ochraceus*), giant plumose anemones (*Metridium faricimen*) and sea pens (*Pennatulacea*). Algal diversity was relatively low, with most species occurring on the small section of rip rap. The dominant algal species within the photic zone include brown bladed algae and sea lettuce (*Ulva* sp.).

Several fish species were observed during the 2013 subtidal survey. Pricklebacks and flatfish were abundant on soft bottom habitat, and two sculpins were also observed. Flatfish were not identified to species level, but likely included English sole, rock sole and starry flounder based on the known distributions and habitat requirements of flatfish in British Columbia. Other fish that were not identified, but likely to be present in the area include gobies and ronquils.

In the shallow rip rap sections and around pilings, several species of perch were observed, including shiner perch, pile perch, kelp perch and striped perch. Two lingcod were also observed in the rip rap habitat. Several small fish, likely juveniles, were observed during fieldwork. These fish could not be identified due to poor visibility and swift movement. Although rockfish (*Sebastes* sp.) and Pacific salmon (*Oncorhynchus* sp.) were not observed during fieldwork, both are known to use or migrate within Burrard Inlet. Historically, Pacific herring (*Clupea pallasii*), anchovy (*Engraulidae* sp.) and eulachon (*Thaleichthys pacificus*) have also been documented in Burrard Inlet (Stacey 1995; Hay 1985; Pierson 2011); however, all three species have undergone drastic population declines in the region (Pierson 2011). Little information is available on eulachon in the area; however, the population is thought to be sparse in the Strait of Georgia (Hay 1985). The first herring spawning event recorded in Burrard Inlet in many years occurred in False Creek in 2009 (Hume 2009); however, there are no recent records of herring spawning near the Terminal within Central Harbour of Burrard Inlet.

3.2.8 Vegetation

3.2.8.1 Riparian

Marine riparian vegetation along the western foreshore (i.e., west of the existing utility dock) was cleared in early 2018 during the excavation and removal of shoreline rip rap. The remaining marine riparian vegetation east of the utility dock will be removed prior to the start of Phase 3 foreshore works.

Riparian vegetation along watercourse BC-789 in the tunnel portal area was cleared in early 2018 as part of Phase 1 works. An additional smaller area of riparian vegetation near the southern boundary of the Terminal property (south of the tunnel portal area) will be cleared prior to the start of Phase 3 portal works. This vegetation also borders watercourse BC-789.

3.2.8.2 Upland

A survey of upland areas within the Terminal was carried out on September 3, 2014 and one patch of a provincial noxious weed, Japanese knotweed (*Reynoutria japonica*), was observed. Additional invasive plants of concern observed in the upland forested lands included: policeman's helmet, morning glory, and foxglove. No rare plants or ecological communities of concern have been identified within the upland area of the Terminal to date. To accommodate the Works at the Terminal less than 1.3 ha of upland habitat was cleared under the Phase 1 works (resulting in the removal of approximately 270 trees).



3.2.9 Wildlife and Wildlife Habitat

The Westridge Marine Terminal is located at the edge of the defined English Bay and Burrard Inlet Important Bird Areas (Bird Studies Canada and Nature Canada 2016). The Burnaby Mountain Conservation Area is across highway 7A from the Westridge Marine Terminal and the Terminal is adjacent to Barnet Marine Park. The Terminal is not located within or adjacent to any Migratory Bird Sanctuaries (Government of Canada 2017), National Wildlife Areas (Government of Canada 2019), Western Hemisphere Shorebird Reserves (WHSRN 2013), Ramsar Wetlands of International Importance (Bureau of the Convention on Wetlands 2013), World Biosphere Reserves (UNESCO 2013), designated caribou range (BC MOE 2008), ungulate winter range (BC MOE 2005a), or Wildlife Habitat Areas (BC MOE 2005b).

3.2.10 Human Use and Protected Areas

3.2.10.1 Groundwater Users

Potable water is supplied in the region through the municipal water system, which derives its supply from outside of the groundwater flow model domain. Historically and currently, groundwater wells are reported on a voluntary basis and have no mechanism to track the volume or rate of extraction from different wells (Hatch et al. 2017).

The British Columbia Geographic System (BCGS) Map Interface was accessed to search for the records of water wells near the proposed alignment. The search yielded 52 well records. There are several shallow wells owned by Shell Canada, at their Burnaby site, approximately 500 m west-southwest of Westridge Marine Terminal; these appear to be observation or monitoring wells. The search did not identify any water-supply wells (i.e., other groundwater users) within 4.5 km of any portion of the proposed alignment.

3.2.10.2 Marine Use

Burrard Inlet has served as the Vancouver Harbour starting in the early 19th century with industrial and municipal development along the shoreline being sources of wastewater discharge (MWLAP 2004; PICES 2001). Industrial activities in Burrard Inlet include petroleum refineries, shipyards, chlorine plants, food and seafood processing, fuel loading docks and marinas and forestry (PICES 2001).

The Terminal is located on approximately 6.2 ha of land owned by Trans Mountain, except for a small portion of land leased from CP Rail. The Terminal is on the southern shoreline of Burrard Inlet. Burrard Inlet can be divided into five sub-areas (BIEAP-FREMP 2012):

- Outer Harbour (comprising English Bay, False Creek and the area between Point Grey, Point Atkinson, and the First Narrows)
- Inner Harbour (the area between the First Narrows and Second Narrows)
- Central Harbour (extending from the Second Narrows to Barnet Marine Park)
- Port Moody Arm (between Barnet Marine Park and Port Moody)
- Indian Arm (from Belcarra and North Vancouver to the Indian River estuary)



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The Terminal is in Central Harbour of Burrard Inlet. Land use at the Terminal is defined by the Burnaby Official Community Plan, and the current land use at the Terminal is zoned as a Heavy Industrial District with a zoning code of M3. The Terminal is surrounded by land designated as Park and Public Use District (zone code P3) (the Barnet Marine Park) (BurnabyMap 2019).

Marine vessel traffic in Burrard Inlet is regulated by the VFPA. Marine vessel traffic in Burrard Inlet around the Terminal included tugs, tankers, barges and other cargo vessels, service vessels, passenger vessels (such as pleasure craft and harbour cruises), and fishing vessels (Stantec 2017).

Commercial fishing activity in Burrard Inlet targets Dungeness crab, prawn and shrimp. Typically, vessels are smaller than those used by commercial fishers in the Strait of Georgia. A small commercial fishery for surf smelt takes place in Burrard Inlet, mostly off spawning beaches in English Bay (DFO 2012).

3.2.10.3 Recreational Use and Protected Areas

There are various recreational uses near the Terminal that are popular for both terrestrial and marine recreational use. The shoreline and marine areas of Burrard Inlet are used recreationally by residents and visitors. There are several parks near the Terminal that support a variety of land and water-based recreational activities including: Barnet Marine Park, Burrard Inlet Conservation Area, Scenic Park, and Stratford Park.

Other land uses near Terminal include residential areas, and other industrial and commercial uses such as: a railroad, marine transportation services (tug and barge services), and industrial facilities and terminals.

The Terminal is located within the Rockfish Conservation Area 28—Eastern Burrard Inlet (Figure 1-1) and is within the Tsleil-Waututh Burrard Inlet Action Plan boundary. The five goals outlined in the Tsleil-Waututh Burrard Inlet Action Plan and their reference within this TAR are describe in Table 3-7.



Table 3-7 Tsleil-Waututh Burrard Inlet Action Plan Goals and Relevant Sections of the TAR

Goal	Section(s) of the TAR that Address Goal
Goal A: Improve Water Quality and Reduce Contamination	Sections 2.1, 2.2, 2.4, 3.3.4, 0
Goal B: Protect and Enhance Fish and Wildlife Habitat	Section 3.3.5
Goal C: Protect and Recover Key Species Populations and Food Webs	Section 3.3.5
Goal D: Protect and Restore Supporting Biophysical Processes/ Ecological Integrity	Section 3.3.5
Goal E: Identify and Track Emerging Issues	Trans Mountain has not addressed this goal specifically, but the reporting requirements and commitments in Section 4.4 will contribute to this goal. Trans Mountain's management plans incorporate adaptive management strategies to track and correct potential environmental issues.

3.3 ANALYSIS OF POTENTIAL IMPACTS

The Phase 3 activities at the Terminal have the potential to impact the quantity of water discharged from the site as a result of a reduction in permeability of land surfaces and release of groundwater from tunnel boring activities. Further, the Phase 3 activities have the potential to impact water quality and may result in increased TSS levels, as well as pH levels as a result of concrete works, and total residual chlorine, dissolved iron and propylene glycol as a result of the hydrostatic testing of delivery lines and facility piping. TMEP has proposed several ESC and additional mitigation measures to manage and treat water to a set of proposed permit limits as described throughout Section 2.0.

Sections 3.3.1 through 3.3.8 assess the potential impacts of the changes to permeability and the increase in potential contaminants on the receiving environment and recommend additional mitigation measures as necessary to further reduce these potential impacts. Following the application of these mitigation measures, the potential impacts (as described below) on the receiving environment are expected to be limited.

3.3.1 Hydrology

Hydrologic modelling was conducted to estimate the WTP capacity required to treat the construction contact water from rainfall as a result of the Works during different sub-phases. Hydrologic modelling methodology, results, and calibration/validation steps are described in the following sections.

Hydrologic modelling was completed for the sub-phases that require the West WTP (Phase 3.1), East WTP (Phases 3.2 and 3.3), and Foreshore WTP (Phases 3.4.1 and 3.4.2). Treatment of contact concrete curing contact water with CO₂ bubblers during Phases 3.5. and 3.6 is described in Section 2.1.9; WTPs are not in place during these sub phases.



3.3.1.1 Hydrologic Modelling Methods

The construction contact water runoff response of the Terminal was modelled using the US Army Corps of Engineers HEC-HMS software, version 4.2.1. The software was used to estimate the runoff generated from the basins affected during Phase 3. The main modelling objective was to estimate discharge expected, with various return period storms, at the WTPs.

Section 3.2.1 describes the storm events selected for this hydrological modelling and analysis. The larger 10-year and 100-year storms were selected because they are adopted as stormwater design criteria used by the City of Burnaby to size stormwater infrastructure for minor and major systems, respectively (Burnaby 2014). The two-year and five-year storms were selected for the analysis because they are considered more common (higher probability) events. The probability of these storms occurring in any given year is the inverse of the return period. Hence, the probability of the 2-year, 5-year, 10-year and 100-year events of occurring in any given year is 50%, 20%, 10% and 1%, respectively. Similarly, probability of these events not occurring (PENO) in any given year is 50%, 80%, 90%, and 99%, respectively.

The WTPs will be in operation for less than 27 months during the Works. The probability (P) of a storm occurring at least once in the 27-month period (2.25 years) is calculated by the formula below:

$$P = 1 - PENO^{2.25}$$

Therefore, the chances of a 2-year, 5-year, 10-year, and 100-year storm occurring at least once during the 27-month period is 79%, 39%, 21%, and 2%, respectively.

For sizing WTPs, a 10-year storm event is selected which can accommodate the common storm events (e.g., 2-year and 5-year). The minimum capacity target of a 10-year storm event was selected based on professional judgement, experience with similar projects/developments, and City of Burnaby Engineering guideline (Burnaby 2014).

The return period rainfall depths (Section 3.2.1) were discretized into 6-minute rainfall time-series using the Soil Conservation Service Type 1a rainfall distributions. This rainfall distribution has been defined as typical for the US Pacific Northwest and is extended to cover British Columbia's lower mainland.

The Soil Conservation Service curve number approach was used to calculate the hydrological response in the sub-basins (USDA 2009). These curve numbers are area-weighted for land use in catchment areas of each WTP. Soil Conservation Service curve number calculations are included in Appendix Q for each WTP. Soils on site are Capilano sediments overlying Vashon drift (Section 3.2.6.1). The Capilano Sediments, glaciomarine soil, (C_d) are broadly described as silt loams and clay loams and are the infiltration-limiting soils across the existing onshore Terminal area. These soils correspond to hydrologic soil group C which has moderately high runoff potential when thoroughly wet and water transmission through the soil is somewhat restricted. Group C soils typically have between 20% and 40% clay and less than 50% sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures (USDA 2009).



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Average antecedent moisture conditions were assumed at the beginning of each storm event. Sub-phase 3.2 includes constant tunnel seepage rate of 10 l/s (this is equivalent of the maximum unmitigated flush flow of 600 l/min; Hatch et al. 2017).

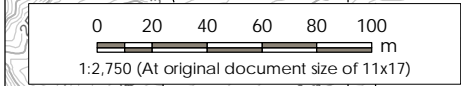
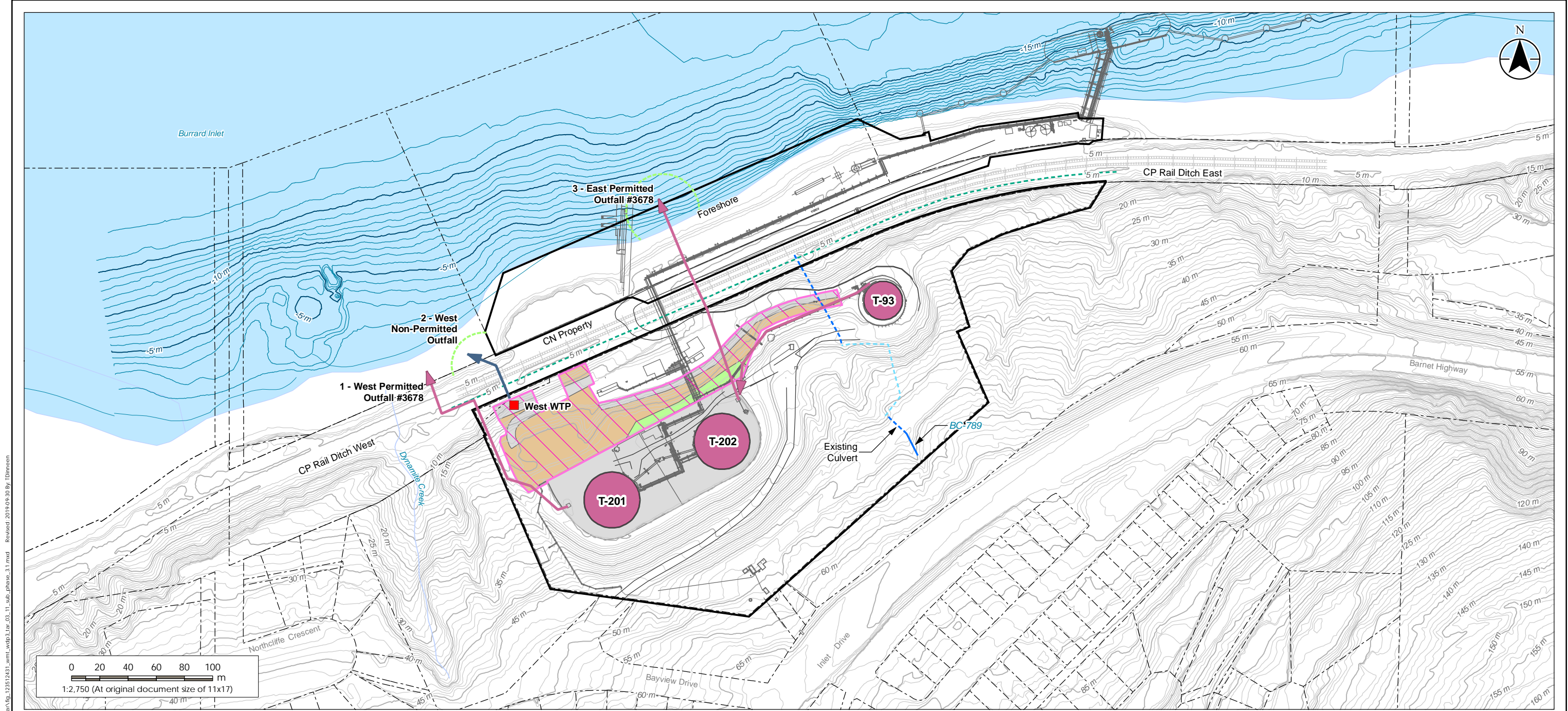
The Terminal was separated into sub-basins based on existing topography and drainage features. The secondary containment areas (SCAs; dyked tank areas) around the tanks drain to the West and East Permitted outfalls (Figure 1-2). Maximum catchment areas reporting to the West WTP during sub-phase 3.1, East WTP during sub-phases 3.2 and 3.3, and Foreshore WTP during sub-phases 3.4.1 and 3.4.2 are shown in Table 3-8 and Figure 3-11, Figure 3-12 and Figure 3-13. Specific to sub-phase 3.4.2, the Spoils and Batch Plant barges will have sufficient water storage capacity to store the stormwater and are drained to the Foreshore WTP the day after storm events. Land use in the basins draining to the WTPs includes impervious (paved) areas, cleared land, and grassed areas. General direction of site runoff, outside the areas that require water treatment, remains unchanged from that presented in Figure 1-2.

Water storage features of 75 m³ will be available for each of the East, and Foreshore WTPs, and a 60 m³ water storage will be available for the West WTP. These storage features can attenuate the peak flow into the West, East, and Foreshore WTP. Furthermore, a 225 m³ pond will be installed at the tunnel portal area and it will be able to attenuate the peak flow from the tunnel before mixing with surface water runoff in the East WTP's storage feature of 75 m³. The 24-hour storm peak flows into the WTPs were modelled with these water storage features.

Table 3-8 Water Treatment Plant Catchment Areas and Associated Water Storage Volume

Water Treatment Plant	Sub-Phases Requiring the Water Treatment Plant	Maximum Contributing Catchment (ha)	Water Storage Volume (m ³)
West WTP	3.1	0.80	60
East WTP	3.2 and 3.3	1.04	75
Foreshore WTP	3.4.1 and 3.4.2	0.46	75





Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
3. Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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- Project Property Boundary
- Parcel Lot
- Existing Building/Facility
- Existing Road/Rail
- Topographic Contour (m)
- Bathymetric Contour (m)
- Watercourse
- Waterbody

- Water Treatment Plant (WTP) Location
- Permit #3678 Outfall
- Non-Permit Outfall
- Turbidity Curtain
- Existing Watercourse
- Existing Culvert
- Diverted Culvert
- Existing CP Rail Ditch

- Permit #3678 Discharge Area
- West WTP Sub-Basin Macro Drainage Outfall Area
- Landcover:**
 - Cleared
 - Grass
 - Impervious



Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINNEEN 20190708
PM Review LHARRISON 20190927

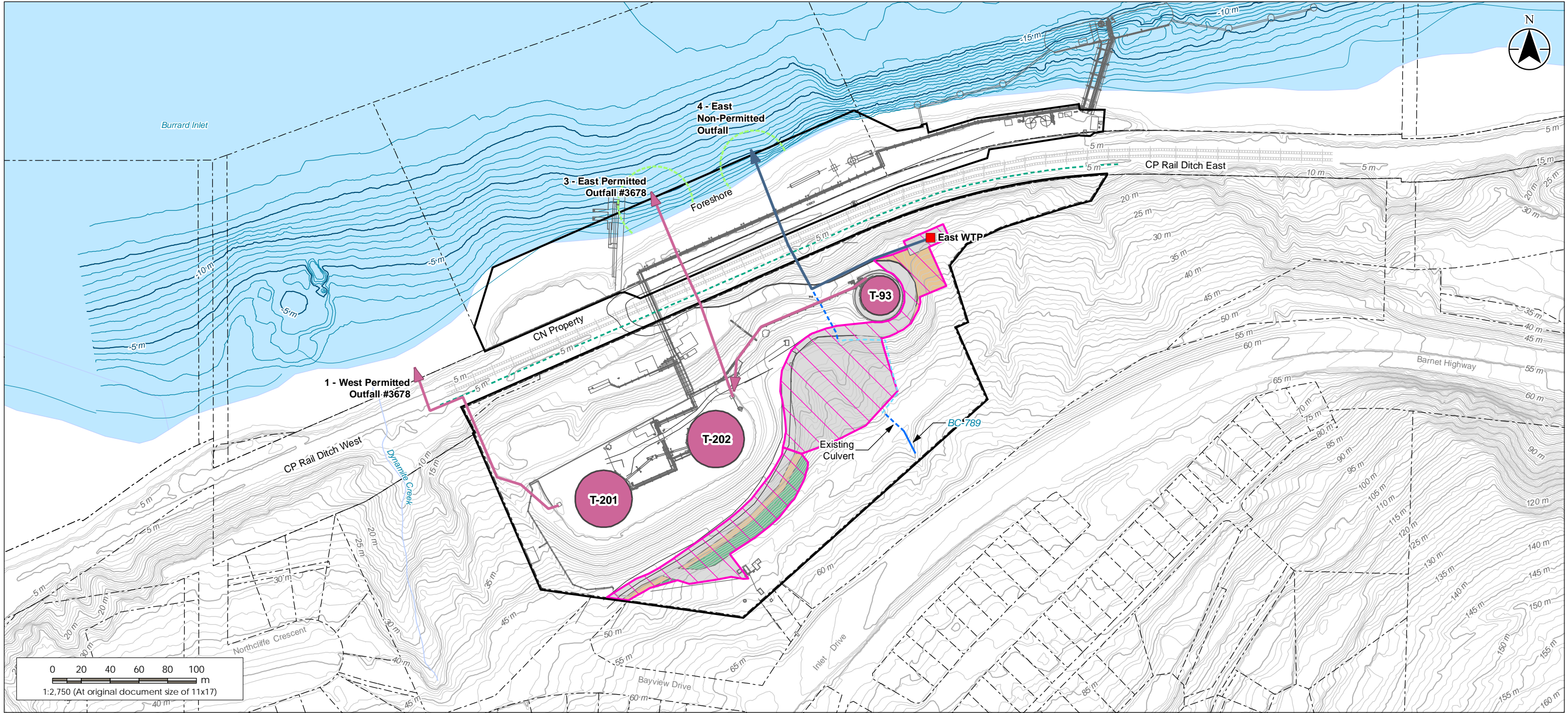
Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project
Waste Discharge Phase 3
Technical Assessment Report

Project Contact
Bronwyn Pountney
403-514-6726
Suite 2700, 300 5th Avenue SW,
Calgary, AB, T2P 5J2

Figure No. 3-11
Page No. 1 of 1
Doc No. 01-13283-TW-WT00-EV-RPT-0007

**Westridge Marine Terminal
Phase 3
Sub-Phase 3.1
Hydrological Modelling – Drainage Area**

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Revised: 2019-09-30 By: TDinneen



Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
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- Project Property Boundary
- Parcel Lot
- Existing Building/Facility
- Existing Road/Rail
- Topographic Contour (m)
- Bathymetric Contour (m)
- Watercourse
- Waterbody

- Water Treatment Plant (WTP) Location
- Permit #3678 Outfall
- Non-Permit Outfall
- Turbidity Curtain
- Existing Watercourse
- Existing Culvert
- Diverted Culvert
- Existing CP Rail Ditch

- Permit #3678 Discharge Area
- East WTP Sub-Basin Macro Drainage Outfall Area
- Landcover:**
 - Cleared
 - Impervious
 - Trees



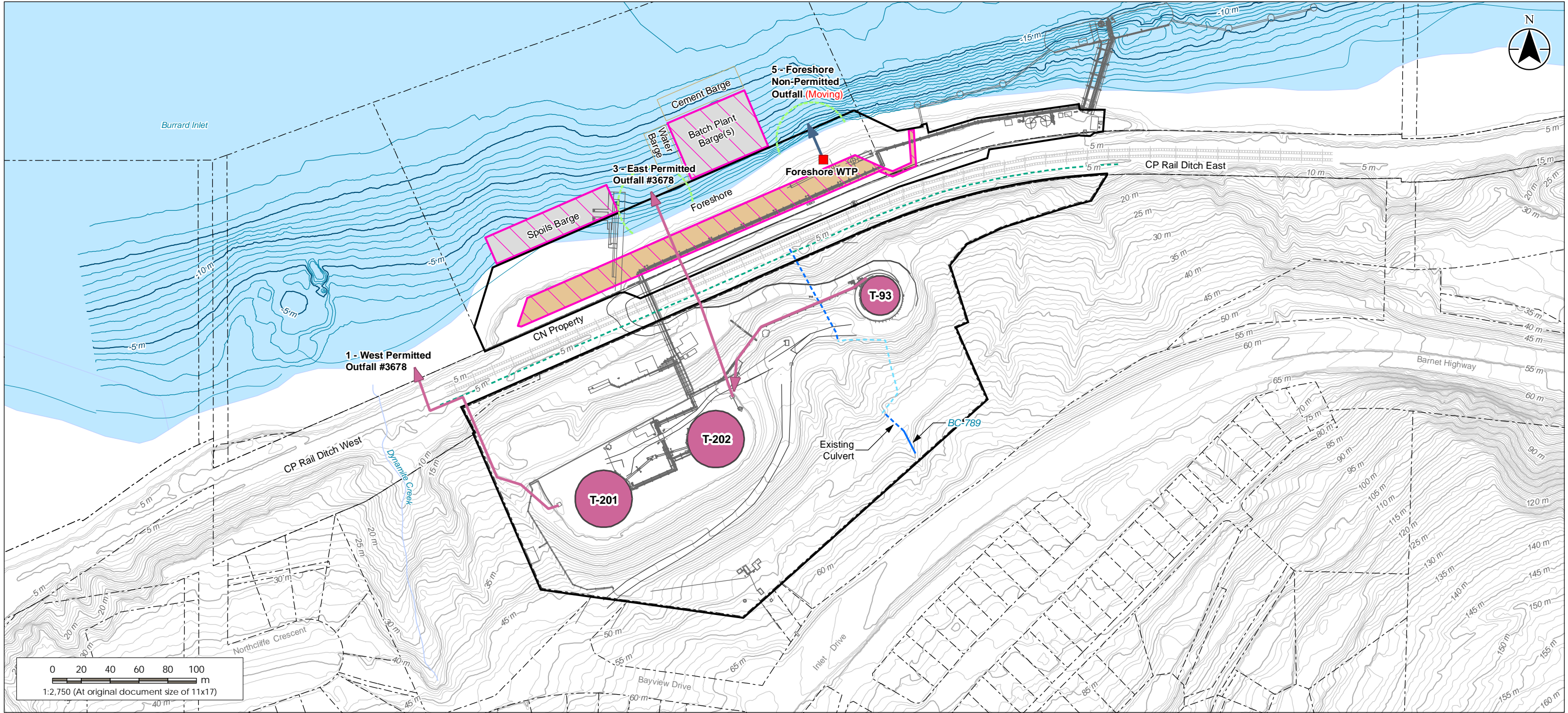
Project Location NTS: 092G07 BCGS: 92G.026 UTM: 10U 503386 5459495	Project Number 123512431 Prepared by TDINNEEN 20190708 PM Review LHARRISON 20190927
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Client/Project Trans Mountain Pipeline ULC Trans Mountain Expansion Project Waste Discharge Phase 3 Technical Assessment Report	Project Contact Bronwyn Pountney 403-514-6726 Suite 2700, 300 5th Avenue SW, Calgary, AB, T2P 5J2
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Figure No. 3-12	Page No. 1 of 1	Doc No. 01-13283-TW-WT00-EV-RPT-0007
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Title Westridge Marine Terminal
Phase 3
Sub-Phase 3.2 & 3.3
Hydrological Modelling – Drainage Area

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Revised: 2019.09.30 By: TDinneen



Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
3. Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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- Project Property Boundary
- Parcel Lot
- Existing Building/Facility
- Existing Road/Rail
- Topographic Contour (m)
- Bathymetric Contour (m)
- Watercourse
- Waterbody

- Water Treatment Plant (WTP) Location
- Permit #3678 Outfall
- Non-Permit Outfall
- Turbidity Curtain
- Existing Watercourse
- Existing Culvert
- Diverted Culvert
- Existing CP Rail Ditch

- Permit #3678 Discharge Area
- Foreshore WTP Sub-Basin Macro Drainage Outfall Area
- Landcover:
 - Cleared
 - Impervious
 - Barge



Project Location NTS: 092G07 BCGS: 92G.026 UTM: 10U 503386 5459495	Project Number 123512431 Prepared by TDINNEEN 20190708 PM Review LHARRISON 20190927
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Client/Project Trans Mountain Pipeline ULC Trans Mountain Expansion Project Waste Discharge Phase 3 Technical Assessment Report	Project Contact Bronwyn Pountney 403-514-6726 Suite 2700, 300 5th Avenue SW, Calgary, AB, T2P 5J2
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Title **Westridge Marine Terminal
Phase 3
Sub-Phase 3.4.1 & 3.4.2
Hydrological Modelling – Drainage Area**

3.3.1.2 Hydrologic Results

The hydrologic response of the WTP basins were calculated based on the assumptions outlined in Section 3.3.1.1. Four 24-hour storm events (2-year, 5-year, 10-year and 100-year) were considered for each model to estimate the peak flow.

Peak WTP inflow estimates with water storage of 75 m³ at the East and Foreshore WTPs, and 60 m³ at the West WTP are shown in Table 3-9. To accommodate the 10-year storm event, the capacity of the West, East, and Foreshore WTPs should be 400 (GPM) (0.025 m³/s), 800 GPM (0.050 m³/s) and 200 GPM (0.013 m³/s), respectively.

Table 3-9 Peak Water Treatment Plant Inflow Estimates

Water Treatment Plant	24-hour Storm Peak Flow (m ³ /s)			
	2-Year	5-Year	10-Year	100-Year
West WTP	0.025	0.025	0.025	0.043
East WTP	0.050	0.050	0.050	0.075
Foreshore WTP	0.013	0.013	0.013	0.016

3.3.1.3 Model Calibration/Validation

Runoff forecast models are normally calibrated to the watershed system in question by entering known input (rainfall) and output (streamflow) data. The model coefficients which represent physical variables or “fixed” basin and channel characteristics are adjusted so that input (e.g., precipitation) variables produce estimates of streamflow (Coulsen 1991).

The hydrological model could not be calibrated due to the lack of records for onsite stormwater flows. As agreed to with BC ENV, to further validate the hydrologic model recorded rainfall events are to be coded onto the HEC-HMS model using the assumptions in Section 3.3.1, and the results will be compared to discharge measured in summer and fall of 2019. These results will be submitted to BC ENV as a supplemental filing. Further, the inflows to the WTPs will be measured by flow meters; this flow data can be used to validate the hydrologic model through comparison with modelled flows.

Before implementation of the abovementioned validations, an effort has been made to compare SCA's outflows to the precipitation on the impervious SCA. The climate station (ID:1101158) at SFU reported data only sporadically in 2018. Data from this same period from Metro Vancouver weather station BU35 (Metro Vancouver 2018a⁹), located 3.7 km south-east of the Westridge Marine Terminal boundary, in the south eastern corner of the Simon Fraser University campus (BCG Engineering Inc. 2009), was used in this analysis. The 2018 rainfall data was acquired from Metro Vancouver via email inquiry.

⁹ Disclaimer: Please note that the data file provided by Metro Vancouver contains “Unverified Data”. Data in the file has been subject to some automated quality assurance/quality control (QA/QC) procedures built into the data acquisition system but may be subject to more detailed QA/QC procedures conducted by staff at a future time.



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This rainfall gauge is referred to by Metro Vancouver's Sewer and Drainage Operations as BU35, while the Metro Vancouver Air Quality and Climate Change division refers to the gauge as T014. For the purposes of this TAR, this gauge is referred to as BU35 (Figure 3-14).

The 2018 stormwater discharge information for SCAs was collected by hydrometric meters on the SCA discharge valve. Daily precipitation data was converted into the daily inflow volume of the known area (SCA's) and compared to the daily volume discharge from the SCAs. A difference of 12% between the annual inflow and outflow volume was determined for T201 (Figure 3-15); the difference was 33% for T202 and T93 (Figure 3-16). Some of the differences between inflow and outflow volumes are due to evaporation and infiltration of ponded water in the SCA's before being discharged the following day.



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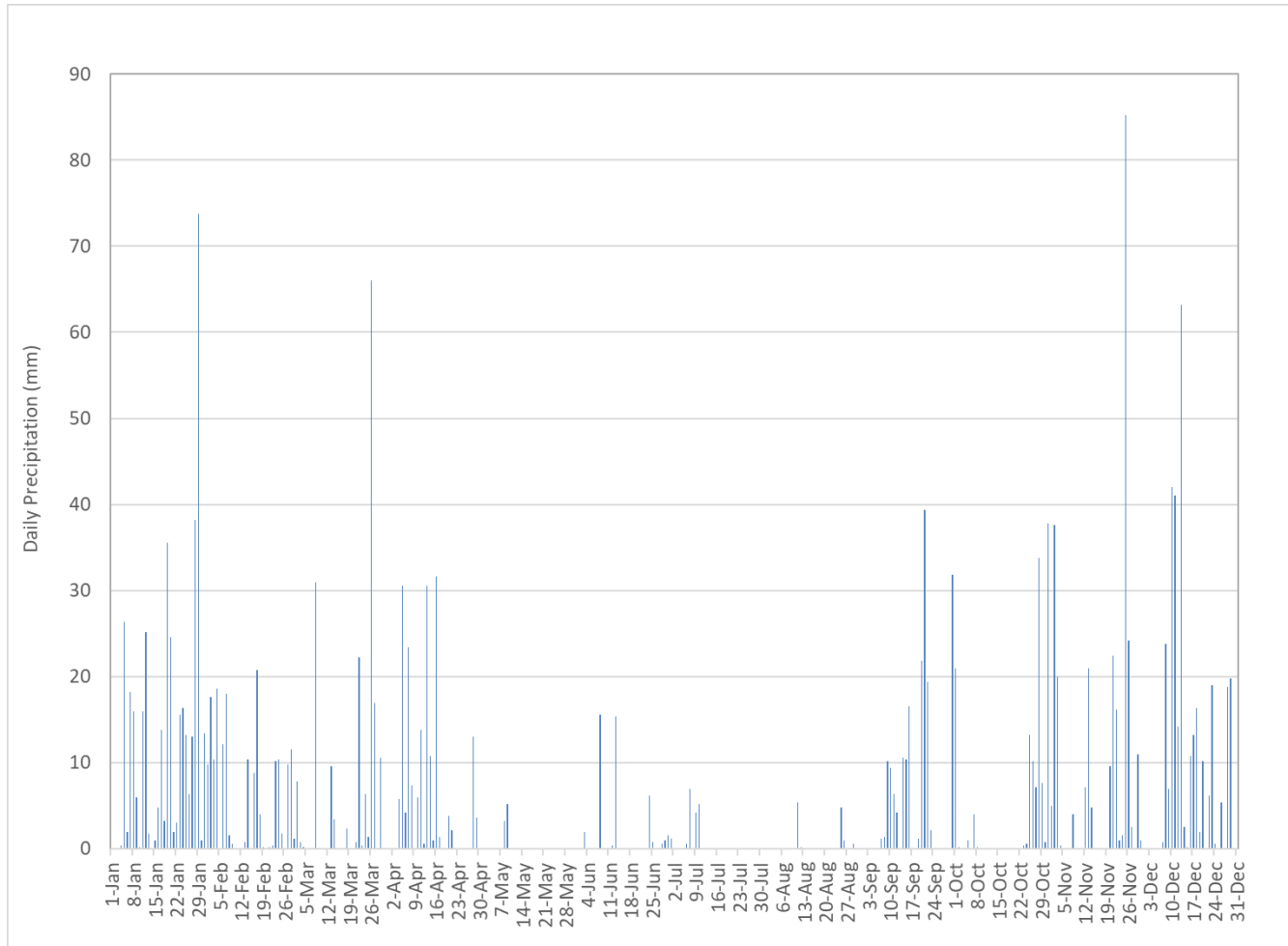


Figure 3-14 2018 Daily Precipitation at Metro Vancouver Weather Station at top of Burnaby Mountain (BU35)



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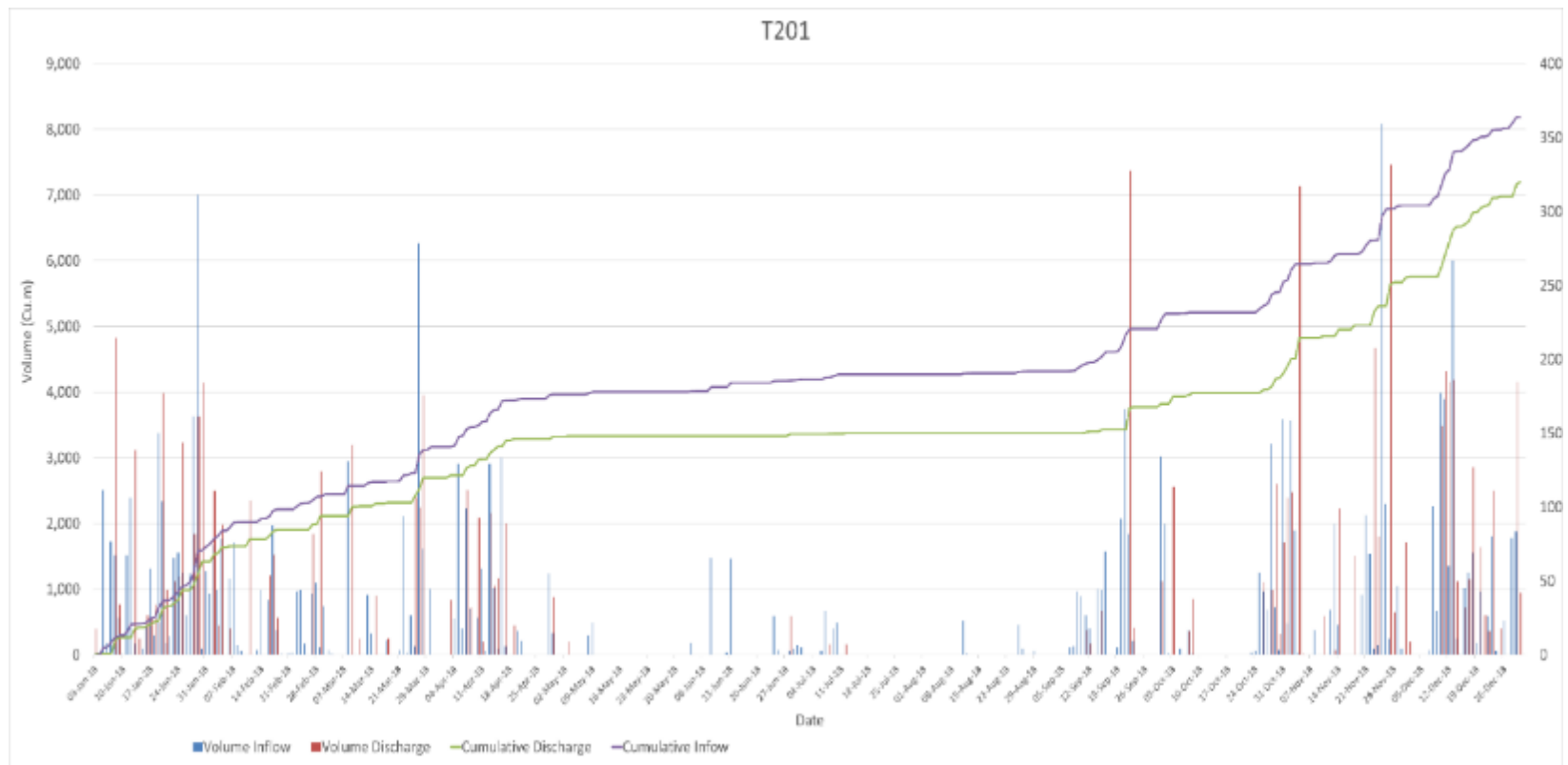


Figure 3-15 Yearly cumulative outflow of SCA vs the model for T201



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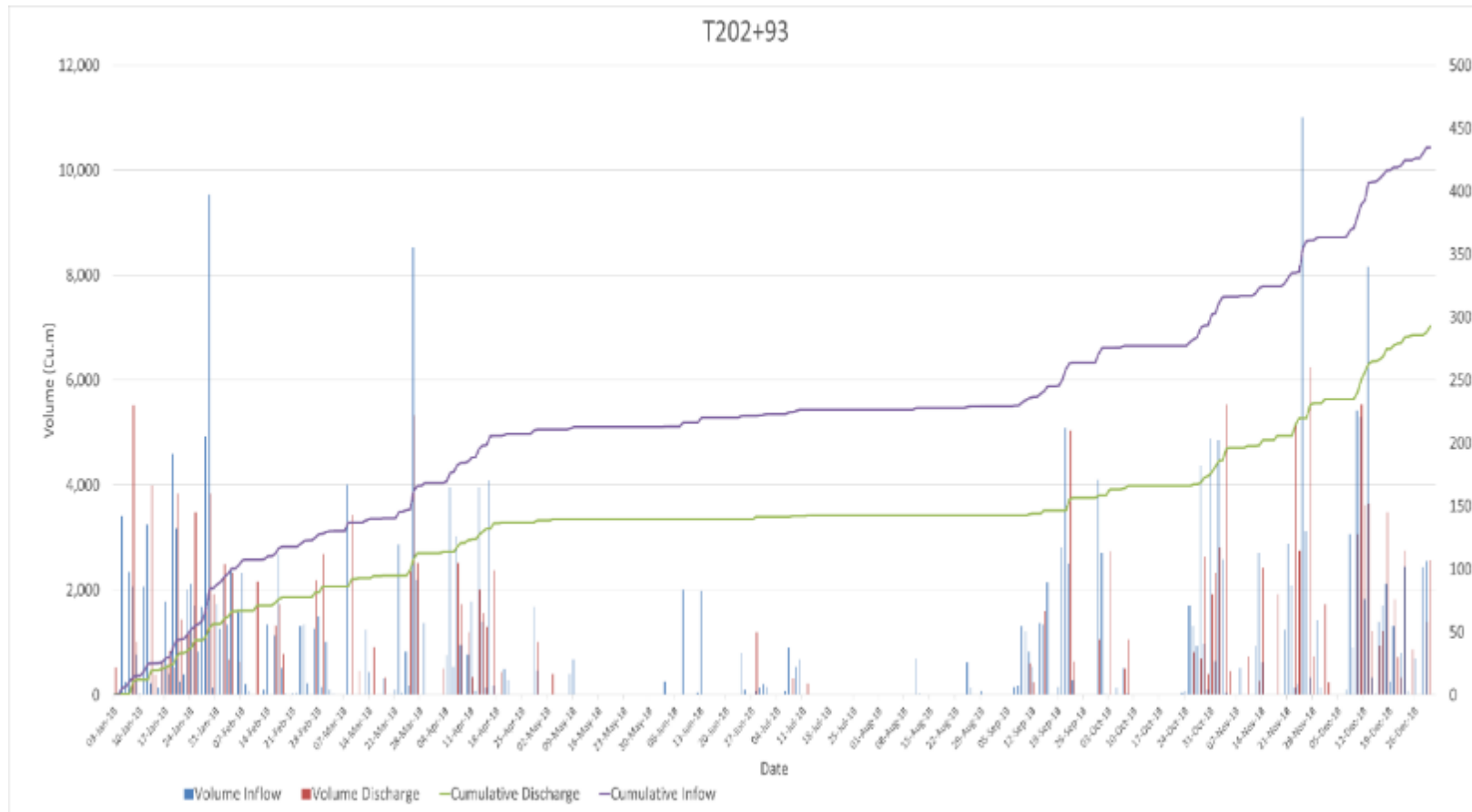


Figure 3-16 Yearly cumulative outflow of SCA vs the model for T202+T93



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3.3.1.4 Water Treatment Plant Capacity and Discharge Quantity

During sub-phases 3.1 to 3.4.2, the West, East, and Foreshore WTPs are anticipated to treat construction contact water from rainfall, and seepage and construction water from the tunnel. During sub-phases 3.5 and 3.6, CO₂ bubblers will be used to treat concrete curing contact water. Proposed capacities and associated water storage are summarized in Table 3-10, with the following assumptions:

- WTP capacity is calculated based only on treatment of construction contact rainwater, and seepage and construction water from the tunnel
- Water from the following construction activities will be held and released for treatment and subsequently discharged during dry periods, and was not included in calculations of WTP capacity:
 - Concrete curing contact water in CO₂ bubblers
 - Groundwater and tidal-influenced seepage in the bore pit (Phase 3.1)
 - Hydrostatic test water in tunnel delivery lines/facility piping

Table 3-10 Proposed Capacity and Water Storage of Water Treatment Plants

Water Treatment Plant	Capacity (Flow Rate)	Water Storage (m ³)
West WTP	2,180 m ³ /day (400 GPM)	60
East WTP	4,360 m ³ /day (800 GPM)	75
Foreshore WTP	1,090 m ³ /day (200 GPM)	75
Foreshore CO ₂ Bubbler	300 m ³ /day*	300*
NOTE: * Foreshore CO ₂ bubbler capacity is based on the 90% wet scenario in Table 2-1, assuming the total volume being discharged in one day.		

When storm water is being treated, WTPs will discharge continuously. Trans Mountain will monitor daily discharge quantity, through the electronic monitoring included as part of the Tervita WTPs and by sampling of the water quantity leaving the WTPs in accordance with the Westridge Marine Terminal Construction Water Quality Management Plan—Phase 3 (Appendix G).



3.3.1.5 Ditch and Culvert Conveyance Capacity

It is important that stormwater management systems are designed to be able to transport stormwater on site; ditches and culverts, as applicable, must be sized appropriately to manage water flows from the site.

Water from the East and West WTPs enter Burrard Inlet through culverts. Treated water from the East WTP will be discharged into the storm drain that flows to Burrard Inlet under the CP Rail line by a 600 mm culvert. Treated water from the West WTP will be discharged to the CP Rail ditch which is filled with coarse-gravel (railway ballast). Although, water in the CP Rail ditch generally infiltrates to groundwater it cannot be relied upon; therefore, it is conservatively assumed that water entering the CP Rail ditch from the West WTP will be discharged into Burrard Inlet through a 750 mm culvert.

The two culverts discharging from the West and East WTPs terminate in outfalls onto the shore of Burrard Inlet, and the slopes of these culverts are unknown. Therefore, the conveyance capacities of these culverts are estimated using the Manning's equation below, with the following assumptions: culverts are flowing full, have a 1% slope and roughness coefficient of 0.03 (conservative assumption), and that outlets and inlets are not flooded.

$$Q = \frac{1}{n} \times A \times R^{\frac{2}{3}} \times S^{\frac{1}{2}}$$

Where: Q = discharge (m³/s)

n = Manning's roughness coefficient

A = cross sectional area (m²)

R = Hydraulic Radius (Area / Wetted Perimeter, m)

S = channel slope (m/m)

Based on these assumptions, the east and west culverts could convey 0.26 m³/s and 0.48 m³/s respectively. These culverts can therefore convey the WTP discharge values (0.025 m³/s for the West WTP and 0.050 m³/s for the East WTP), plus other runoff from the rest of the Terminal for the 24-hour storm with a 10-year return period.

3.3.1.6 Conclusion

The potential impact to hydrology as discussed above is the potential contact water discharge beyond the capacity of WTPs. Based on current Project design and understanding of climate data and existing hydrological conditions, the planned mitigation measures (including the use of the WTPs with water storage) are anticipated to be effective in limiting the potential impact to hydrology to acceptable levels (i.e., stormwater design criteria used by the City of Burnaby to size stormwater infrastructure for minor systems; Burnaby 2014).



3.3.2 Hydrogeology

A review of previous reports as well as recent field work indicates that a conceptual model is not suitable to present groundwater and surface water effects together as there is a weak connection from the surface to groundwater for contaminants to be transported.

3.3.2.1 Predicted Impacts on Groundwater

Impacts on groundwater users has been assessed in the general Project area instead of being specific to a given groundwater user; because of the voluntary disclosure of groundwater use, not all groundwater users can be identified. The presence of groundwater users is assumed, and potential impact is defined spatially.

Potential groundwater quality impacts would be related to the construction phase of the tunnel boring activities. Groundwater seepage within the tunnel as it is being constructed is generally deemed compatible with the baseline environment. Based on recent undisturbed groundwater quality sampling results, the average total concentrations of metal species were below applicable BC WQGs. Arsenic and copper concentrations appear to be naturally elevated in groundwater, and the maximum total concentration of these species only marginally exceeded their WQGs. No toxicity concerns for these concentrations of metals are identified if groundwater is discharged to the marine environment.

In general, groundwater levels above the tunnel will be drawn down as tunneling progresses and localized dewatering occurs, and the drawdown cone will slowly move along with tunnel boring alignment (Hatch et al. 2017). This impact will be reversible. Groundwater level recovery will be initiated as soon as tunnel walls are sealed as the tunnel boring machine moves forward.

Due to the bedrock aquifers' low hydraulic conductivities, groundwater level recovery will be relatively slow, resulting in groundwater levels lower than usual for a significant period of time, but gradually recovering (Hatch et al. 2017). The recovery might occur over a few years, subject to annual weather conditions.

Groundwater seepage to surface, along the Burrard Inlet escarpment, may see a reduction in flow during the construction phase, due to the short vertical distance between the tunnel alignment and those groundwater seepages to surface, caused by the dewatering action of the tunnel as it progresses. This impact is reversible and temporary. Groundwater seepages to surface will resume flowing when the proximal tunnel walls are sealed, and groundwater level starts recovering (Hatch et al. 2017).

3.3.2.2 Proposed Mitigation Measures

The proposed tunnel boring approach, including simultaneous wall sealing, will limit groundwater seepage during construction hence limiting the quantity of water requiring treatment.



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Tunnel Boring Activities

A potential risk during tunnel boring activities is the release of groundwater. If groundwater flows are encountered during tunnel boring activities, the TBM can be returned to a pressurized mode in a matter of seconds and no water flows into the tunnel will occur. Additionally, conservative model outputs indicate a maximum flush flow (unmitigated flows) of 600 L/min (Hatch et al. 2017); this has been incorporated into hydrology modelling, and subsequently, the sizing of WTPs (see Section 3.3.1). Design features of the TBM will further reduce the unlikely release of groundwater. These are summarized in Section 2.1.10.

The requirements of NEB condition 87 related to Groundwater Seepage Management Plan at the Burnaby Mountain Tunnel Construction are addressed as follows:

- An estimate quantifying the anticipated average and maximum amounts of groundwater seepage into the tunnel, and an assessment of potential impacts on the water table: the numerical groundwater flow model predicts inflow rates between 1.5 and 3.0 litres per second (Lps) depending on storage capacity value used for the bulk bedrock in which the tunnel will be bored. A cumulative inflow is estimated at a bit less than 4,000 m³ over the time of construction. Predicted impacts are a drawdown of the potentiometric head by tens of metres right above the tunnel, and between 0.1 to 1.0 m at 20 m horizontal from the tunnel alignment.
- A discussion of Trans Mountain's proposed pumping, treatment, and disposal options: Groundwater and construction water will flow along the tunnel by gravity to the Westridge tunnel portal. From the portal, water will be collected in a ditch at the entrance to the tunnel, along with any construction water from portal operations. The collected water will flow to a sump where the water will be pumped into a lined pond near the portal area. The lined pond will pre-treat potentially turbid water. Water will then be conveyed to a WTP where turbidity, pH and flow will continuously be measured. The treatment system will utilize a chitosan enhanced sand filtration system, which will include a liquid flocculent injection system and sand filtration with automatic backwash. Excessive flow will be handled at the source: tunnel boring will stop and ingress of groundwater will be sealed prior to re-initiating boring.
- A description of the potential effects of dewatering of bedrock aquifers, springs and streams on local groundwater and surface water resources, and of measures that Trans Mountain would implement to mitigate such effects: If connection exists with gaining surficial streams within this zone of influence, stream flow could be affected by few percent. The loss will be temporary. The effect will be mitigated by the sealing of tunnel walls as the TBM progresses, allowing recovery of potentiometric head loss; the tunnel will open for no more than 9 m at any given time. This will keep spatial and temporal impact to minimum and restore bedrock to near-original porosity, avoiding the creation of preferential flow paths.
- A description of measures that Trans Mountain would implement during the operations phase in the event that there is groundwater seepage into the tunnel: the segments will be fully backfilled with Low Density Cellular Concrete (LDCC) between low permeability concrete plugs. The LDCC backfill and low permeability concrete plugs are designed to prevent groundwater flow paths. The LDCC will fully encapsulate the pipelines and fill the voids.

Hydrogeological parameters assessment was carried out through an aquifer test and groundwater level and quality data collection. Collected data was used, along with baseline groundwater level monitoring



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data, to build, calibrate and test a numerical groundwater flow model. The numerical groundwater flow model was used to identify and quantify impacts on water resources. Analytical models were used to estimate inflow rates using those same data from the hydrogeological assessment.

3.3.2.3 Data Gaps/Uncertainties

During tunnel boring, there is potential for a fractured bedrock area to be intercepted, producing a higher instant inflow rate for a short period of time. The effects of these singular inflows would be temporary: the tunnel walls will be sealed as the tunneling progresses.

3.3.2.4 Conclusion

Potential impacts to hydrogeology as discussed above are the potential impact to groundwater via groundwater drawdown and groundwater seepage cut-off during tunnel boring. Based on current Project design and understanding of baseline data and existing hydrogeological conditions, the planned mitigation measures (including tunnel wall sealing) are anticipated to be effective in limiting the potential impact to hydrogeology.

3.3.3 Oceanography and Marine Sediment Quality

The proposed Phase 3 Works are not expected to affect oceanographic conditions in the vicinity of the Terminal (i.e., currents, tidal flux). Works on the foreshore area (i.e., excavation, ground improvement, concrete foundation) will take place within and behind the sheet pile cells that isolate the work areas from the marine environment. Works associated with the offshore superstructure for the marine trestles and berths will take place above the water (the superstructure is supported on piles). All other works occurring in upland areas (e.g., manifold and pipe rack construction, tunnel and substation construction, tunnel reclamation) are land-based and physically removed from the ocean.

There is potential for Phase 3 Works to affect marine sediment quality through the introduction of contaminants in discharge water—see Section 3.3.4 for a summary of potential impacts.

3.3.4 Marine and Freshwater Water Quality

The Works at the Terminal have the potential to result in a change in freshwater and marine surface water quality as outlined in the following discussion. Overall, potential changes to water quality are not anticipated to cause parameters to be above CCME or BC WQG as a result of Phase 3 activities. Drinking water will not be impacted as there are no sources of drinking water within or downstream of the Terminal.

Exposed soils have the potential to impact surface water quality. Vegetation clearing around the tunnel portal, along the ditches and the marine foreshore has already occurred in previous phases. However, Phase 3 activities on land will disturb soil during construction of the tunnel manifold, relocation or modification of ditch alignments, and construction of outfalls. Exposed sediments can influence surface water quality following precipitation events which may create surface run off within these exposed areas.



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The soil quality assessment (see Section 3.2.6) indicates that soil quality is generally good with all parameters below guidelines, with the exception of one exceedance of the guideline for arsenic in the foreshore excavation area. Leachate testing (TCLP) did indicate the potential for increased arsenic, cadmium, copper, iron and lead concentrations above guidelines. In addition, the laboratory had to increase the detection limits for cobalt, nickel, selenium and zinc above the CCME / BC CSR water quality guidelines; therefore, to be conservative, it should be assumed that there is a possibility that these metals may also be present in higher concentrations. However, leachate tests are not representative of natural conditions as they utilize acids to determine leachable constituents and natural rainwater will not create the same concentrations within runoff water. Therefore, to be conservative, it is assumed that exposed soils have the potential to increase concentrations of these parameters within surface waters provided there is an exposure pathway (i.e., soils are exposed during periods of precipitation).

Construction activities including concrete works and hydrostatic testing (outlined in Section 2.1.9) also have the potential to increase contaminants, suspended solids and pH in surface water.

3.3.4.1 Mitigation

Land-Based Construction Activities: To mitigate the impact of exposed soils, soils will be covered where feasible and revegetated following construction activities. Stockpiled soils will be stabilized using land cover such as tarps, cocoa mats or equivalent.

Contaminants from Hydrostatic Testing: CO₂ bubblers will be installed and WTPs will be equipped with additional modules capable of treating contaminants resulting from hydrostatic testing activities to the limits proposed in Table 2-2.

Concrete Works: Concrete curing contact water can also increase pH levels. Surface contact water will be directed to the CO₂ bubblers and WTPs (as appropriate) prior to discharge. There currently is no discharge criterion for pH under the existing Permit, as previous activities did not have potential for pH changes. However, with the addition of concrete works it is recommended that a pH range of 7.0 To 8.7 be added to the Permit criteria (see Marine Water Quality below).

Total Suspended Solids: WTPs will be equipped to treat for TSS and Trans Mountain proposes a 75 mg/L limit for TSS during Phase 3. This aligns with the limit defined in the Land Development Guidelines for the Protection of Aquatic Habitat (Appleby and Scarratt 1989; DFO 1993; Birtwell et al. 2008). Run-off will discharge to Burrard Inlet within the turbidity curtains around the discharge culverts and outfalls.

Marine Water Quality: Discharge water has the potential to alter marine water quality through changes to chemical constituents or the introduction of sediments. Discharge water will be treated to meet discharge criteria prior to entering marine waters. Therefore, TSS levels at the discharge point, prior to dilution, will already meet the permit requirements, and TSS levels will not be high enough to cause impacts to the marine environment. Consequently, initial dilution zone modelling is not required. pH will also be treated to meet marine water quality guidelines prior to discharge.



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Based on baseline studies (water, groundwater, soil) of existing conditions parameters not included within the discharge criteria have the potential to occasionally be elevated in surface water. Naturally elevated metals present in disturbed soils have the potential to cause temporary elevated levels in surface contact water and would be associated with increased TSS. Metals associated with TSS would be removed with TSS by the WTPs.

The use of turbidity curtains around the discharge locations has the potential to reduce the mixing ability and slow down the dilution time particularly for sediment which cannot pass through the curtain; however, as released water will be below discharge limits for TSS it is not anticipated that this will result in marine areas with increased turbidity or sediment deposition outside the curtain.

3.3.4.2 Conclusion

The potential impact to marine and freshwater water quality as discussed above is the potential impact to marine water quality as a result of construction activities which may disturb soils cause changes to surface water quality which would be discharged into the marine environment. Based on current Project design and understanding of baseline data and existing water quality conditions, the planned mitigation measures (including WTPs, erosion and sediment control measures and surface water controls) are anticipated to be effective in limiting the potential impact to marine and freshwater water quality (e.g., water quality meeting CCME or BC WQG).

3.3.5 Aquatic Resources

3.3.5.1 Freshwater Fish and Fish Habitat

There is no freshwater fish habitat within the Westridge Marine Terminal. One watercourse, BC-789 (a non-fish-bearing stream) is present within the Westridge Marine Terminal property. BC-789 flows north across the Terminal through a combination of open channel and culverted sections and then discharges into Burrard Inlet. The nearest fish-bearing habitat is the marine environment of Burrard Inlet. There is no fish access between Burrard Inlet and BC-789 due to culvert connection, culvert gradients and a sump pump located downstream of the WMT and the CP Rail ditch. A *Water Sustainability Act* section 11 permit for instream work at BC-789 for the Westridge Marine Terminal was issued by the OGC on May 1, 2018. Works at this location are subject to mitigation measures developed to protect flow and water quality and limit impacts to downstream fish-bearing habitats (i.e., the marine environment).

In consideration that the drainage pathway from the WTP to the marine environment does not provide fish habitat, no adverse effects to the freshwater receiving environment are anticipated as a result of discharges from Phase 3 activities.



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3.3.5.2 Marine Fish and Fish Habitat

For Phase 3 construction activities the Terminal outfalls and effluent will discharge into Burrard Inlet adjacent to soft-sediment aquatic habitats. Potential impacts from these activities will be controlled using the WTP prior to discharge and installation of turbidity curtains at each outfall. Increased TSS and/or changes to pH are anticipated to be the most likely potential impact to the marine environment from freshwater discharge.

Elevated TSS concentrations in marine waters may result in sublethal and, in extreme instances, lethal effects to fish and invertebrates present in the area. Fish eggs and fish larvae are susceptible due to their inability to move away from areas of dispersing suspended sediment (Morgan and Levings 1989; Newcombe and Jensen 1996). Juvenile and adult fish are more mobile and tend to avoid areas with elevated TSS concentrations (Servizi and Martens 1992; Newcombe and Jensen 1996; Wilber and Clarke 2001). Appleby and Scarratt (1989) provide evidence that nearshore fish and invertebrates experience, and can survive a wide range of suspended sediment concentrations. In many instances nearshore fish and invertebrates experience sediment transport along the shoreline associated with tides and currents, and also experience high turbidity associated with seasonal plankton blooms. As described in Section 3.3.4, water discharged to Burrard Inlet will be below the discharge limits for TSS. With the installation of turbidity curtains around the outfalls, temporary increases in TSS over background levels will be confined to relatively small areas around the outfalls. The turbidity curtains will also act to exclude fish and invertebrates, further mitigating potential effects.

Marine users including marine vessel traffic, commercial and recreational fishing vessels, and other recreational users (e.g., paddle boards, kayaks) will not be impacted by the Works as there will be no changes to the marine physical environment or marine water quality, except within the turbidity curtain. This area is already inaccessible to marine uses as it is behind the marine construction safety boom which defines and limits access to the active Westridge Marine Terminal construction and operations area. More information about navigation safety is available in NEB Condition 48 report.¹⁰

3.3.5.3 Conclusion

Potential impacts to marine and freshwater habitats as discussed above are through the potential impacts to freshwater and marine water quality which may impact habitat quality during construction activities. Based on current Project design and understanding of baseline data and existing conditions, the planned mitigation measures (including the use of the WTP prior to discharge and the installation of turbidity curtains at each outfall) are anticipated to be effective in limiting the potential impact to marine and freshwater habitats.

¹⁰ NEB Condition 48: Navigation and Navigation Safety Plan (NEB Filing ID A90948): <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3540106>



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3.3.6 Vegetation

Vegetation and riparian area clearing as described in the Westridge Marine Terminal Phase 1 information update (submitted to BC ENV August 17, 2017) will have been completed prior to the start of Phase 3 activities; no additional impacts on vegetation during Phase 3 are expected.

Introduction or spread of weeds, or both, during Project activities will act cumulatively with existing operation and maintenance activities. However, proposed invasive species management measures for the Project and, by association, TMEP¹¹, will limit potential impacts.

3.3.7 Wildlife and Wildlife Habitat

Direct impacts on wildlife and wildlife habitat by the Phase 3 construction activities are not expected as wildlife habitat is limited.

3.3.8 Human Use

Groundwater users were not identified within 4.5 km of any portion of the proposed tunnel alignment; therefore, no impact to human use is anticipated.

Marine users including marine vessel traffic, commercial and recreational fishing vessels, and other recreational users (e.g., paddle boards, kayaks) are not anticipated to be impacted by the Works as there will be no changes to the marine physical environment and changes to marine water quality are anticipated to be limited to within the turbidity curtain. This area is already inaccessible to marine users as it is behind the marine construction safety boom which defines and limits access to the active Westridge Marine Terminal construction and operations area. More information about navigation safety is available in NEB Condition 48 report.¹²

¹¹ NEB Condition 45: Weed and Vegetation Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (NEB Filing ID A85541-13): <https://apps.cer-rec.gc.ca/REGDOCS/File/Download/3307970>

¹² NEB Condition 48: Navigation and Navigation Safety Plan (NEB Filing ID A90948): <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3540106>



4.0 PROPOSED CHANGES TO PERMIT CONDITIONS

Following the application of mitigation and erosion and sediment control measures, the implementation of management plans, the installation of three WTPs and CO₂ bubblers, the potential impacts on the receiving environment are expected to be limited.

To accommodate changes to stormwater discharge during Phase 3 Works on the Terminal, proposed amendments to the Permit are provided below.

4.1 DISCHARGE QUANTITY

During the Phase 3 activities, changes to the management and discharge of site water, compared to existing conditions, include:

- Water from disturbed areas during sub-phases 3.1 to 3.6 will be treated in the WTPs and CO₂ bubblers prior to discharge into Burrard Inlet. Under existing site conditions, runoff from these areas is considered non-contact water and discharges into Burrard Inlet without treatment.
- Additional water expected to discharge into Burrard Inlet, compared to under existing conditions, includes the water used for hydrostatic testing and seepage during tunnel boring activities.

Hydrostatic test water will be held in the tunnel delivery lines and facility piping and released as per Section 2.1.11.5 (i.e., during drier conditions) and have not been incorporated as an input in the hydrologic modelling, which simulates the rain-driven discharges. Further, the tunnel boring seepage is expected to contribute a limited volume of water to existing stormwater volumes.

The current Waste Discharge Permit (#3678) (Appendix B) is for effluent discharge from the dyked tank farm through two discharge locations (E213525 and E258155; Figure 1-2); the Permit allows for the continuous discharge of up to 415 m³ per day and an annual average rate of 26 m³ per day, per location from these two locations. Trans Mountain requests that the Permit be amended as described in Table 4-1 with the provision of a daily discharge quantity limit for each compliance point (i.e., WTP or CO₂ bubbler). Trans Mountain requests that the current permitted annual average rate of discharge (26 m³ per day per location) be removed for locations E213525 and E258155 and that no fixed quantity be implemented for the new compliance locations because the average or total annual stormwater discharge is dependent on the number of and magnitude of rainfall events.



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Table 4-1 Proposed Discharge Quantity Limits for Each Compliance Point

Compliance Point	Daily Discharge Quantity (m ³)
Existing Permit #3678 location E213525	415
Existing Permit #3678 location E258155	415
West Water Treatment Plant	2,180
East Water Treatment Plant	4,360
Foreshore Water Treatment Plant	1,090
Foreshore CO ₂ Bubbler	300

4.2 DISCHARGE QUALITY

4.2.1 Total Suspended Solids and Total Extractable Hydrocarbons

The existing Permit #3678 includes a permit limit for TEH (5 mg/L), while the Phase 2 Approval included a permit limit for both TSS (75 mg/L) and TEH (5 mg/L). Trans Mountain proposes that given the similarity of construction activities between Phases 2 and 3, as well as the assessment of potential impacts on the receiving environment described in Section 3.3:

1. TEH limit of 5 mg/L be retained for Phase 3 for all compliance points and during all sub-phases (construction activities are not expected to effect areas that may come in to contact with oily water)
2. A permit limit of 75 mg/L for TSS be added to Permit #3678 at all new compliance points and during all sub-phases

In addition, the following four-stage process is being adopted:

1. Ongoing restoration at construction areas
2. Ongoing mitigation measures, with proven effectiveness, e.g., weather forecasting and adjusted work activities
3. Installation of WTPs, sumps and pumps to manage discharge
4. Monitoring around the Terminal at construction locations to effectively manage discharge from construction activities

As described in Section 2.4.1, a TSS-turbidity curve will be established for the Westridge Marine Terminal to allow for conversion of in situ turbidity measures to TSS for comparison to the compliance threshold. This will be submitted as a supplemental filing.

4.2.2 pH

With the addition of concrete works during Phase 3, and in consideration of the associated mitigation measures related to runoff from concrete activities, including the installation of a CO₂ bubbler to treat for



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elevated pH, Trans Mountain proposes a pH limit of between 7.0 and 8.7 to align with the BC WQGs (BC ENV 2019) from all new compliance points and during all sub-phases.

4.2.3 Potential Contaminants from Hydrostatic Testing Waters and Municipal Water

As described in Section 2.1.11 and presented in Table 2-2, potential contaminants could be present in hydrostatic test water. Trans Mountain requests that limits be added to Permit #3678 for pH, total residual chlorine (only when municipal water is used), dissolved iron and propylene glycol to cover instances when hydrostatic testing is taking place.

4.3 AUTHORIZED WORKS

No changes are proposed to the existing discharges from the dyked tank areas included in the Permit #3678 (E213525 and E258155) as part of Phase 3 construction activities. Trans Mountain requests that the Permit be updated to include the locations of four new compliance points in the updated Permit.

The infrastructure in place for each of the proposed new compliance points include only temporary WTPs, CO₂ bubblers, and ESC and mitigation measures; permanent infrastructure will not be active during Phase 3. Trans Mountain proposes that the authorized works be updated as part of the Phase 4 operations activities Permit Major Amendment application when this infrastructure will be in operation.

4.4 PERMIT CONDITIONS, INCLUDING MONITORING AND REPORTING REQUIREMENTS

Trans Mountain requests that the water quality parameters and associated limits as described in Table 4-2 be added to Permit #3678 dependent on the construction activity or phase of construction.

Table 4-2 Proposed Water Quality Parameters to Add to Permit #3678

Parameter	Proposed Limit
TSS	75 mg/L
pH	7.0–8.7
Total extractable hydrocarbons (TEH)	5 mg/L
Total residual chlorine ^{1, 2}	0.003 mg/L
Dissolved iron ¹	0.35 mg/L
Propylene glycol ¹	500 mg/L
¹ Only during hydrostatic testing	
² Only when municipal water is used.	

Table 4-3 identifies the compliance point for each sub-phase, and based on construction activities during each sub-phase, details the parameters that will be monitored. Water quality monitoring for Permit



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compliance will take place as water leaves each of the three WTPs (East, West or Foreshore), or from the Foreshore CO₂ bubbler (see Figure 4-1 and Table 4-3).



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Table 4-3 Permit Compliance Points and Parameters

					Compliance Parameters				
Sub-Phase	Compliance Point	Latitude N	Longitude W	Discharge Quantity (m³/d)	TSS	pH	TEH	Hydrostatic Test Parameters¹	TEH alone²
3.1	West WTP	49.288468	-122.956119	2,180	✓	✓	✓	✓	-
3.2 and 3.3	East WTP	49.289483	-122.952034	4,360	✓	✓	✓	✓	-
3.4.1 and 3.4.2	Foreshore WTP	49.289941	-122.953012	1,090	✓	✓	✓	-	-
3.5 and 3.6	Foreshore CO₂ Bubbler	Dependent on location of construction activities		300	-	✓	-	✓	-
Ongoing Westridge Marine Terminal Operations									
West Permitted Discharge	Exit of T-201 (E258155)	49.288449	-122.957330	415²	-	-	-	-	✓
East Permitted Discharge	Exit of T-202 (E213525)	49.289635	-122.954261	415²	-	-	-	-	✓
NOTES:									
¹ As described in Section 2.1.11.4 and Table 4-2—total residual chlorine, dissolved iron, propylene glycol									
² No change from existing permit									
The Westridge Marine Terminal Construction Water Quality Monitoring Plan—Phase 3 (Appendix G) references the following compliance points: West WTP = C1; East WTP = C2; Foreshore WTP = C12; and Foreshore CO₂ Bubbler = C16.									



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Discharge water from sub-phases 3.1 – 3.6 (either following exit from a WTP or from a CO₂ bubbler) will enter Burrard Inlet from six main discharge locations each behind a turbidity curtain if construction activities are active—see Figure 4-1. Note that in some cases discharge flows are combined, a discharge location may move along the shoreline to accommodate construction activities, or an outfall is removed (see Section 2.1.5) as construction progresses. Detail on which discharge location is active during a sub-phase can be found in Appendix E.

Monitoring and reporting will include monthly and end-of-year reporting on water quality discharge monitoring results. Reporting will include exceedances, if any, of Permit levels over the duration of the Works, with dates and descriptions. Details of water quality monitoring are outlined in the Westridge Marine Terminal Construction Water Quality Monitoring Plan—Phase 3 (Appendix G) for the Terminal which was developed in consultation with BC ENV. A Compliance Monitoring Plan will be developed following Permit issuance and submitted to BC ENV as per the Permit guidance.

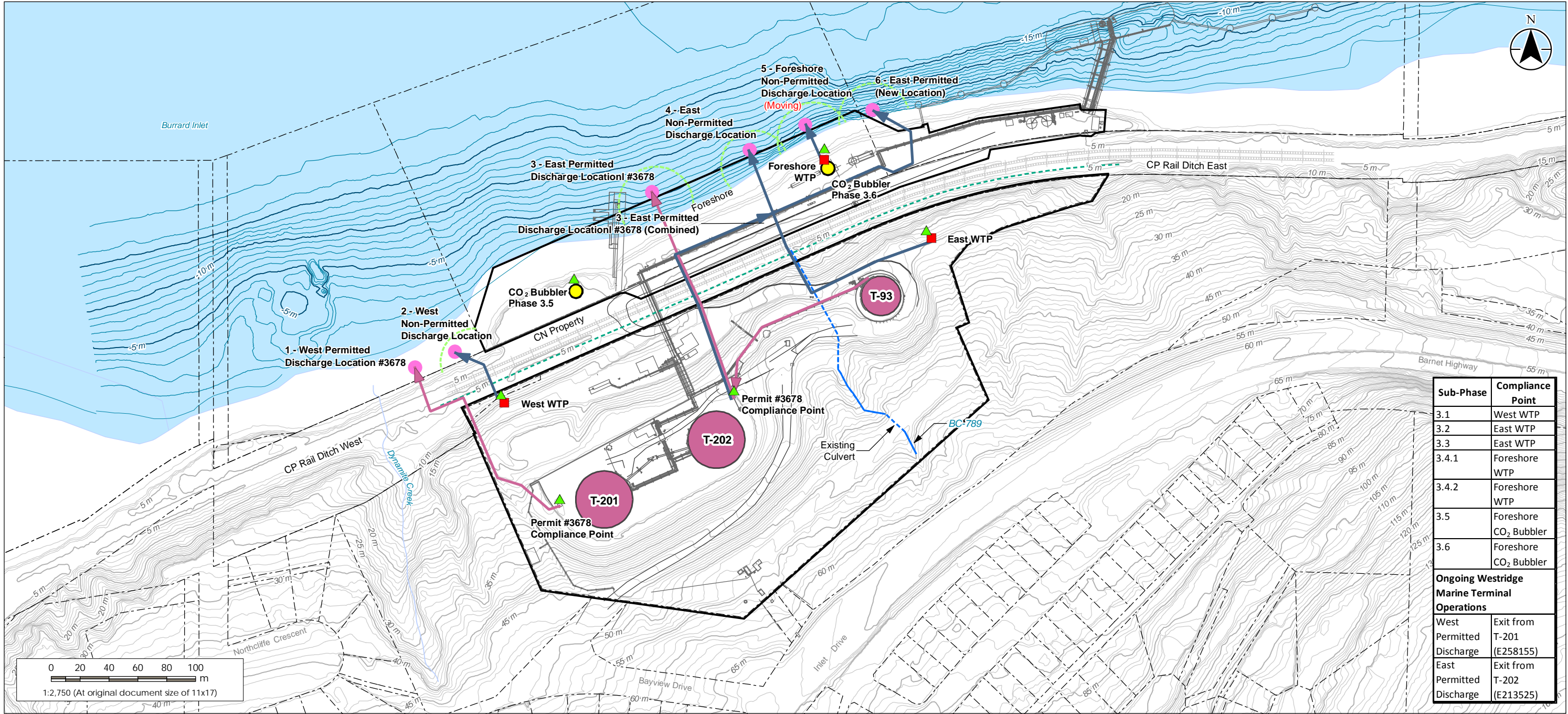
In the event of a non-compliance, Trans Mountain will:

- Immediately notify the Director of EMA, BC ENV of any non-compliance with the Permit
- Identify remedial actions and controls implemented within 24 hours
- Submit a written report on the non-compliant event (i.e., discharge and quality, etc.) to the Director of EMA, BC ENV within 30 days of the event, including: test results, probable causes, toxicity results, and remedial actions

Spills to the environment will be reported immediately in compliance with the Spill Reporting Regulation with notification to the Provincial Emergency Program at 1-800-663-3456. In addition, Trans Mountain will adhere to the mitigation measures outlined in the Westridge Marine Terminal EPP and EMP related to spills (Appendix A).



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Revised: 2019-09-30 By: TDinneen



Sub-Phase	Compliance Point
3.1	West WTP
3.2	East WTP
3.3	East WTP
3.4.1	Foreshore WTP
3.4.2	Foreshore WTP
3.5	Foreshore CO ₂ Bubbler
3.6	Foreshore CO ₂ Bubbler
Ongoing Westridge Marine Terminal Operations	
West Permitted Discharge	Exit from T-201 (E258155)
East Permitted Discharge	Exit from T-202 (E213525)



- Project Property Boundary

Parcel Lot

Existing Building/Facility

Existing Road/Rail

Topographic Contour (m)

Bathymetric Contour (m)

Watercourse

Waterbody
- Compliance Point

Discharge Location

CO₂ Bubbler

Water Treatment Plant (WTP)

Permit #3678 Outfall

Non-Permitted Outfall
- Turbidity Curtain

Existing Watercourse

Existing Culvert

Existing CP Rail Ditch

Permit #3678 Discharge Area

Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINNEEN 20190708
PM Review LHARRISON 20190927

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project
Waste Discharge Phase 3
Technical Assessment Report

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Figure No. 4-1
Rev. 1
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Doc No. 01-13283-TW-WT00-EV-RPT-0007

Westridge Marine Terminal Compliance Points and Discharge Locations

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5.0 CLOSURE

The proposed Phase 3 Works at Westridge Marine Terminal require a Major Amendment of Permit #3678 under the Waste Discharge Regulation and Public Notification Regulation of the EMA through the BC ENV. This TAR was prepared on behalf of Trans Mountain to apply for the required Major Amendment of EMA Permit #3678 and was based on BC ENV's March 13, 2019 email addressed to Trans Mountain titled 2019-03-13 AID with Final IRT for WMT Phase 3. Trans Mountain will continue to engage with BC ENV regarding the appropriate Permit terms and conditions for the proposed Works outlined in this Permit amendment application.

We trust that the information summarized in this Report and associated attachments meet BC ENV's requirements for reviewing proposed Phase 3 Works at the Westridge Marine Terminal.



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6.0 REFERENCES

- Alberta Government. 1999. Code of Practice for the Release of Hydrostatic Test Water from Hydrostatic Testing of Petroleum Liquid and Gas Pipelines.
<http://www.qp.alberta.ca/documents/codes/RELEASE.PDF>. Accessed May 2019.
- Appleby, J.P. and D.J. Scarratt. 1989. Physical effects of suspended solids, on marine and estuarine fish and shellfish with special reference to ocean dumping: A Literature Review. *Can. Tech. Rep. Fish. Aquat. Sci.* 1681:v + 33 p.
- Armstrong, J.E. and S.R. Hickock. 1979. Surficial Geology, Vancouver, British Columbia. Geological Survey of Canada, "A" Series Map, Ottawa, ON.
- BC Contaminated Sites Regulation. 2019. *Environmental Management Act* (B.C. Reg. 375/96 including amendments up to B.C. Reg. 13/2019, January 24, 2019).
- BC ENV (British Columbia Ministry of Environment and Climate Change Strategy). 2019. Approved and Working Water Quality Guidelines. Available at:
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines>. Accessed: March 2019.
- BC MOE (British Columbia Ministry of Environment). 2005a. BC Ungulate Winter Range (digital file). Victoria, BC. Available at: <https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: November 2012.
- BC MOE. 2005b. BC Wildlife Habitat Areas (digital file). Victoria, BC. Available at:
<https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: June 2012.
- BC MOE. 2008. Caribou Herd Locations for BC (digital file). Victoria, BC. Available at:
<https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: July 2011.
- BC MOE. 2013. BC Field Sampling Manual. Available at:
https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/bc_field_sampling_manual_complete.pdf. Accessed: July 2019.
- BC MOE. 2016. Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Version 2 – June 2016.
- BC OGC (BC Oil and Gas Commission) 2017. Environmental Protection and Management Guidelines July 2017. Available at: <http://www.bco.gc.ca/node/5899/download>
- BC WQG (British Columbia Approved Water Quality Guidelines). 2018. Aquatic Life, Wildlife and Agriculture. Summary Report. Water Protection & Sustainability Branch, BC Ministry of Environment. 36p. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf.



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References

October 2, 2019

BGC Engineering Inc. (Burnaby Mountain Tunnel Phase II Site Investigation: Westridge Marine Terminal). 2015b. Project no. 0095-150-15. Document no. TMEP15-096. December 2015.

BGC Engineering Inc. (Westridge Tunnel Investigation – 2014 Site Investigation Data Report). 2015a. Revision 1. Project no. 0095150-15. Document no. 0095150.0107. January 2015.

BIEAP (Burrard Inlet Environmental Action Program). 2002. Consolidated Environmental Management Plan for Burrard Inlet. January 2002.

BIEAP-FREMP (Burrard Inlet Environmental Action Program and Fraser River Estuary Management Program). 2012. Annual Report: 2011/2012. Available at: <https://waves-vagues.dfo-mpo.gc.ca/Library/353687.pdf> Accessed: July 2019.

Bird Studies Canada and Nature Canada. 2016. Important Bird Areas of Canada Database. Website: <http://www.ibacanada.com/>. Accessed: July 2019.

Birtwell, I.K., M. Farrell, and A. Jonsson. 2008. The validity of including turbidity criteria for aquatic resource protection in Land Development Guidelines. (Pacific and Yukon Region). Can. Manuscr. Rep. Fish. Aquat. Sci. 2852: xiii + 72 p.

Bureau of the Convention on Wetlands. 2013. The Ramsar Convention Manual, 6th Edition. Available at: <http://www.ramsar.org/sites/default/files/documents/library/manual6-2013-e.pdf>

Burnaby (City of Burnaby). 2014. Engineering Department Design Criteria Manual

BurnabyMap. 2019. City of Burnaby Open Data Portal. Accessed online July 2019: <https://gis.burnaby.ca/burnabymaplite/>

CCME (Canadian Council of Ministers of the Environment). 2019. Water Quality Guidelines for the Protection of Aquatic Life. Available at: https://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html. Accessed: July 2019

Coulson, C.H. (ed.). 1991. Manual of operational hydrology in British Columbia second edition.

deYoung, B. and S. Pond. 1988. The deepwater exchange cycle in Indian Arm, British Columbia. Estuarine, Coastal and Shelf Science 26: 285-306

DFO (Fisheries and Oceans Canada). 1993. Land Development Guidelines for the Protection of Aquatic Habitat. 129 pp. <http://www.dfo-mpo.gc.ca/Library/165353.pdf>.

DFO. 2012. Pacific Region Integrated Fisheries Management Plan: Surf Smelt - April 1, 2012 to December 31, 2014. Website: <http://www.dfo-mpo.gc.ca/Library/343255.pdf>. Accessed: July 2019.

EBA. 2013. Oceanographic Observations at Trans Mountain's Westridge Marine Terminal. EBA Engineering Consultants Ltd. Vancouver, BC.



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References

October 2, 2019

ECCC (Environment and Climate Change Canada). 2016. Canadian Climate Normals. Available at: http://climate.weather.gc.ca/climate_normals/

Government of Canada. 2017. Migratory bird sanctuaries across Canada. Available at: <https://www.canada.ca/en/environment-climate-change/services/migratory-bird-sanctuaries/locations.html>. Accessed: August 2019.

Government of Canada. 2019. Current national wildlife areas. Available at: <https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/locations.html>. Accessed: August 2019.

Hatch, Mott and MacDonald. Inflow during Construction – Rates and Impact – Hydrogeological Modelling Report – Burnaby Mountain Tunnel. KMC Doc # 01-13283-S7-M002-PL-RPT-0012. May 2017.

Hay, D.E. 1985. Reproductive biology of Pacific herring (*Clupea harengus pallasii*). Canadian Journal of Fisheries and Aquatic Science 42 (Suppl. 1): 111-126.

Hume, S. 2009. Herring Spawning Again in False Creek. The Vancouver Sun, Vancouver, BC.

Kumar, M.N.R. 2000. A Review of Chitin and Chitosan Applications. React. Funct. Polym. 46: 1–27.

Metro Vancouver. 2018a. Rainfall data from Metro Vancouver Climate Station BU35.

Metro Vancouver. 2018b. Water – Greater Vancouver Water District 2018 Water Quality Annual Report. Available at: http://www.metrovancouver.org/services/water/WaterPublications/2018_Quality_Annual_Report-Volume1.pdf.

Morgan, J.D., and C.D. Levings. 1989. Effects of suspended sediment on eggs and larvae of lingcod (*Ophiodon elongatus*), Pacific herring (*Clupea harengus pallasii*), and surf smelt (*Hypomesus pretiosus*). Canadian Technical Report of Fisheries and Aquatic Sciences No. 1729. Department of Fisheries and Oceans, Biological Sciences Branch.

MWLAP (Ministry of Water, Land and Air Protection). 2004. Water quality objectives attainment monitoring in Burrard Inlet in 2002. Diane Sutherland, Surrey, BC, July 2004.

NESCO (United Nations Educational, Scientific and Cultural Organization). 2013. Biosphere Reserves. Accessed at: <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/> Accessed: June 2013.

Newcombe, C.P. and J.O. Jensen. 1996. Channel suspended sediments and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4):693-727.



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References

October 2, 2019

- Nijman, R.A. 1990. Ambient water quality objectives for Burrard Inlet Coquitlam-Pitt River area. Overview report. Available at: <http://www.env.gov.bc.ca/wat/wq/objectives/burrard/burrard.html>. Accessed: July 2019.
- PennDOT (Pennsylvania Department of Transportation). 2016. Acid Bearing Rock Policy. Publication 293 Geotechnical Engineering Manual. Chapter 10 – Acid Bearing Rock.
- PICES (North Pacific Marine Science Organization). 2001. Environmental Assessment of Vancouver Harbour Data Report for the PICES Practical Workshop. PICES Scientific Report No. 16, 205pp.
- Pierson, N. 2011. Bridging Troubled Waters: Zooarchaeology and Marine Conservation on Burrard Inlet, Southwest British Columbia. M.A. Thesis, Simon Fraser University, Burnaby, BC. 116 pp.
- Province of British Columbia. 2005. B.C. Reg. 245/2005 Oil and Gas Regulation. Includes amendments to April 1, 2018. Available at http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/32_254_2005. Accessed May 2019.
- Servizi, J.A., and D.W. Martens. 1992. Sublethal response of coho salmon (*Oncorhynchus kisutch*) to suspended sediments. Can. J. Fish. Aquat. Sci. 49: 1389-1395.
- Stacey, D. 1995. Eulachon: a Historical Overview. Common Resources Fishery Research. 79 pp.
- Stacey, M.W., R. Pieters, and S. Pond. 2002. The stimulation of deep water exchange in a fjord: Indian Arm, British Columbia, Canada. American Meteorological Society, October 2012. 13 pp. Available at: <https://journals.ametsoc.org/doi/full/10.1175/1520-0485%282002%29032%3C2753%3ATSODWE%3E2.0.CO%3B2>. Accessed: July 2019.
- Stantec (Stantec Consulting Ltd.). 2013. Marine Resources - Westridge Marine Terminal Technical Report for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project. Available at: <https://apps.cer-rec.gc.ca/REGDOCS/File/Download/2393199>. Accessed: September 2019.
- Stantec (Stantec Consulting Ltd.). 2017. Westridge Marine Terminal Technical Report for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project. Burnaby, BC. 109 pp.
- Thomson, R.E. 1981. Oceanography of the British Columbia Coast, Canadian Special Publication of Fisheries and Aquatic Sciences 56. Department of Fisheries and Oceans. Ottawa, ON. 291 pp.
- Trans Mountain. 2013. Marine Sediment and Water Quality for the Westridge Marine Terminal Report. Available at: <https://docs.neb-one.gc.ca/il-eng/llisapi.dll/open/2393566>
- USDA (United States Department of Agriculture). 2009. Part 630 Hydrology National Engineering Handbook
- USDA. 2018. Soil Texture Calculator. Accessed at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054167



WESTRIDGE MARINE TERMINAL TECHNICAL ASSESSMENT REPORT

References

October 2, 2019

WHSRN (Western Hemisphere Shorebird Reserve Network). 2013. Sites in the Western Hemisphere Shorebird Reserve Network. Website: <https://whsrn.org/whsrn-sites/>. Accessed: July 2019.

Wilber, D.H. and D.G. Clarke. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. *North American Journal of Fisheries Management* 21: 855–875.



APPENDIX A

Westridge Marine Terminal Environmental Protection Plan

VIA ELECTRONIC SUBMISSION

July 20, 2018

National Energy Board
Suite 210, 517 Tenth Avenue S.W.
Calgary, Alberta T2R 0A8

To: Ms. Sheri Young, Secretary, National Energy Board

Dear Ms. Young:

**Re: Trans Mountain Pipeline ULC ("Trans Mountain")
Trans Mountain Expansion Project ("Project")
Westridge Marine Terminal (Phase 1)
Condition 81: Westridge Marine Terminal Environmental Protection Plan
National Energy Board Condition Compliance Letter No. 19**

NEB Condition Compliance Letter No. 19 highlighted an inadvertent omission made in the Westridge Environmental Protection Plan (EPP) Rev 5, filed with the Board in March 2018. That omission has been corrected as per the direction of the Board, and Trans Mountain hereby files the Westridge Marine Terminal EPP Rev 6. The only change in the document from Rev 5 is addition of a sentence in Section 6 and updating of dates as set out in Table 1 below.

TABLE 1: WESTRIDGE MARINE TERMINAL NEB CONCORDANCE TABLE

Section	Sub-heading	Update/Change	Reason
All	--	Updated relevant dates and revision numbers throughout the EPP	Update the WMT EPP
Section 6	<i>Species at Risk or Species of Concern PDF page 14</i>	Added " <i>Report observations of species of concern immediately to an Environmental Inspector</i> "	Letter Report No. 19

Should you have any questions or wish to discuss this matter further, please contact the undersigned at regulatory@transmountain.com or (403) 514-6400.

Yours truly,

Original signed by

Scott Stoness
Vice President, Regulatory and Compliance
Kinder Morgan Canada Inc.



**ENVIRONMENTAL PROTECTION PLANS
VOLUME 4
WESTRIDGE MARINE TERMINAL
ENVIRONMENTAL PROTECTION PLAN
FOR THE
TRANS MOUNTAIN PIPELINE ULC
TRANS MOUNTAIN EXPANSION PROJECT
NEB CONDITION 81**

July 2018

REV 6

687945

01-13283-TW-WT00-EV-PLN-0001

Prepared for:



TRANSMOUNTAIN

Trans Mountain Pipeline ULC

Kinder Morgan Canada Inc.
Suite 2700, 300 – 5th Avenue S.W.
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TABLE OF CONCORDANCE

National Energy Board (NEB) Condition 81 is applicable to the OC-064 (CPCN) legal instrument. Table 1 describes how this Westridge Marine Terminal EPP addresses the Condition requirements applicable to Project activities.

TABLE 1

LEGAL INSTRUMENT CONCORDANCE WITH NEB CONDITION 81

NEB Condition 81	OC-064 (CPCN)
<p>The updated EPP must be a comprehensive compilation of all environmental protection procedures, mitigation measures, and monitoring commitments, as set out in Trans Mountain's Project application, its subsequent filings, or as otherwise committed to during the OH-001-2014 proceeding. The updated plan must describe the criteria for implementing all procedures and measures using clear and unambiguous language that confirms Trans Mountain's intention to implement all of its commitments. The updated EPP must include the following:</p> <p>a) environmental procedures (including site-specific plans), criteria for implementing these procedures, mitigation measures and monitoring applicable to all Project phases and activities;</p>	<p>Environmental procedures, criteria for implementing these procedures, mitigation measures, and monitoring applicable to all Project phases and activities are described throughout this EPP.</p> <p>Site-specific plans are provided in Appendix D of this EPP.</p>
<p>b) policies and procedures for environmental training and the reporting structure for environmental management during construction, including the qualifications, roles, responsibilities, and decision-making authority for each job title identified in the updated EPP;</p>	<p>Section 4.0 of this EPP and the Compliance Management Plan (Volume 10 of the Environmental Plans).</p>
<p>c) any additional measures arising from supplemental pre-construction studies and surveys;</p>	<p>Resource-Specific Mitigation Table (Appendix D of this EPP).</p>
<p>d) updated contingency plans and management plans;</p>	<p>Updated contingency plans are provided in Appendix B of this EPP.</p> <p>Updated management plans are provided in the accompanying Volume 6 of the Environmental Plans.</p>
<p>e) updated facility drawings, including relevant site-specific resources and mitigations;</p>	<p>Appendix E of this EPP.</p>
<p>f) a description of how Trans Mountain has taken available and applicable Aboriginal TLU and TEK into consideration in developing the plan, including demonstration that those Aboriginal persons and groups who provided Aboriginal TLU information and TEK, as reported during the OH-001-2014 proceeding and/or pursuant to Condition 97, had the opportunity to review and comment on the information; and</p>	<p>Section 1.2 and Appendix F of this EPP.</p>
<p>g) a summary of its consultations with Appropriate Government authorities and any potentially affected Aboriginal groups. In its summary, Trans Mountain must provide a description and justification for how Trans Mountain has incorporated the results of its consultation, including any recommendations from those consulted, into the plan.</p>	<p>Appendix F of this EPP.</p>

ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Full Name
the Application	Facilities Application
ATK	Aboriginal Traditional Knowledge
BC	British Columbia
BC MFLNRO	British Columbia Ministry of Forests, Lands and Natural Resource Operations
BC MOE	British Columbia Ministry of Environment
BC OGC	British Columbia Oil and Gas Commission
CMP	Compliance Management Plan
CRA	commercial, recreational and Aboriginal
CSA	Canadian Standards Association
dB	Decibel
DFO	Fisheries and Oceans Canada
EPP	Environmental Protection Plan
ERP	Emergency Response Plan
ESA	Environmental and Socio-Economic Assessment
ESC	Erosion and Sediment Control Plan
GIS	Geographical Information System
GPS	global positioning system
ISLMS	Integrated Safety and Loss Management System
km	Kilometre
KEEP	Knowledge and Experience Enhancement Program
KMC	Kinder Morgan Canada Inc.
MOC	Management of Change
m	Metre
NEB	National Energy Board
<i>NEB OPR</i>	<i>National Energy Board Onshore Pipeline Regulations</i>
RCT	Regulatory and Compliance Team
SARA	<i>Species at Risk Act</i>
TEK	Traditional Ecological Knowledge
the Project	Trans Mountain Expansion Project
the Program	Environmental and Compliance Education Program
TLU	Traditional Land Use
TMEP	Trans Mountain Expansion Project
Trans Mountain	Trans Mountain Pipeline ULC
TSS	total suspended solids
VFPA	Vancouver Fraser Port Authority
WHMIS	Workplace Hazardous Materials Information System
WMT	Westridge Marine Terminal
WQM	water quality monitoring

GLOSSARY

Term	Definition
air quality	A measure of the chemical pollutant loading in the atmosphere. As a measure or metric, it is generally related to human health endpoints, odour thresholds or environmental effects that are developed and regulated by municipal, provincial or federal government authorities. Ambient air quality objectives or standards have been developed to reflect the more stringent effect and measured or predicted levels are commonly compared to these values as a gauge of compliance as well as the degree of quality of the air.
Appropriate Government Authorities	The regulators and relevant government authorities that are to be consulted prior to and during construction regarding approvals, notifications, constraints and the direction of activities.
berthing dolphins	A group of steel piles that form a vessel berth structure.
borrow material	Imported, non-native soil, aggregate or consolidated materials that are used during construction.
construction footprint	This area comprises the permanent facility footprint and temporary workspace that is disturbed during construction.
circular sheet pile wall	Circular structures made of sheet piles placed in a vertical configuration down to the substrate and linked together to form circular cells. The ground inside the cells will have ground improvement measures implemented to meet seismic design requirements.
Contractor	The main company contracted for the construction coordination, supervision and completion of the Westridge Marine Terminal component of the Trans Mountain Expansion Project.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
development zone	The area located within the facility footprint, where facility infrastructure is located.
<i>Environment, Health and Safety Policy</i>	Kinder Morgan Canada Inc.'s <i>Environment, Health and Safety Policy</i> , which has been adopted by Trans Mountain. This is the formalization of Trans Mountain's commitment to conduct business in a safe and environmentally responsible manner.
Environmental and Compliance Education Program	An Environmental and Compliance Education Program (the Program) has been designed to ensure that all Project personnel have adequate knowledge of environmental protection and mitigation measures, as well as the Compliance Management Plan. The Program ensures that work is conducted in accordance with all applicable legal requirements, regulations, permits, approval Conditions, and all commitments made by Trans Mountain.
environmental feature	An environmental feature includes rare plants and rare ecological communities, wildlife species at risk, species of concern, wildlife habitat, archaeological features, TLU sites and any other sensitive environmental or cultural features.
feasible	Capable of being reasonably accomplished or brought about given environmental and economic considerations.
Health, Safety and Environment Policy	The formalization of Trans Mountain Pipeline ULC's commitment to conduct business in a safe and environmentally responsible manner supported through a series of commitments.
high tide	The state of the tide at its highest level.
hydrostatic testing	The use of water for hydrostatic testing facility piping in order to expose potential defects or leaks and to ensure integrity.
Kinder Morgan Canada Inc.	Kinder Morgan Canada Inc. is a corporation owned by Kinder Morgan Inc. Kinder Morgan Canada Inc. operates Trans Mountain Pipeline L.P., a general partner of Trans Mountain Pipeline ULC.
low tide	The state of the tide at its lowest level.
Lower Mainland Region	The geographic area located approximately west of Hope, British Columbia to Vancouver, British Columbia.
merchantable timber	Timber that will be salvaged and meets the minimum salvage specifications.
mitigation measures	Mean measures for the elimination, reduction or control of a project's adverse environmental effects, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means.
mooring dolphins	A group of steel piles used as a point to moor vessels.
National Energy Board	An independent federal agency established in 1959 by the Parliament of Canada to regulate international and interprovincial pipelines and associated facilities.
Noxious weeds	A plant designated in accordance with the regulations as a Noxious weed, which includes the plant's seeds; a person shall control a Noxious weed that is on land in which the person owns or occupies (<i>Weed Control Act</i>).
onshore	The area of land extending back from the high tide mark.
Vancouver Fraser Port Authority	A non-shareholder, financially self-sufficient Crown corporation established by the Government of Canada in January 2008, pursuant to the <i>Canada Marine Act</i> , and accountable to the federal Minister of Transport. It is the principal authority for shipping and port-related land and sea use in the Metro Vancouver region.
practical	Capable of or suitable to being put into effect, given environmental and economic considerations.
root zone material	The upper layer of soil in non-agricultural areas.
species of concern	Refers to wildlife species that have increased potential to be affected by Project activities due to spatial or temporal overlap with the Project during sensitive life stages and therefore have identified setbacks and timing windows.
shoreline	The line along which a large body of water (e.g., ocean inlet) meets the land.
species at risk	Refers to wildlife species listed as Special Concern, Threatened or Endangered on Schedule 1 of the <i>SARA</i> and/or by the Committee on the Status of Endangered Wildlife in Canada, and Red or Blue-listed in BC or listed under the BC <i>Wildlife Act</i> . Species at risk also include vegetation as defined in the Rare Ecological Community and Rare Plant Population Management Plan (Volume 6 of the Environmental Plans) for the purpose of this EPP.
topsoil	The upper layer of soil, usually the top 10-40 cm in agricultural areas. It has the highest concentration of organic matter and micro-organisms and is distinct from subsoil usually by colour.
warranted	Justify or necessitate a course of action.

Term	Definition
Westridge Marine Terminal	Trans Mountain-owned marine loading facility located within Burrard Inlet and the Vancouver Fraser Port Authority that can accommodate ships up to 120,000 deadweight tonnes and barges. The Westridge Marine Terminal has been in operation since 1957.
Westridge Marine Terminal Environmental Facility Drawing	A map noting the locations of select environmental features that are encountered by the construction of the Westridge Marine Terminal, associated potential issues and recommended mitigation measures.

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1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) submitted a Facilities Application (the Application) to the National Energy Board (NEB) in December 2013 for the Trans Mountain Expansion Project (the Project or TMEP). The Application included a draft Environmental Protection Plan (EPP) to address Project activities at the Westridge Marine Terminal (WMT), which includes terrestrial and marine infrastructure and staging areas. This updated WMT EPP (Volume 4 of the Environmental Plans) was prepared to address the requirements of NEB Condition 81. A draft of the updated WMT EPP was submitted to Appropriate Government Authorities and potentially affected Aboriginal groups on November 17, 2016 for review. Feedback was requested by February 24, 2017. Trans Mountain incorporated any feedback into the final WMT EPP or has provided rationale for why input has not been included, as summarized in Appendix F.

The WMT EPP (Volume 4 of the Environmental Plans) is applicable to the new dock complex, as well as a utility dock at WMT, as described above, as well as land-based work at WMT. Tunneling between Burnaby Terminal and the WMT will take place and is covered under the Burnaby Mountain Tunnel EPP (Volume 9 of the Environmental Plans). The WMT EPP is based on:

- Kinder Morgan Canada Inc.'s (KMC's) Integrated Safety and Loss Management System (ISLMS) as required by the *National Energy Board Onshore Pipeline Regulations (NEB OPR)*;
- Volumes 5A and 5B of the Environmental and Socio-Economic Assessment (ESA) filed for the Project;
- results of the biophysical and engineering field programs completed to date;
- feedback obtained through engagement;
- Traditional Ecological Knowledge (TEK)/Traditional Land Use (TLU) information;
- Trans Mountain's commitments made in the ESA, to Appropriate Government Authorities and to the public;
- industry standard and best management documents; and
- professional experience based upon over 30 years of pipeline and facility planning in Western Canada.

Construction at the WMT will occur over at least 2 years during both summer and winter seasons. A summary of the WMT construction schedule is provided in EB Condition . Figure 1.1-1 illustrates the regional location of the WMT.

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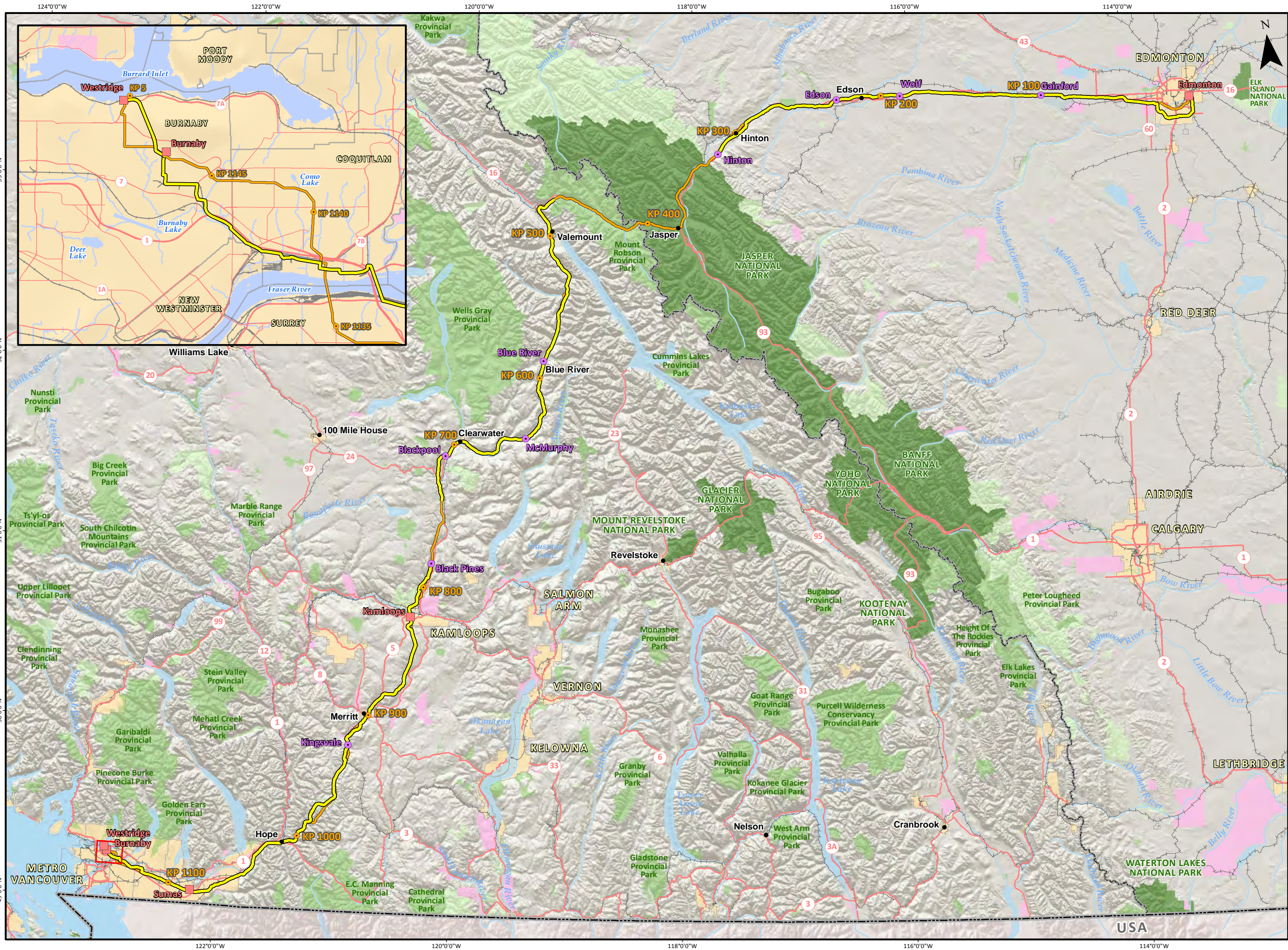


FIGURE 1.1-1
PROJECT OVERVIEW
ALBERTA AND BRITISH COLUMBIA
TRANS MOUNTAIN
EXPANSION PROJECT

- TMPL Kilometre Post (KP)
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Pipeline (TMEP)
- Existing Pump Station
- Terminal
- Highway
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- National Park
- Provincial Park
- Protected Area / Natural Area / Provincial Recreation Area / Wilderness Provincial Park / Conservancy Area
- Provincial Boundary
- International Boundary

Projection: Modified LCC.
Proposed Centreline SSE10005, provided by UPI Jan 10, 2017; Baseline TMPL Route Revision 0, provided by KMC, May 2012; Facilities provided by KMC December 2016; Transportation: NRCan 2015, BC MFLNRO 2012 & NRCan 2012; Geopolitical Boundaries: NRCan 2003, AltaUS 2016, BC MFLNRO 2007 & ESRI 2005; First Nation Lands: Government of Canada 2016, AltaUS 2010; Hydrology: NRCan 2010, IHS Inc. 2004 & BC MFLNRO 2008; Parks and Protected Areas: NRCan 2016, AltaUS 2012, ATPR 2012 & BC MFLNRO 2008; Canadian Hillshade: TERA Environmental Consultants, 2008; US Hillshade Copyright: © 2014 Esri.

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Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.



MAP NUMBER	201509_MAP_CH2M_GEN_00796_REV4	PAGE	SHEET 1 OF 1
DATE	April 2017	CH2M REF.	687945
SCALE	1:2,250,000	PAGE SIZE	11x17
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DISCIPLINE	GEN	DESIGN	TGG

0 25 50 75 100 km
ALL LOCATIONS APPROXIMATE

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1.1 Purpose

The purpose of this EPP is to communicate Trans Mountain's environmental procedures and mitigation measures to construction and inspection personnel in a clear, concise format. These potential mitigation measures are to be implemented, where warranted, during construction of the WMT to mitigate, avoid or reduce potential adverse environmental effects during construction of the Project.

Specifically, the WMT EPP:

- identifies mitigation measures to be implemented during Project construction activities;
- provides recommendations for carrying out construction activities in a manner that will avoid or reduce adverse environmental effects; and
- serves as reference information to support the decision-making process and provides direction to more detailed information (*i.e.*, resource-specific mitigation and management and contingency plans).

The current revision of the WMT EPP is an update required by NEB Condition 81. This updated WMT EPP is intended to be a comprehensive compilation of all environmental protection procedures, mitigation measures and monitoring commitments, as set out in Trans Mountain's Application, its subsequent filings, or as otherwise committed to during the NEB proceedings. Trans Mountain confirms its intention to implement all of its commitments pursuant to NEB Conditions 2 and 6.

1.2 Traditional Ecological Knowledge and Traditional Land Use

Aboriginal Traditional Knowledge (ATK) is typically documented as a means to preserve historical and familial connections, territorial occupation, land and resource use and temporal execution strategies. ATK includes, but is not limited to, the collection of TEK during biophysical field survey participation for the Project and TLU study information from potentially affected Aboriginal groups. Preliminary background ATK data was compiled for the Application and was consulted during the development of the NEB Condition Plans, which helped determine the mitigation measures included in the WMT EPP. The following sources were used:

- publicly available ATK, TEK and TLU reports;
- open houses and community gatherings;
- meetings and conversations with Aboriginal community representatives;
- a public record of comparable past projects or previous environmental assessments;
- published reports from regulatory authorities involved in administering or regulating a specified area or resource (*e.g.*, integrated resource plans, land and resource management plans, etc.); and
- Geographical Information System (GIS) tools to determine spatial relationships of source data to the Project.

TEK was collected during biophysical field surveys conducted for the Project. Trans Mountain has reviewed information provided in TLU reports from participating Aboriginal groups and traditional knowledge. Trans Mountain will continue to take available and applicable Aboriginal TLU and TEK into consideration in developing the WMT EPP and other NEB Condition Plans. TEK and TLU information collected is provided in the relevant NEB Condition Plans. Trans Mountain has incorporated available Aboriginal TLU and TEK into this updated WMT EPP, where appropriate.

2.0 ENVIRONMENTAL PROTECTION PLAN ORGANIZATION

This section provides an overview of the organization and scope of the WMT EPP.

2.1 Organization

The WMT EPP identifies the mitigation measures that may be implemented during pre-construction, construction and post-construction activities at the WMT, as well as contingency plans to address potential effects, events or conditions that may arise during construction. Management Plans (see Volume 6 of the Environmental Plans) will describe the specific environmental management procedures that may apply to ongoing, planned events associated with construction. The WMT EPP applies to the WMT, which includes terrestrial and marine infrastructure, as well as staging areas required to support construction of the WMT.

Environmental mitigation measures are identified under the heading "Measures" by "Activity/Concern" in accordance with the progression of construction activities and are intended to be read in conjunction with the WMT Environmental Facility Drawing (see Appendix E of this EPP). The WMT Environmental Facility Drawing and the Resource-Specific Mitigation Table (see Appendix D of this EPP), identify specific locations where mitigation measures are to be implemented at the WMT.

The WMT EPP provides:

- an understanding of the general environmental and socio-economic background of the facility site;
- the extent and limitations of the WMT EPP;
- information to identify specific or unique mitigation measures to be implemented to address environmental and socio-economic issues associated with the WMT; and
- general mitigation measures or industry-accepted standards and procedures that are typically applied during marine terminal construction; these measures are generally provided in accordance with the sequence of construction of a marine terminal.

This version of the WMT EPP comprises the following sections and Appendices:

- **Section 1.0 Introduction** provides an introduction to the WMT EPP and outlines the purpose.
- **Section 2.0 EPP Organization** provides details on the layout and general scope of the WMT EPP.
- **Section 3.0 Consultation and Engagement** provides details on the program conducted for the Project in relation to the WMT EPP, pursuant to NEB Condition 81.
- **Section 4.0 Environmental Compliance** provides information regarding the tools, decision-making processes and documentation to facilitate compliance with all legislation, regulatory approvals, permits, commitments and the specific requirements set forth in the WMT EPP.
- **Section 5.0 Notification of Interested Parties** provides details regarding specific activities to be followed to ensure that all Appropriate Government Authorities, potentially affected Aboriginal groups, landowners and applicable interested parties are properly notified prior to commencing construction activities at the WMT or, as warranted, during the construction period.
- **Section 6.0 General Measures** provides an overview of the mitigation measures that may be implemented to avoid or reduce potential adverse environmental effects associated with any or all phases of general terrestrial and marine construction activities at the WMT.
- **Section 7.0 Terrestrial Construction** outlines the mitigation measures that may be implemented during construction in terrestrial environments associated with the WMT, including surveying, clearing, access, topsoil handling and grading.

- **Section 8.0 Marine Construction** outlines the mitigation measures that may be implemented to avoid or reduce potential adverse environmental effects associated with the marine component of the WMT construction activities.
- **Section 9.0 Clean-Up and Reclamation** outlines mitigation measures that may be implemented for construction clean-up and reclamation at the WMT.
- **Section 10.0 WMT Testing** outlines the mitigation measures that may be implemented during air and hydrostatic testing at the WMT.
- **Section 11.0 References** lists the sources and reference material used to create the mitigation measures and strategies provided in the WMT EPP.
- **Appendices** to the WMT EPP are as follows.
 - Appendix A of this EPP (Contacts) provides general contact information of Project representatives and Appropriate Government Authorities that are to be consulted and or contacted during construction activities at the WMT. The Prime Contractor will provide emergency contact information in the site-specific Emergency Response Plan (ERP) for WMT.
 - Appendix B of this EPP (Contingency Plans) provides contingency measures that may be implemented to mitigate potential environmental effects that may occur (but are not anticipated to occur) during construction activities.
 - Appendix C of this EPP (Drawings/Details) illustrate and describe general mitigation outlined in the WMT EPP.
 - Appendix D of this EPP (Resource-Specific Mitigation Table) details known environmental features and recommended mitigation measures at the WMT.
 - Appendix E of this EPP (WMT Environmental Facility Drawing) illustrates environmental considerations at the WMT construction site.
 - Appendix F of this EPP (Consultation and Engagement) contains a summary of the consultation efforts completed by Trans Mountain for the Project.
 - Appendix G of this EPP (Aboriginal Groups Engaged on the WMT EPP) contains a summary of the Aboriginal groups engaged on this EPP.
 - Appendix H of this EPP (Marine Water Quality Management Plan during Rip Rap Removal) provides a summary of the water quality measures to be implemented during rip rap removal at the WMT.

3.0 CONSULTATION AND ENGAGEMENT

Consultation and engagement activities related to the mitigation measures in the WMT EPP were conducted between May 2012 and February 2017 with Appropriate Government Authorities and potentially affected Aboriginal groups. Opportunities to discuss the WMT construction and issues or concerns were provided to public stakeholders through online information, workshops, meetings and ongoing engagement activities during the reporting period. Appendix F includes a comprehensive record of these engagement activities, stakeholder feedback and Trans Mountain responses.

The draft of the updated WMT EPP was released on November 17, 2016 for review. Feedback was requested by February 24, 2017. Trans Mountain incorporated any feedback into the final WMT EPP or has provided rationale for why input has not been included, as summarized in Appendix F.

4.0 ENVIRONMENTAL COMPLIANCE

Environmental compliance is facilitated through sharing of information, providing orientation/training, retaining qualified personnel and providing on-site inspection of activities through a proactive and adaptive inspection program.

Trans Mountain has developed a Compliance Management Plan (CMP) (Volume 10 of the Environmental Plans) (to support the construction execution plan and to ensure full compliance with all applicable legal requirements, regulations, permits, approval conditions and commitments made by Trans Mountain. In addition, an Environmental and Compliance Education Program (the Program) has been designed to ensure that all Project personnel are trained and aware of roles and responsibilities, as well as imparting critical information regarding environmental protection, mitigation and compliance requirements. A description of the Program was previously found in Section 4.3 of this WMT EPP, and has now been relocated to Section 4.2 of the CMP (Volume 10 of the Environmental Plans). Roles and responsibilities can be found in Section 1.0 and Appendix A of the CMP (Volume 10 of the Environmental Plans) (previously found in Section 4.4 of this WMT EPP) and the Project Organizational Structure prepared to meet NEB Condition 88 (Section 1.0 of Volume 6 of the Environmental Plans).

As part of the CMP, Trans Mountain established the ISLMS pursuant to Section 6 of the 2013 *NEB OPR*. The NEB expects that companies have effective management systems and protection programs that provide for continual improvement. The management system must apply to all of the company's activities, including the design and construction of a pipeline. The ISLMS outlines KMC's commitment to establishing, implementing and monitoring processes and controls to ensure that it is conducting business in a safe, environmentally responsible and sustainable manner. ISLMS describes how the company operates in a way that minimizes risk to its employees, Contractors, the public and the environment throughout the life cycle of the Project. Information of the ISLMS was previously found in Section 4.2 of the WMT EPP, but has been relocated to Section 1.0 of the CMP (Volume 10 of the Environmental Plans).

During the course of construction, it may be necessary to modify or create new procedures to address site conditions not previously identified in the WMT EPP. Field-based decision-making and Project approved contingency plans will be implemented to address unexpected conditions, as described in Field Level Environmental Change Management in Section 4.4 of the CMP. Section 2.7 of the CMP includes the Management of Change (MOC) processes, which outline the process for the development or modification of procedures, if changes cannot be managed at the field level. Information for the MOC processes was previously found in Section 4.7 of the WMT EPP, but has been relocated to Section 2.7 of the CMP (Volume 10 of the Environmental Plans).

4.1 Potential Permits, Approvals and Authorizations

While these tables are comprehensive, they are not exhaustive and additional permits may be required. Hard copy permits, approvals and authorization binders will be assembled with the applicable documents on file and will remain at the construction offices throughout the construction and commissioning phases of the Project.

TMPL is regulated by the NEB, a fully independent agency of the Government of Canada. As an NEB federally-regulated entity, TMPL requires approval from the NEB prior to the construction of TMEL. TMPL also complies with all ancillary legislation, unless it conflicts with or frustrates federal legislation, in which case, TMPL will comply with federal legislation, as ultimately determined by the NEB.

TABLE 4.1-1

**POTENTIAL FEDERAL ENVIRONMENTAL PERMITS AND
APPROVALS THAT MAY BE REQUIRED FOR TERMINAL CONSTRUCTION**

Regulatory Authority	Legislation	Permit, Approval, Authorization and/or Notification	Activity/Trigger
NEB	Section 52 of the <i>NEB Act</i>	<ul style="list-style-type: none"> Certificate of Public Convenience and Necessity 	<ul style="list-style-type: none"> Facility construction
Canadian Transportation Agency	<i>Railway Relocation and Crossing Act</i>	<ul style="list-style-type: none"> Crossing Permit 	<ul style="list-style-type: none"> Approval to cross railways with access roads and power lines
Environment and Climate Change Canada	<i>Species at Risk Act (SARA)</i>	<ul style="list-style-type: none"> Permit pursuant to Section 73 of the <i>SARA</i> 	<ul style="list-style-type: none"> Activities that affect (i.e., kill, harm, harass and/or capture) a species listed on Schedule 1 of <i>SARA</i> as endangered or threatened (including wildlife and fish species) and its critical habitat or residence
	<i>Migratory Birds Convention Act, 1994</i>	<ul style="list-style-type: none"> Migratory Bird Damage or Danger Permit 	<ul style="list-style-type: none"> Installation and use of permanent deterrent devices to prevent birds from nesting in areas that could cause damage or danger to infrastructure, or injury to the birds themselves.
Fisheries and Oceans Canada (DFO)	<i>Fisheries Act</i> , Section 35(2)	<ul style="list-style-type: none"> Case-specific request for review; may trigger a Request for Authorization 	<ul style="list-style-type: none"> Authorization required if construction will result in serious harm to fish that are part of, or support, a commercial, recreational, or Aboriginal fishery
	<i>Canadian Shipping Act</i> and <i>Safety of Life at Sea Convention</i>	<ul style="list-style-type: none"> Notification as per <i>Canadian Shipping Act</i> and <i>Safety of Life at Sea Convention</i> 	<ul style="list-style-type: none"> Marine Communications and Traffic Services oversight of marine traffic within Canadian jurisdiction (DFO)
Industry Canada	<i>Radiocommunication Act</i>	<ul style="list-style-type: none"> Radio Licence 	<ul style="list-style-type: none"> Radio communication
Vancouver Fraser Port Authority (VFPA)	<i>Canada Marine Act</i>	<ul style="list-style-type: none"> Project Permit Building Permit Water Lease Expansion 	<ul style="list-style-type: none"> Approval for new structures on water or land including modifications to existing structures
Transport Canada	<i>Canada Shipping Act</i>	<ul style="list-style-type: none"> An act respecting shipping and navigation 	<ul style="list-style-type: none"> Ensure compliance of vessels with relevant marine regulations

TABLE 4.1-2

POTENTIAL PROVINCIAL ENVIRONMENTAL PERMITS, APPROVALS AND AUTHORIZATIONS

Regulatory Authority	Permit, Approval, Authorization and/or Notification
British Columbia (BC) Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO)	<ul style="list-style-type: none"> <i>Heritage Conservation Act</i> permits (e.g., Heritage Alteration Permit [Section 12] and Heritage Inspection Permit – Clearance and Fossil Resource Permit). Scientific Fish Collection Permit.
BC Ministry of Transportation and Infrastructure	<ul style="list-style-type: none"> Various permits under the <i>Transportation Act</i>, including: <ul style="list-style-type: none"> Sign Permit; Structure Permit; Work Notification or Land Closure Request Permit; Clearing and Grubbing Permit; and Revegetation Permit. Various permits under the <i>Industrial Roads Act</i>, including: <ul style="list-style-type: none"> Highway Access Permit; Controlled Highway Access Permit; and Access/Road Construction within Right-of-Way. Commercial Vehicle Permit under the <i>Commercial Transport Act</i>.
BC Ministry of Environment (BC MOE)	<ul style="list-style-type: none"> Section 14 Permit under the BC <i>Environmental Management Act</i> for the introduction of waste into the environment. Section 7 Waste Discharge Permit under the <i>Waste Discharge Regulation</i> for testing and disposing of test water with additives.

5.0 NOTIFICATION OF INTERESTED PARTIES

Notification of the construction schedule and timing of specific construction activities will facilitate awareness of upcoming activities and allow Appropriate Government Authorities and potentially affected Aboriginal groups to plan, as appropriate, for construction activities in the area of interest. The following measures will be implemented by Trans Mountain, the Contractor and/or the subcontractor to ensure notification of interested parties in advance of, and during, construction of facilities and access roads. Notifications will be coordinated with the Trans Mountain Stakeholder Engagement and Communications Team and will reflect the commitments outlined in the VFPA Permit. Regulatory notifications and permit applications will be coordinated with the Trans Mountain Regulatory and Compliance Team (RCT).

Objective

The objective of notification of interested parties is to ensure:

- work adheres to applicable approval conditions;
- interruptions to other marine activities (*i.e.*, recreational operators and commercial activity) are limited during construction of the WMT;
- applicable interested parties are aware of construction activities at WMT; and
- Appropriate Government Authority representatives are kept informed throughout construction at the WMT.

Contacts	Notification Measures
<i>Federal Authorities</i>	<ol style="list-style-type: none"> 1. Notify the NEB, as per NEB Condition 62, of the anticipated construction schedule identifying the major construction activities expected and, on a monthly basis, on the first working day of each calendar month from the commencement of construction until after commencing operations, provide updated detailed construction schedules. 2. Submit monthly construction progress reports to the NEB as per NEB Condition 106, from commencement of construction until after commencing operations. Monthly reports are to include any environmental issues and non-compliance that occurred, and measures undertaken to resolve these environmental issues and non-compliance. 3. Notify VFPA of the anticipated construction schedule (see Appendix A of this EPP). Adhere to VFPA Permit advance notice requirements. Contact will be maintained until Project completion. 4. Notify DFO prior to the commencement of marine works. Refer to the <i>Fisheries Act</i> Authorization to determine the advance notice required by DFO. 5. Conduct hydrostatic testing activities in accordance with the <i>NEB OPR</i>, provincial legislation, Transport Canada's Minor Works for Water Intakes (Transport Canada 2009) as well as the latest version of Canadian Standards Association (CSA) Standard Z662 (CSA 2015) and the <i>Waste Discharge Regulation</i>, BC Reg. 320/2004. 6. Ensure that the necessary notifications are provided for applicable permits that must be obtained prior to beginning activities. A list of the potential federal permits, approvals and authorizations is provided in Table 4.1-1. Additional permits beyond those listed in Table 4.1-1 may be required.

Contacts	Notification Measures
<i>Provincial Authorities</i>	<p>7. Notify the BC Environmental Assessment Office prior to entry on Crown lands in BC, as required.</p> <p>8. A notice of Construction Start must be submitted to the BC Oil and Gas Commission (BC OGC), 48 hours prior to equipment arriving on location.</p> <p>9. Follow the applicable requirements outlined in the <i>Waste Discharge Regulation</i> (BC MOE 2004) before, during and after the discharge of hydrostatic test fluid to land.</p> <p>10. Ensure that the necessary notifications are provided for applicable permits that must be obtained prior to beginning activities. A list of the potential provincial permits, approvals and authorizations is provided in Table 4.1-2. Additional permits beyond those listed in Table 4.1-2 may be required.</p>
<i>Government Authority Liaison</i>	<p>11. Inform all appropriate federal (e.g., Health Canada, Industry Canada, Environment Canada, the NEB and DFO), provincial (e.g., BC Parks, BC OGC and BC MFLNRO) and municipal resource agencies of the Project developments, as warranted. Regular liaison with government representatives (e.g., the NEB, DFO, BC OGC and BC Parks) during construction will be the responsibility of the Trans Mountain Environmental Manager, the Senior Compliance Advisor, or designate.</p>
<i>Aboriginal Groups</i>	<p>12. Provide Aboriginal groups with the anticipated construction schedule and facility location maps, and install signage notifying of construction activities in the area, a minimum of 4 weeks prior to the commencement of construction in the vicinity of their respective communities.</p>
<i>Project Notice</i>	<p>13. Provide notification to residents of construction within urban areas through methods determined in collaboration with municipal and regional authorities.</p> <p>14. Provide Project contact information to residents, land users and Aboriginal groups for management of construction-related concerns.</p> <p>15. Install signs at secondary road access points and within the vicinity of construction activities near secondary roads and highways to notify land users of construction activities.</p>
<i>Construction Schedule Change</i>	<p>16. Review the individuals and groups that were initially notified of the construction schedule and notify of any changes in the construction schedule.</p>
<i>Water Users</i>	<p>17. Notify appropriate authorities and licensees, if required by Section 10 of the <i>Water Sustainability Act</i> (in BC) requirements, prior to withdrawing water for hydrostatic testing from sources other than city or municipal water supply.</p>
<i>Marine Operators</i>	<p>18. Notify marine commercial and recreational operators of the hazards associated with construction in accordance with NEB guidelines or approval conditions. Place warning signs (e.g., Warning - Construction in the Vicinity) in terrestrial and marine environments, near construction activities. Follow conditions of permit approvals granted by the NEB.</p> <p>19. Notify appropriate regulatory authorities and licensees and/or distribute a notification to the shipping industry in order to advise commercial and recreational marine operators of the Project schedule and construction activities at the WMT.</p>

Note: - See Appendix A of this EPP for Emergency and Project contact lists.

6.0 GENERAL MEASURES

Introduction

The mitigation measures provided in this section may be applicable either through various phases, or for the duration of, construction at the WMT. These general measures will be implemented, as warranted, by Trans Mountain, its Contractors and subcontractors prior to the commencement construction activities, and will be followed by detailed specifications for each phase of the WMT construction.

Objective

The objective of the following mitigation measures is to avoid or reduce potential adverse environmental effects associated with general terrestrial and marine construction activities at the WMT. Construction will be completed in a manner that avoids or reduces adverse effects on residents in the area, marine users, as well as socio-economic and environmental resources. Refer to the Socio-Economic Management Plan (within NEB Condition 72) for broad mitigation measures related to socio-economic effects and reference to Plans that contain more specific mitigation on socio-economic matters. Refer to the Socio-Economic Effects Monitoring Plan prepared for NEB Condition 13 for the monitoring approach and Project-specific indicators related to select socio-economic effects. Contractor requirements pertaining to worker accommodation during construction and further details on the worker code of conduct can be found in the Worker Accommodation Strategy prepared for NEB Condition 59. These plans are contained in Section 2.0 of Volume 6 of the Environmental Plans.

Activity/Concern	Mitigation Measures
<i>Review Mitigation Measures for Environmental Features</i>	<ol style="list-style-type: none">1. The Environmental Inspector will review mitigation measures to be implemented during construction to avoid or reduce effects on environmental features or cultural features on or in proximity to the facility site. This review will be conducted in advance of construction at known locations where any of the above features are known to be present to ensure that suitable and appropriate procedures have been selected and can be implemented prior to construction where applicable.2. An Environmental Inspector is responsible for monitoring compliance with environmental and socio-economic commitments, undertakings and conditions of permits and approvals, as well as applicable environmental legislation and Trans Mountain's policies, procedures, and industry-accepted standards. An Environmental Inspector may designate responsibility for environmental and socio-economic compliance monitoring in certain cases based on the nature of the activity and the availability of appropriate alternative personnel (e.g., Activity Inspector) (see the Compliance Management Plan in Volume 10 of the Environmental Plans).

Activity/Concern	Mitigation Measures
<i>Review Mitigation Measures for Environmental Features (cont'd)</i>	<ol style="list-style-type: none"> 3. An Environmental Inspector will organize on-site meetings in consultation with the Construction Manager or designate to address any resource-specific issues, and to review construction methodologies (see the Compliance Management Plan in Volume 10 of the Environmental Plans). 4. An Environmental Inspector will review, collect, organize and disseminate all environmentally-related information and documentation that arises during construction, and will be responsible for the preparation of daily Environmental Inspection reports (see the Compliance Management Plan in Volume 10 of the Environmental Plans). 5. Environmental information (e.g., erosion concerns or natural drainage patterns) will be collected by a qualified professional throughout construction for documentation and the assessment of effectiveness of procedures/measures used to aid or inform the decision-making process post-construction (see the Compliance Management Plan in Volume 10 of the Environmental Plans). 6. The Environmental Inspector will document construction methods, decisions related to implementation and location of mitigation measures, final reclamation measures and issues encountered. as the Environmental Inspector will also maintain communication records for discussion with BC MFLNRO or other regulatory agencies. 7. Refer to the environmental Resource-Specific Mitigation Table (see Appendix D of this EPP) and the Environmental Facility Drawing (see Appendix E of this EPP).
<i>Species at Risk or Species of Concern</i>	<ol style="list-style-type: none"> 8. Where species at risk or species of concern are discovered during future vegetation, aquatics and wildlife habitat studies, or during construction the facilities, implement the applicable Management Plan in Volume 6 of the Environmental Plans and Contingency Plans (see Appendix B of this EPP). 9. Ensure that sighting records for species at risk are provided to an Environmental Inspector. Records will be maintained and made available for reporting to applicable regulatory agencies (e.g., BC Conservation Data Centre). 10. Refer to the environmental Resource-Specific Mitigation Table for aquatics, vegetation and wildlife species at risk or their habitats provided in Appendix D of this EPP. Ensure that all mitigation measures concerning species at risk are communicated to the Contractor and enforced by an Environmental Inspector. 11. Suspend activity if previously unidentified species at risk or species of concern are encountered on the work site during construction. Implement the following plans as appropriate: <ul style="list-style-type: none"> • Rare Ecological Communities or Rare Plant Species of Concern Discovery Contingency Plan (see Appendix B of this EPP); • Wildlife Conflict Management Plan (see Section 6.5 of Volume 6 of the Environmental Plans); and • Wildlife Species of Concern Encounter and Discovery Contingency Plan (see Appendix B of this EPP).

Activity/Concern	Mitigation Measures
<i>Species at Risk or Species of Concern (cont'd)</i>	<p>12. Report observations of species of concern immediately to an Environmental Inspector.</p> <p>13. Implement the appropriate vegetation management measures in consideration of species at risk and their habitat (e.g., restrict vegetation management to the minimum width required for the safe operation and inspection of the WMT, and allow vegetation outside of this area to regenerate).</p> <p>14. Minimize the use of herbicides. Consider non-chemical options as the primary method to manage non-woody problem vegetation (e.g., mowing or hand pulling). When non-chemical vegetation management options are not practical (e.g., invasive plant removal) utilize spot treatment applications of herbicides as necessary.</p>
<i>Wildlife (Terrestrial or Marine)</i>	<p>15. Follow the measures outlined in the Bald Eagle Nest Management Plan: WMT and outlined in Section 7.2 for mitigation measures to be implemented prior to construction.</p> <p>16. Complete migratory bird nest sweeps as necessary prior to construction if construction is initiated during the migratory bird nesting period of March 26 to August 16 (Environment and Climate Change Canada [ECCC, 2017]).</p> <p>17. Clear areas of vegetation outside of the migratory bird nesting period to reduce the risk of migratory birds nesting on the construction site where work is scheduled to occur during the migratory bird nesting period.</p> <p>18. In the event that clearing or construction activities are scheduled to commence within the migratory bird nesting period, consult with a Wildlife Resource Specialist to determine the need to conduct a non-intrusive area search for evidence of nesting (e.g., presence of territorial males, alarm calls, distraction displays and adults carrying nesting material/food). Searches for evidence of nesting should occur within 7 days prior to the construction activity. In the event that there are extended periods of inactivity between construction activities during the migratory bird nesting period (i.e., a period greater than 7 days), consult with an Environmental Inspector regarding the potential need for follow-up searches for evidence of nesting.</p> <p>19. In the event that an active nest is found, it will be subject to site-specific mitigation measures (e.g., clearly marked species-specific buffer around the nest or non-intrusive monitoring). The appropriate mitigation measures will be selected by an Environmental Inspector, in consultation with a Wildlife Resource Specialist (see also the Wildlife Species of Concern Encounter and Discovery Contingency Plan provided in Appendix B of this EPP).</p> <p>20. Discuss wildlife issues that are identified during construction, as necessary, with an Environmental Inspector, a Wildlife Resource Specialist and the appropriate regulatory authority representatives, as directed in the Wildlife Species of Concern Encounter and Discovery Contingency Plan (see Appendix B of this EPP). Refer to the environmental facility drawings provided in Appendix E of this EPP.</p> <p>21. Adhere to the measures in the Noise Management Plan for Construction at Terminals and Pump Stations (Section 10.0 of Volume 6 of the Environmental Plans) to limit the duration of sensory disturbance to wildlife.</p>

Activity/Concern	Mitigation Measures
<i>Wildlife (Terrestrial or Marine) (cont'd)</i>	<p>22. Implement the Wildlife Species of Concern Encounter and Discovery Contingency Plan (see Appendix B of this EPP) in the event of an encounter with wildlife during construction, either at the construction site or on the commute to or from the construction site. Report any incidents or collisions with wildlife to an Environmental Inspector who will consult with the Appropriate Government Authorities and the local conservation officer, if applicable. Follow the incident reporting processes outlined in the Project ERP (NEB Condition 89) for safety-related incidents.</p> <p>23. Do not harass or feed wildlife. Do not store food in beds of pick-up trucks or areas readily accessible to wildlife.</p> <p>24. Report any incidents or collisions with wildlife with construction equipment or construction infrastructure (e.g., bird entanglement with the safety boom) to an Environmental Inspector or designate. The Environmental Inspector will complete follow up reporting or consultation with the Appropriate Government Authority and the local police detachment, if applicable.</p> <p>25. The Environmental Inspector will collect information on mortality and collision events during construction and will include this information, as applicable, in post-construction monitoring reports for the WMT.</p> <p>26. Notify an Environmental Inspector and contact a wildlife Resource Specialist, as warranted, to determine suitable methods for removal of wildlife trapped inside the construction area.</p> <p>27. Store food in vehicles or equipment, or in the construction office. Do not store food in beds of pick-up trucks or areas readily accessible to wildlife.</p> <p>28. Prohibit all Project personnel from having firearms on the construction site or in Project vehicles.</p> <p>29. Prohibit all Project personnel from having pets on facility sites.</p> <p>30. Install guards and/or wildlife protectors, where warranted, at substations to reduce the risk of avian electrocution.</p>
<i>Archaeological/ Palaeontological Heritage Resources</i>	<p>31. Follow applicable recommendations identified in the Archaeological Impact Assessment.</p> <p>32. Refer to environmental resource-specific mitigation measures for historical resources provided in Appendix D of this EPP.</p> <p>33. Suspend work in proximity (i.e., within 30 m or other distance as specified in the applicable regulatory permit) to archaeological, palaeontological or historical sites (e.g., arrowheads, modified bone, pottery fragments and fossils) if discovered during construction and notify an Environmental Inspector and Construction Manager, who will contact the Environmental Manager. Implement the contingency measure identified in the Heritage Resources Discovery Contingency Plan (see Appendix D of this EPP). No work at that particular location shall continue until permission is granted by the Environmental Manager in consultation with a Resource Specialist, or, if warranted, the Appropriate Government Authority. For more information, refer to Heritage Resources prepared for NEB Condition 100 (Section 2.0 of Volume 6 of the Environmental Plans).</p> <p>34. Prohibit the collection of historical, archaeological or palaeontological resources by Project personnel.</p>

Activity/Concern	Mitigation Measures
<i>Archaeological/ Palaeontological Heritage Resources (cont'd)</i>	35. Avoid disturbance of geodetic or legal survey monuments, to the extent feasible. If a geodetic monument is disturbed during construction of the WMT, the Construction Manager or designate will immediately report such disturbance to a Trans Mountain representative who will report such disturbance to the Appropriate Government Authority. The monument will be re-established, where feasible, in accordance with the instructions of the Dominion Geodesist.
<i>Noise Emissions</i>	<p>36. Adhere to applicable federal (<i>i.e.</i>, Environment Canada, <i>Motor Vehicle Safety Act</i> and <i>Oil and Gas Occupational Safety and Health Regulations</i>) and provincial (<i>i.e.</i>, <i>BC Noise Control Best Practices Guidelines</i> [BC OGC 2009], <i>Worker's Compensation Act</i> and <i>Occupational Health and Safety Regulations</i>) guidelines and legislation for noise management, where feasible. Ensure that work is carried out in accordance with the Noise Management Plan for Construction at Terminals and Pump Stations provided in Section 10.0 of Volume 6 of the Environmental Plans.</p> <p>37. Enforce vehicle speed limits. Use of engine retarder braking in urban areas is prohibited.</p> <p>38. Ensure that tools and equipment utilized are proportionate to the activity being conducted to limit excessive noise resulting from construction. Locate compressors and generators away from noise receptors, to the extent feasible.</p> <p>39. Use vibratory methods of pile installation, to the extent feasible. Limit impact pile driving to daytime only, if feasible.</p>
<i>Waste and Hazardous Material Storage</i>	<p>40. Follow measures outlined in the Waste Management Plan (see Section 3.1 in Volume 6 of the Environmental Plans) for storage of waste or hazardous materials on the work site.</p> <p>41. Personnel will be made aware of their responsibilities for proper handling, identification, documentation and storage of hazardous materials and wastes.</p> <p>42. Personnel handling hazardous materials and wastes will possess valid Workplace Hazardous Materials Information System (WHMIS) training (Health Canada 2015).</p> <p>43. An appropriate number of portable toilets or wash facilities will be made available to ensure that facility construction crews have ready access to washroom facilities. Service and clean facilities regularly and ensure that they are adequately secure.</p> <p>44. Store bulk hazardous waste or hazardous materials in accordance with applicable regulatory requirements. Store wastes in designated areas and dispose in accordance with the Waste Management Plan provided in Section 3.1 of Volume 6 of the Environmental Plans.</p> <p>45. Store fuel, oil or hazardous materials required to be stored on-site within secondary containment. Fuel, oil or hazardous materials stored on the terrestrial component of the WMT is to be located greater than 100 m from a watercourse or wetland.</p>

Activity/Concern	Mitigation Measures
<i>Waste and Hazardous Material Storage (cont'd)</i>	<p>46. Store bulk tanks containing hazardous materials (e.g., fuel for construction equipment) in a bermed area lined with an impervious polyethylene liner. Secondary storage for fuel storage tanks is required for volumes exceeding 1,000 L. Design and size secondary containment for hydrocarbons in accordance with applicable provincial and federal requirements. Remove any rainwater that accumulates within the containment structure, if directed by an Environmental Inspector. If there is a visible sheen or odour, the water in the containment structure should be characterized for disposal at an approved facility.</p> <p>47. Maintain documentation on all hazardous materials or wastes being stored at the facility sites.</p> <p>48. Visually inspect fuel tanks on a regular basis, as well as when the tank is refilled. Maintain inspection records for each tank. Take remedial action as soon as a leak is detected.</p>
<i>Waste Disposal</i>	<p>49. Collect construction debris and other waste materials on a regular basis and dispose of it at an approved facility and in accordance with the Spill Contingency Plan (see Appendix B of this EPP) and the Waste Management Plan (see Section 3.0 in Volume 6 of the Environmental Plans). Recycle wastes to the extent feasible.</p> <p>50. Store garbage in wildlife-proof containers when potential wildlife/human conflicts may occur.</p> <p>51. Ensure that the construction site is left in a tidy and organized condition at the end of each day.</p>
<i>Scheduling</i>	<p>52. All nearshore in-water Project construction activities (within a 50-m horizontal distance seaward of the higher high water large tide level) at the WMT that have the potential to harm fish are restricted to a modified work timing window from August 16 to March 15 each year.</p> <p>53. Review and abide by all applicable timing restrictions and least risk biological windows as shown in the Resource-Specific Mitigation Table and Environmental Facility Drawings (Appendices D and E of this EPP), where feasible. When construction activities are scheduled outside of preferred construction timing windows, ensure that necessary regulatory approvals are in place. Refer to the Resource-Specific Mitigation Tables (Appendix D of this EPP) for mitigation measures and preferred timing windows.</p> <p>54. In the event that a permit or approval is likely to expire prior to the completion of the applicable construction activities, notify Trans Mountain well in advance of the expiration date (e.g., 1 month) to obtain renewal or extension of the permit and/or approval.</p> <p>55. Schedule construction activities in consideration of applicable approval conditions and municipal bylaws, where feasible.</p>
<i>Roads and Access</i>	<p>56. Confine construction activities to the allotted construction footprint and approved temporary workspace (e.g., grade areas). Restrict construction traffic to existing roads.</p>

Activity/Concern	Mitigation Measures
<i>Construction Traffic</i>	<p>57. Establish speed limits, approved by Trans Mountain, and in compliance with provincial regulation, on access roads and on the construction site. Post signs stating the applicable speed limits for construction traffic.</p> <p>58. Adhere to the mitigation measures provided in the Access Control and Management Plan, prepared pursuant to NEB Condition 73.</p> <p>59. Transport construction personnel to and from the WMT site by multi-passenger vehicle, to limit traffic volume and the potential for vehicle/wildlife interactions.</p> <p>60. Implement wheel washing for equipment leaving the WMT and entering public roads, where warranted, if vehicles/equipment is not subject to a wash-down. Shovel and sweep clean, as quickly as practical, any mud, soils debris or foreign material tracked onto roads from vehicles leaving the construction site.</p>
<i>Public Access</i>	<p>61. Maintain existing access control measures (e.g., signs, gated entry and fencing) at the WMT.</p>
<i>Air Quality/ Odour/Greenhouse Gas Emissions</i>	<p>62. Notify landowners and/or occupants of the potential to be affected by emissions from construction activities prior to commencement of these activities in proximity to lands owned or occupied by the respective landowners and/or occupants.</p> <p>63. Restrict the duration that vehicles and equipment are allowed to sit and idle, to the extent practical.</p> <p>64. Conduct work at facilities in accordance with the measures contained in the following management plans as applicable:</p> <ul style="list-style-type: none"> • Air Emissions Management Plan for WMT (Section 10.0 of Volume 6 of the Environmental Plans); and • Fugitive Emissions Management Plan for WMT (Section 10.0 of Volume 6 of the Environmental Plans). <p>65. Burning of slash is prohibited in the Lower Fraser Valley and Greater Vancouver areas including the WMT and Westridge Delivery lines from KP 0 to KP 3.4.</p>
<i>Lighting</i>	<p>66. Design lighting requirements at the WMT to meet the <i>Canada Occupational Health and Safety Regulations</i> and the International Ship and Port Facility Security Code (for compliance), for worker safety and terminal security during construction, while minimizing environmental and socio-economic effects. Refer to the Lighting Emissions Management Plan for the WMT (NEB Condition 82).</p> <p>67. Where feasible, prevent sky-lighting, which may lead to bird disorientation and/or collisions by: using low-level and low-intensity lighting; using no lighting in areas where no work is planned; using downturned shaded fixtures in light standards; and using a higher lumen/watt (light out to power in) ratio, such as metal halide lighting.</p> <p>68. During migratory bird periods and/or during extreme weather events, bird strike warnings will be issued to marine construction vessels with a request to reduce deck lighting.</p>

Activity/Concern	Mitigation Measures
<i>Lighting (cont'd)</i>	<p>69. Direct lighting for construction activities downward and, where feasible, position it to avoid or reduce annoyance of nearby residents.</p> <p>70. Install lighting control systems in the facility site that permit the reduction of the amount of lighting during periods of low activity.</p> <p>71. Use lighting in the yellow spectrum, where feasible, to reduce disruption to nocturnal fish activities and bird strikes.</p>
<i>Recreational Activities</i>	<p>72. Prohibit recreational activities (e.g., fishing, hunting, swimming and diving) by Project personnel from or in the vicinity of the WMT.</p>
<i>Spill Prevention</i>	<p>73. Report spills immediately to an Environmental Inspector, who will notify the Senior Compliance Advisor for reporting to the Appropriate Government Authorities in accordance with the Spill Contingency Plan (see Appendix B of this EPP).</p> <p>74. Maintain all appropriate spill equipment at all work sites. Assess the risk of spills to determine the appropriate type and the quantity of spill response equipment and materials to be stored on-site and in a suitable location for storage. Ensure that Operators and on-site Construction Foremen are trained to contain spills or leakage from equipment.</p> <p>75. Post specific instructions at the field construction offices and in construction environmental training handbooks regarding applicable contacts and appropriate response actions to be taken in the event of a spill, including the measures provided in the Spill Contingency Plan (see Appendix B of this EPP) and contacts for spill reporting (see Appendix A of this EPP).</p> <p>76. Place an impervious tarp or drip tray underneath equipment and vehicles when performing service and routine maintenance (e.g., oil changes and servicing of hydraulic systems).</p> <p>77. Store all hazardous substances and fuels in proper containment systems, to prevent release to the environment. Handle all hazardous materials in accordance with applicable WHMIS protocols.</p> <p>78. Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides or other chemicals are dumped onto the ground or into the marine environment. In the event of a spill onshore that does not have the potential to migrate into the marine environment, implement the Spill Contingency Plan (see Appendix B of this EPP). In the event of a spill in the marine environment or onshore with the potential to migrate into the marine environment, implement the Marine Spill Contingency Plan (see Appendix B of this EPP).</p> <p>79. Ensure that bulk fuel trucks, service vehicles and pick-up trucks equipped with box-mounted fuel tanks carry spill prevention, containment and clean-up materials that are suitable for the volume of fuels or oils carried. Carry spill response supplies on bulk fuel and service vehicles that are suitable for use on land and water (i.e., sorbent pads, sorbent boom and rope).</p>

Activity/Concern	Mitigation Measures
<i>Spill Prevention (cont'd)</i>	<p>80. Employ the following measures to limit the risk of fuel spills in water if refueling within 100 m of the marine environment is necessary and is approved by an Environmental Inspector:</p> <ul style="list-style-type: none">• all containers, hoses and nozzles are free of leaks;• all fuel nozzles are equipped with automatic shut-offs;• Operators are stationed at both ends of the hose during fuelling, unless the ends are visible and readily accessible by one Operator; and• fuel remaining in the hose is returned to the storage facility. <p>81. Do not wash equipment or machinery in the marine environment. Control wastewater from construction activities to avoid discharge directly into the marine environment.</p>

7.0 TERRESTRIAL CONSTRUCTION

7.1 General Terrestrial Measures

Introduction

The following mitigation measures will be implemented as needed during the onshore construction of the WMT.

Objective

The objective of these mitigation measures is to avoid or reduce potential adverse environmental effects associated with the terrestrial component of the WMT construction activities.

Activity/Concern	Mitigation Measures
<i>Roads and Access</i>	<ol style="list-style-type: none">1. Confine construction activities to the allotted construction footprint and approved temporary workspace (e.g., grade areas). Restrict construction traffic to approved roads.2. During construction, use flagging, staking, fences or signs to delineate the boundaries of the WMT, access roads, and environmental features of concern that require protection.3. Apply appropriate measures (e.g., signs, boundary markers, gates and fences) to ensure that Project vehicles remain on the designated access.4. Install and maintain signs, gates or other temporary barriers at potential access points to the WMT or temporary construction access to deter unauthorized access during the construction period.5. Deactivate and reclaim temporary construction access that does not have a third-party disposition to native vegetation or pre-construction land use. Implement access controls on deactivated temporary roads.
<i>Drainage</i>	<ol style="list-style-type: none">6. Reduce the potential for soil erosion by water during construction activities by avoiding ponding of water or the unintentional channelization of surface water flow.7. Maintain existing surface drainage across the WMT, to the extent feasible. Restore drainage patterns following construction where surface drainage was disrupted due to construction activities.
<i>Hydrogeology</i>	<ol style="list-style-type: none">8. Consult the Hydrogeological Resource Specialist to determine if wells located within the vicinity of the construction site will be sampled for water quality and flow rate prior to the commencement of construction.9. Existing Trans Mountain groundwater monitoring wells will be pre-identified and flagged prior to construction. Groundwater monitoring wells will be decommissioned in accordance with applicable provincial guidelines in the event they will be disturbed by construction activities

Activity/Concern	Mitigation Measures
<i>Erosion and Sedimentation</i>	<ol style="list-style-type: none"> 10. Prepare a site-specific Erosion and Sediment Control Plan (ESC) in compliance with regulatory requirements and submit to the Environmental Inspector for review. 11. Ensure that excavation and construction procedures are undertaken in such a manner as to prevent sediment-laden runoff from the site of the work from directly entering natural drainage systems or marine environment. 12. Ensure that disturbed areas are kept dewatered with concentrated surface runoff either directed around work areas with interceptor ditches or temporarily contained within closed conduits. 13. Direct concentrated surface runoff to water conveyance and storage features (e.g., settling pond). Ensure that water contained in on-site settling ponds, or an approved equivalent, is treated and, where warranted, sampled prior to discharge (refer to Monitoring mitigation measures provided below in this section). 14. Manage the potential for off-site migration of sediments through the installation of erosion and sediment control measures (e.g., coir logs, erosion control matting, sediment fence and crushed gravel) where indicated in the ESC. Ensure that surface runoff not collected into water conveyance and storage features passes through installed erosion and sediment control features prior to migration off-site.
<i>Monitoring</i>	<ol style="list-style-type: none"> 15. Regularly monitor erosion and sediment control measures in accordance with regulatory requirements and the ESC (<i>i.e.</i>, a minimum of weekly during normal operations and daily during storm events). Initiate corrective measures or implement supplemental erosion and sediment control measures in areas where deficiencies are noted, in consultation with the Environmental Inspector. 16. Monitor turbidity and/or total suspended solids (TSS) concentrations during construction to ensure that water discharged from the site does not have TSS in excess of 25 mg/L (dry conditions) or 75 mg/L (rainy conditions) above background levels of the receiving water prior to discharge.
<i>Dust Control</i>	<ol style="list-style-type: none"> 17. Consult with land agents to provide opportunities for nearby residents with the potential to be affected by dust emissions from construction to report on issues related to dust emissions so that corrective actions can be implemented, if warranted. 18. Water down the construction footprint, when warranted, to reduce or avoid the potential for dust emissions due to soil pulverization. Increase the frequency of watering roads and sites during periods of high risk (e.g., high winds or periods of drought). Additional dust abatement measures will be implemented, when warranted and approved by an Environmental Inspector. 19. Ensure that watering of the construction footprint does not generate excessive formation of surface water accumulation (<i>i.e.</i>, puddles or excessive mud generation) or result in overland water flow or sedimentation of nearby watercourses or the marine environment. 20. Implement wheel washing for equipment leaving the WMT and entering public roads, where warranted, if vehicles/equipment is not subject to a wash-down.

Activity/Concern	Mitigation Measures
<i>Weeds</i>	<p>21. Ensure that equipment arrives at construction sites clean and free of soil or vegetative debris. Inspect, verify, and document clean equipment.</p> <p>22. Clean equipment (<i>i.e.</i>, shovel and sweep, pressurized water or compressed air) involved in topsoil/root zone material handling at weed-infested sites prior to leaving the location. Clean equipment involved in topsoil handling at weed-infested sites prior to leaving the location.</p> <p>23. Develop weed control plans in consideration of the requirements of local municipalities and the Line List. Refer to the Weed and Vegetation Management Plan provided in Section 5.0 of Volume 6 of the Environmental Plans.</p>
<i>Use of Herbicides</i>	<p>24. Restrict the application of herbicides to licensed applicators.</p> <p>25. Restrict the application of herbicide within 30 m of known rare plant populations or rare plant communities. Spot spraying, wicking, mowing or hand-picking are acceptable weed control measures in proximity to rare plants and rare plant communities.</p> <p>26. Follow all regulatory requirements for herbicide use adjacent to waterbodies and wells. Consult with potentially affected Aboriginal groups and the VFPA prior to the use of herbicides. The VFPA prefers that non-chemical means of weed control are used wherever feasible.</p>
<i>Work Around the Marine Environment</i>	<p>27. Ensure that approvals are in place prior to work on the upland area adjacent to the marine environment.</p> <p>28. Install sediment fences at the base of cut/fill areas to reduce sediment discharge into the marine environment, where warranted (see Drawing 1 [Sediment Fence] provided in Appendix C of this EPP).</p> <p>29. Maintain sediment fences in place at the base of cut/fill areas, where warranted, until revegetation is stable.</p>
<i>Contaminated Soils</i>	<p>30. Implement the Contamination Discovery Contingency Plan (see Appendix B of this EPP) in the event that contaminated soils are discovered during construction. Adhere to applicable measures provided in the Waste Management Standard and Contamination Identification and Assessment Plan (provided in Section 3.0 of Volume 6 of the Environmental Plans) for handling of contaminated material.</p>
<i>Traditional Land and Resource Use</i>	<p>31. Implement the contingency measures identified in the TLU Sites Discovery Contingency Plan (see Appendix B of this EPP) in the event that TLU sites not previously identified are found during facility construction. Notify an Environmental Inspector who will collaborate with an Aboriginal Monitor for protection of these features.</p>

7.2 Surveying, Clearing and Access

Introduction

The following mitigation measures will be implemented by Trans Mountain, its Contractors and subcontractors during surveying, clearing of vegetation and accessing of the WMT construction site.

Objectives

The objectives of these mitigation measures are to:

- reduce or avoid adverse effects to the terrestrial construction footprint; and
- limit disturbance of vegetation, to the extent practical.

Activity/Concern	Mitigation Measures
<i>Schedule</i>	1. Refer to scheduling and wildlife information provided in Section 6.0 of this EPP.
<i>Bald Eagle Nesting Site</i>	<p>2. Determine if any active stick nests (e.g., bald eagle and great blue heron) are located in the area to be cleared or adjacent to the WMT immediately prior to clearing. Follow the measures outlined in the Bald Eagle Nest Management Plan: WMT for mitigation measures to be implemented prior to construction. These measures include:</p> <ul style="list-style-type: none"> • The eagles are expected to disperse from the Project area by mid to late August, with adults returning in October to evaluate/initiate nesting. Install nest deterrent within the known bald eagle nest at the WMT upon confirmation that the nest is inactive and the bald eagles have dispersed from the area. Adhere to the conditions of the <i>Wildlife Act</i> Permit (Permit SU17-264155) issued for the installation of the nest deterrent. • Install artificial nests within two alternate nest trees to reduce the risk of lost nesting opportunities. • The nest deterrent and artificial nests will be installed by a qualified arborist upon confirmation that the nest is inactive and the eagles have dispersed from the area. The installation will be completed prior to October 2017 (when nest evaluation and territory establishment is expected to occur).
<i>Staking/Flagging/Fencing</i>	<p>3. Stake all boundaries of the facility construction footprint, including access roads and borrow sites.</p> <p>4. Stake or flag environmental features and buffers (e.g., archaeological site, rare plant species and wildlife habitat features) prior to commencing construction to avoid the resource site. Clearly mark all resource-specific environmental features identified on the WMT Environmental Facility Drawing prior to construction, as warranted.</p> <p>5. Confirm locations of environmental features and ensure staking, flagging or fencing is maintained during construction.</p> <p>6. Prior to commencement of clearing or construction activities, ensure that boundary and environmental feature flagging/staking has been surveyed and remains intact. Stake and label topsoil/root zone material and spoil stockpiles.</p>

Activity/Concern	Mitigation Measures
<i>Signage</i>	7. Post signs in the vicinity of environmental features to alert construction personnel of their presence. Recommended setback distances are resource-specific, and should be determined in consultation with an Environmental Inspector and/or Resource Specialist, if required.
<i>Clearing</i>	8. Confine all clearing/mowing within the staked/flagged construction footprint boundaries. Do not clear, mow or grade beyond the stakes. Clear vegetation from only those areas essential for construction. Adhere to clearing restrictions associated with special environmental features and buffer areas in addition to those areas outlined in the Resource-Specific Mitigation Table (see Appendix D of this EPP).
<i>Grubbing</i>	9. Postpone root grubbing until immediately prior to grading within the facility boundary, if practical, and where there is a potential for soil erosion to occur, due to sloping terrain and erodible soils.
<i>Shrubby Vegetation Disposal</i>	10. Clear and chip shrubby vegetation or mulch (mulch not to exceed a depth of 5 cm) where grading will not be required and a smooth work surface is required. Dispose of excess chips at an approved location outside of the WMT site. 11. Ensure there is no burning of vegetation or construction waste.
<i>Gates</i>	12. Install construction fencing around newly cleared areas outside of the existing WMT site following clearing. Keep gates locked and assign security personnel to block access, if warranted.
<i>Bar Ditch and Foreign Line Ramps</i>	13. To facilitate access across the railway, construct foreign line ramps with borrow material (not topsoil/root zone material), as per agreement with the owner of the rail facility. 14. Install culverts in bar ditch ramps to maintain drainage. Culvert specifications will be determined by the Project Engineer in consultation with the Environmental Inspector.
<i>Construction Traffic</i>	15. Restrict construction traffic on the shoreline to approved access points. 16. Establish speed limits, approved by Trans Mountain, and in compliance with provincial regulation, on access roads and on the construction site. Post signs stating the applicable speed limits for construction traffic. 17. Transport construction personnel to and from the facility site by multi-passenger vehicle, to limit the potential for vehicle/wildlife interactions and to limit traffic volume and congestion on-site. 18. Implement wheel washing for equipment leaving the WMT and entering public roads, where warranted, if vehicles/equipment is not subject to a wash-down. Shovel and sweep clean, as quickly as practical, any mud, soils debris or foreign material tracked onto roads from vehicles leaving the construction site.

7.3 Soils Handling and Grading

Introduction

The following mitigation measures will be implemented by Trans Mountain, its Contractors and subcontractors during terrestrial construction at the WMT site.

Objective

The objective of these mitigation measures is to avoid or reduce effects on topsoil/root zone material productivity and surface drainage patterns, and to conserve surface material in order to facilitate reclamation of disturbed areas.

Activity/Concern	Mitigation Measures
<i>Resource-Specific Environmental Features</i>	<ol style="list-style-type: none"> 1. Refer to mitigation measures provided under the Staking/Flagging/Fencing and Signage headings in Section 7.2 of this EPP. Confirm the placement of stakes, flags and signage along the construction sites following clearing and prior to topsoil/root zone material handling and grading. Replace any stakes, flags and signage damaged during pre-clearing. 2. Review resource-specific locations to be avoided during topsoil/root zone material salvage and grading activities.
<i>Wet Soil Conditions</i>	<ol style="list-style-type: none"> 3. Adhere to the measures outlined in the Wet Soils Contingency Plan (see Appendix B of this EPP) if wet soil conditions are encountered prior to the removal of topsoil/root zone material from the development area.
<i>Topsoil/Root Zone Material Salvage</i>	<ol style="list-style-type: none"> 4. Salvage topsoil/root zone material from the development zone and areas to be graded within the construction footprint that will be disturbed during construction.
<i>Topsoil/Root Zone Material Salvage Depth</i>	<ol style="list-style-type: none"> 5. Salvage all available topsoil/root zone material (minimum 15 cm or 50% organic material), unless the material is unsuitable (e.g., bedrock, gravel, rock and/or disturbed land). Where soils are not readily distinguishable by colour, an Environmental Inspector and Resource Specialist will provide direction based on an evaluation of soil texture and structure. 6. Salvage very shallow surface soils to a minimum depth of 15 cm. If minimum depth of surface soils cannot be salvaged because the underlying material is unsuitable (e.g., gravel and rock), salvage all available topsoil/root zone material.
<i>Storage of Topsoil/Root Zone Material/Spoil</i>	<ol style="list-style-type: none"> 7. Map the locations of topsoil/root zone material piles on as-built drawings to ensure that they can be easily located in the future to support reclamation efforts at the site. 8. Should quantities of salvaged topsoil/root zone material reduce the practicality of on-site storage, haul excess material off-site for disposal at an approved location or as directed by Trans Mountain. 9. If off-site movement of salvaged topsoil/root zone material or spoil is required, adhere to conditions specified in the applicable permits.

Activity/Concern	Mitigation Measures
<i>Topsoil/Root Zone Material/Grade Spoil Separation</i>	10. Keep spoil piles separate from topsoil/root zone material piles. Maintain a minimum separation distance of 1 m between topsoil/root zone material and grade spoil piles or place a barrier (e.g., approximately 15 cm thick straw barrier, tarps or other material approved by an Environmental Inspector) at areas where a 1 m separation cannot be maintained between topsoil/root zone material and spoil stockpiles due to workspace limitations.
<i>Grading</i>	11. Ensure that there is no grading beyond the stakes. Grade only those areas essential for construction. 12. Grade, if required, to level the surface to be developed. Grade the surface to facilitate water drainage into water conveyance features (e.g., ditches and culverts). 13. Ensure that grade spoil does not migrate off-site. 14. Clearly identify grade spoil with signs or staking where the topsoil/spoil colour change is not obvious.
<i>Monitor Topsoil/Root Zone Material Stockpiles</i>	15. Monitor topsoil/root zone material piles during the growing season for erosion and weed growth until the soils are removed from site, replaced or stored in berms. Implement remedial measures to control erosion, when warranted (see the Soil Erosion and Sediment Control Contingency Plan in Appendix B of this EPP), and weed growth (see Weed and Vegetation Management Plan provided in Section 5.0 of Volume 6 of the Environmental Plans).

7.4 Facility Construction

Introduction

The following mitigation measures may be implemented during the construction of the WMT.

Objectives

The objectives of these mitigation measures are to:

- ensure that construction activities are conducted in accordance with all approval conditions and permits; and
- avoid or reduce potential adverse environmental effects associated with general facility construction activities.

Concern/Activity	Mitigation Measures
<i>Site Preparation</i>	1. Do not drive or set equipment on portions of the facility site where unsalvaged and unprotected topsoil/root zone material is present in order to avoid rutting and subsequent topsoil/root zone material and spoil admixing.
<i>Hotline Exposure/Hydrovac</i>	2. Ensure that all hydrovac tanks are clean and free of contaminants prior to use on-site. 3. Empty clean hydrovac material onto subsoil at sites approved by an Environmental Inspector. Ensure that hydrovac material will not migrate to a watercourse or wetland, or onto topsoil/root zone material). 4. Backfill and compact all hydrovac holes during rough clean-up with native, loose, dry material to ensure that settling of material does not pose a hazard for wildlife or livestock. 5. Implement measures in the Contaminated Sites Discovery Contingency Plan (Appendix B of this EPP) if potential contamination of hydrovac materials is encountered or suspected. 6. Refer to the Hydrovac Cutting and Disposal Management Plan (Section 3.0 of Volume 6 of the Environmental Plans) for additional mitigation measures to be implemented during hydrovac activities.
<i>Excavation</i>	7. Where groundwater and/or soil contamination is suspected, implement the Contaminated Sites Discovery Contingency Plan (Appendix B of this EPP). Refer to the Contamination Identification and Assessment Plan provided in Section 3.0 of Volume 6 of the Environmental Plans for areas of known contamination encountered by the Project. 8. Limit the duration of time that the excavations will be left open to reduce the potential for sloughing. 9. Ensure that contaminated soil and water, if present, are not transported off-site or disposed until analytical results have been received, as per federal and provincial regulations and legislation as determined by the Contaminated Sites Resource Specialist. 10. Develop a plan for disposal of rock for approval by the Environmental Inspector and implement the plan during construction.

Concern/Activity	Mitigation Measures
<i>Temporary Soil Stockpile Locations</i>	<p>11. Locate and clearly mark temporary soil storage piles away from grade and spoil materials, construction activities and day-to-day operations, as approved by an Environmental Inspector. Ensure that temporary soil storage piles are accessible and available for hauling.</p> <p>12. Locate the soil stockpile sites in upslope positions to avoid disruption of drainage and drainage channels. Ensure that drainage through low areas associated with spring breakup will not impact soil piles.</p>
<i>Dewatering</i>	<p>13. Assess the need for well points or other dewatering methods, prior to commencing excavations, to intercept groundwater at site-specific locations.</p> <p>14. Delay excavations until immediately prior to construction works at locations with a high-water table or where there is a risk of sloughing.</p> <p>15. Dewater the excavation sites, if warranted. Place pumps on a tray or within an excavated sump lined with polyethylene sheeting. Pump water onto stable and well-vegetated areas, tarpaulins or sheeting in a manner that does not cause erosion or sediment-laden water to re-enter a watercourse or wetland. Dewater the excavation sites if existing or anticipated (based on precipitation forecasts) water levels in the excavation could overwhelm existing water control measures.</p> <p>16. Use floating suction hose and elevated intake, or other measures approved by an Environmental Inspector, to prevent soil material from being sucked from the bottom of the excavation.</p> <p>17. Monitor the water discharge site to ensure that erosion, saturation of the discharge site or flooding does not occur. Ensure that water does not flow off the property, unless proper authorizations are in place from the Appropriate Government Authority. Suspend dewatering and either apply erosion control measures, reduce the flow or move the discharge site if it appears that the above effects could occur.</p>
<i>Gravel</i>	<p>18. In areas where a gravel pad will be established (<i>i.e.</i>, where infrastructure will be installed and in areas that will be subject to travel during the operations phase of the Project), grade the gravel pad in such a manner as to ensure that the pad does not interfere with the local surface drainage pattern.</p>
<i>Bird Deterrents</i>	<p>19. Install guards and/or wildlife protectors, where warranted (<i>e.g.</i>, electrical substations), at the facility to reduce the risk of avian nesting.</p> <p>20. Nest deterrents will be installed outside the primary nesting period (which is March 26 to August 16) for migratory birds (ECCC, 2017), and may include visual, physical (<i>e.g.</i>, guards or protectors) or energized deterrents depending on the type of infrastructure.</p>

8.0 MARINE CONSTRUCTION

Introduction

The following mitigation measures are applicable to the construction of marine components of the WMT throughout all phases of construction by Trans Mountain, its Contractor and subcontractors.

Objective

The objective of the following mitigation measures is to avoid or reduce potential adverse environmental effects associated with the marine component of the WMT construction activities including: in-water excavation of existing rip rap; installation of circular sheet pile walls associated with the foreshore extension; installation of cylindrical pipe piles for the marine trestle and berths; and overwater construction of dock infrastructure.

General Marine Measures

General marine environmental protection specifications are to be implemented along with the general measures (onshore and marine) outlined in Section 6.0 of this EPP.

Activity/Concern	Mitigation Measures
<i>Permits and Approvals</i>	<ol style="list-style-type: none"> 1. Review notification requirements identified in Section 5.0 of this EPP and ensure that notifications have been completed. 2. Ensure that a <i>Fisheries Act</i> Authorization (Section 35 [2]) is obtained from DFO for all activities that are likely to result in residual serious harm to fish, prior to the commencement of marine construction.
<i>Marine Species at Risk or Species of Concern</i>	<ol style="list-style-type: none"> 3. Ensure that all mitigation measures associated with onshore and marine wildlife species at risk and species of concern are communicated to Project personnel.
<i>Public Marine Access</i>	<ol style="list-style-type: none"> 4. Discourage unauthorized marine vessels in the WMT construction area by demarcating it and by use of signs, markers and/or buoys. Refer to the Navigation and Navigation Safety Plan (Section 8.0 of Volume 6 of the Environmental Plans) for more information. Install a marine safety boom around the WMT construction zone, if approved by the VFPA.
<i>Permit Conditions</i>	<ol style="list-style-type: none"> 5. Ensure all conditions outlined in authorizations and/or permits and approvals are adhered to during marine construction.
<i>Schedule</i>	<ol style="list-style-type: none"> 6. Schedule work for daylight hours, where feasible. Refer to mitigation for lighting and noise emissions provided in Section 6.0 of the EPP in the event that construction activities must be undertaken during the night. Written authorization from the VFPA will be required for any work outside the approved Westridge Marine Terminal construction hours. 7. Conduct in-water excavation of rip rap between August 16 and March 15. 8. Install portions of the circular sheet pile wall in contact with the marine environment between August 16 and March 15. 9. Install circular sheet pile walls associated with the marine trestle, loading platforms, berthing dolphins and mooring dolphins year-round following the mitigation measures outlined in the <i>Fisheries Act</i> Authorization (Section 35[2]). .

Activity/Concern	Mitigation Measures
<i>Access</i>	<ul style="list-style-type: none"> 10. For access to the marine construction area with the Contractor's registered marine vessels, ensure the vessels are approved for the Project, inspected and certified fit for use by the Contractor or their designate. 11. Identify terrestrial access routes to the marine construction footprint from designated staging and/or laydown areas. 12. Maintain a list of personnel and vessels eligible to access the marine construction site. 13. Use existing roads for access to the WMT construction footprint. If additional temporary access roads are required at or near the shoreline, they will be constructed of granular fill over a geotextile and removed after construction is completed. Discuss access road siting and mitigation requirements (e.g., sediment fencing) with an Environmental Inspector.
<i>Recreational Activities</i>	<ul style="list-style-type: none"> 14. Prohibit marine recreational activities (e.g., boating, fishing, swimming and diving) by Project personnel on or in the vicinity of the WMT.
<i>Construction Vessel Traffic</i>	<ul style="list-style-type: none"> 15. Ensure that Project vessels are equipped with a high-frequency radio with appropriate channels to monitor vessel traffic in the Project area. 16. Ensure that construction vessel traffic is confined to the general work site, where feasible, and that vessel anchoring or other disturbance only occurs in Trans Mountain approved locations, unless required in an emergency situation. 17. Ensure that pile hammers and backhoes working in water utilize vegetable-based hydraulic fluids and lubricants during this work, if practical. 18. Operate Project-related vessels at slow speeds (< 10 knots) and avoid rapid acceleration to limit the intensity of acoustic emissions (both above and below the water surface) and to decrease the likelihood of striking marine mammals, infrastructure or other vessels. 19. Inform Project-related vessel operators of the potential for birds to collide with vessel structures at night due to deck lighting or inclement weather, and for vessels to collide with marine mammals. Report all bird, mammal and structure strikes/collisions immediately to the Chief Activity Inspector and/or the Environmental Inspector.
<i>Noise</i>	<ul style="list-style-type: none"> 20. Maintain Project-related vessels to reduce acoustic emissions (both above and below the water surface).
<i>Waste Disposal</i>	<ul style="list-style-type: none"> 21. Manage all marine-related solid and liquid waste in accordance with the <i>Canadian Shipping Act</i>. 22. Ensure that solid materials, including construction materials, will not be discharged into the marine environment at any time. 23. Conduct a site clean-up at the end of each day to prevent accumulation of waste materials. 24. Keep vessel and dock surfaces free of construction materials (e.g., concrete fines) to prevent their entry into the marine environment.

Activity/Concern	Mitigation Measures
<i>Marine Sedimentation</i>	<p>25. Use only clean (washed, free of mud or other fines) rock for construction of fish habitat offsets (<i>i.e.</i>, rock reefs) and conduct work between August 16 and March 15. Ensure that a turbidity curtain is installed around the area where rip rap will be placed, to contain any suspended sediment.</p> <p>26. Reduce the risk of sedimentation from upland areas into the marine environment by properly installing appropriate terrestrial erosion and sediment control measures (refer to erosion and sedimentation mitigation provided in Section 7.1 of this EPP).</p>
<i>In-water Excavation</i>	<p>27. Conduct in-water excavation of rock rip rap in accordance with applicable permits and/or approvals and between August 16 and March 15.</p> <p>28. Install a turbidity curtain during in-water excavation of rock rip rap to contain suspended sediment to the work area (see Drawing 2 [Turbidity Curtain Installation {Tidal Conditions}] provided in Appendix C of this EPP).</p> <p>29. During in-water excavation or rip rap, conduct water quality monitoring (WQM) as per the Water Quality Management Plan during Rip Rap Removal (Appendix H of this EPP). Conduct WQM to assess the effectiveness of the turbidity curtain and modify turbidity curtain deployment, if required.</p> <p>30. Unless otherwise approved by DFO, retain all excavated material and dispose at a land-based facility in accordance with applicable regulations</p> <p>31. Adhere to measures outlined in Section 6.0 and the Heritage Resources Discovery Contingency Plan (see Appendix B of this EPP) for historical, archaeological resources, if historical artifacts or remains are discovered during in-water excavation activities.</p>
<i>Pile Installation</i>	<p>32. Conduct pile installation activities in accordance with all applicable permits and/or approvals.</p> <p>33. Conduct in-water impact-hammer pile driving during daylight hours only.</p> <p>34. Use a vibratory method of pile installation preferentially over an impact hammer, where feasible and in accordance with engineering design criteria, to reduce the intensity of underwater noise and pressure emitted to the marine environment.</p> <p>35. Immediately following the installation of each sheet pile cell, and prior to excavation and infilling of that cell, conduct a salvage of commercial, recreational and Aboriginal (CRA) fishery species via crab and fish trapping/netting and seines (where appropriate). Release captured CRA fishery species in a suitable habitat at least 500 m away from marine construction activities.</p> <p>36. Where an impact hammer is required for pile installation, deploy a bubble curtain around the full wetted length of the pile (see Drawing 3 [Air/Bubble Curtain Installation {Pile Installation}] provided in Appendix C of this EPP) to reduce underwater noise and pressure levels.</p> <p>37. Upon commencement of impact pile installation or recommencement of such activities after a delay of 30 minutes or more, conduct a pile installation ramp-up procedure starting with less frequent impact strikes of lower force.</p> <p>38. In-water pile installation within a 50-metre horizontal distance of the high water large tide level will be limited to a timing window between August 16 and March 15.</p>

Activity/Concern	Mitigation Measures
<i>Pile Installation (cont'd)</i>	<p>39. Monitor underwater noise and pressure levels outside of the bubble curtain, within 10 meters of the driven pile, throughout impact pile driving. If monitoring indicates an exceedance of kPa dB re Pa peak during the DFO least risk window for Burrard Inlet (August 16 to February 28) or kPa dB re Pa peak outside of the DFO least risk window for Burrard Inlet (March 1 to August 15), or a fish kill is observed, stop impact pile driving immediately and review and modify methods, as appropriate, in consultation with DFO.</p> <p>40. Prior to the commencement of impact pile driving, conduct visual monitoring (by trained, qualified personnel) for cetaceans and marine mammal species at risk within an initial marine mammal exclusion zone, set to a radius of 1 km from active locations of impact pile driving. Conduct simultaneous visual monitoring within a harbour seal-specific exclusion zone, set to a radius of 150 m. Impact pile driving may only commence if no marine mammals are observed within their respective exclusion zones for 30 minutes prior to the start of the activity. The exclusion zone for cetaceans and marine mammal species at risk will encompass the area within which underwater noise levels exceed 160 dB re: 1 μPa. Underwater noise level field verification will be conducted during the first several days of impact pile driving to define the radius of this zone.</p> <p>41. Conduct field verification of underwater noise levels when there are changes to impact pile driving equipment (e.g., hammer size and pile size) or substantial changes to pile locations to allow for adjustments to the radius of the cetacean and marine mammal species at risk exclusion zone.</p> <p>42. Conduct constant visual monitoring of the marine mammal exclusion zones during impact pile driving. If a cetacean or marine mammal species at risk, or a harbour seal, is observed within its respective exclusion zone, temporarily suspend impact pile driving (or reschedule if deemed necessary) until the marine mammal(s) has left the exclusion zone or does not reappear within 30 minutes.</p> <p>43. Should visual monitoring during in-water pile installation indicate concern regarding turbidity levels, the Environmental Inspector will arrange for in situ sampling of turbidity (nephelometric turbidity units). Should turbidity levels exceed specified thresholds, pile driving will temporarily be halted.</p>
<i>Marine Drilling</i>	<p>44. Conduct marine drilling activities in accordance with applicable permits and/or approvals.</p> <p>45. If drilling of internal pile anchors is required, contain drill cuttings and drill muds and dispose at a land based facility in accordance with applicable regulations.</p>
<i>Cleaning Out Pipe Piles</i>	<p>46. If steel pipe piles that are driven open ended are to be cleaned out, contain all sediment and dispose at a land-based facility in accordance with applicable regulations.</p>

Activity/Concern	Mitigation Measures
<i>Concrete Management</i>	<ol style="list-style-type: none"> 47. Isolate concrete work from the marine environment. 48. Wash all tools, pumps, pipes, hoses and trucks used for finishing, placing or transporting fresh concrete in designated areas, away from the marine environment. 49. Avoid depositing, directly or indirectly, any concrete, mortars or other lime-containing construction materials into or near the marine environment. All forms, if applicable, shall be examined by qualified Inspector(s) prior to pour to ensure they are tight. 50. Ensure that properly sealed chutes are present to avoid spillage, if concrete is discharged or placed directly into the formwork. If the concrete is being placed in the formwork with a concrete pump, properly seal and lock all hose and pipe connections to ensure that the lines will not leak or uncouple. Do not overfill concrete forms. 51. Maintain complete isolation of cast-in-place concrete and grouting from the marine environment for a minimum of 48 hours if the ambient air temperature is above 0°C and for a minimum of 72 hours if the ambient air temperature is below 0°C. 52. Ensure that all concrete work is completed during dry conditions and properly contained within formwork, such that no concrete products enter the surrounding marine environment. Concrete must be set before a change in tidal conditions results in coverage. 53. Use anti-washout admixtures in any concrete or cement grout that must be placed underwater. 54. Collect all stormwater, surface water runoff and wash water generated from construction activities that contains or may contain suspended concrete materials and/or particles. Monitor pH as per the <i>Canadian Water Quality Guidelines for the Protection of Aquatic Life</i>. If the pH of the water is above acceptable levels, it may be adjusted in the water treatment unit. Ensure that pH and turbidity levels in the marine environment are monitored when dust or fines from grinding incompletely cured concrete enter the water column. In the event that levels exceed the acceptable water quality guidelines (<i>i.e.</i>, <i>Canadian Water Quality Guidelines for the Protection of Aquatic Life</i>), introduce preventative measures (<i>i.e.</i>, implementation of turbidity curtains to contain the suspended solids and prevent marine mammals or fish from entering the area) (see Drawing 2 [Turbidity Curtain Installation {Tidal Conditions}] in Appendix C of this EPP). 55. Utilize industry-accepted construction practices for placing concrete over water and take all reasonable precautions to contain and neutralize spills in the event that concrete material is released into the marine environment. Report any spill to the Senior Compliance Advisor who will report to the appropriate regulatory authorities. Conduct ongoing monitoring of pH and turbidity during and following clean-up of the spill and compare to confirm that water quality guidelines for pH and turbidity are reached and maintained. 56. Implement the Marine Spill Contingency Plan (see Appendix B of this EPP), in the event of a concrete fines spill or material release. 57. Remove all concrete and affiliated equipment or materials upon completion of concrete works.

Activity/Concern	Mitigation Measures
<i>Marine Mammals</i>	<p>58. Discuss marine mammal issues that are identified during construction, with the Environmental Inspector, the Marine Resource Specialist and the appropriate regulatory authorities.</p> <p>59. Implement all marine mammal-specific mitigation measures outlined under relevant activities (e.g., impact pile installation above).</p> <p>60. Implement the Onshore or Marine Wildlife Species of Concern Discovery Contingency Plan (see Appendix B of this EPP), in the event of encountering a marine mammal species at risk or species of concern.</p> <p>61. Implement any relevant measures in the Marine Mammal Protection Program, developed pursuant to NEB Condition 132, which will focus on effects from the operations of Project-related marine vessels. Note that the draft Marine Mammal Protection Program will be developed 3 months prior to the start of pile installation, but will be a living document and, therefore, may go through multiple iterations over the life of the Project as the various programs develop over time.</p>
<i>Marine Fish and Fish Habitat</i>	<p>62. Discuss marine fish and fish habitat issues that are identified during construction with the Environmental Inspector, the Marine Resource Specialist and the appropriate regulatory authorities.</p> <p>63. Ensure that barges are anchored or spudded in appropriate areas with minimal effects to intertidal and subtidal marine habitats. Grounding is prohibited, unless authorized by VFPA. Avoid sensitive marine habitats, where feasible.</p> <p>64. Have the Environmental Inspector report immediately to DFO if the extent or nature of permanent alteration or destruction of fish habitat during any marine construction phase is outside of the scope defined in permits and approvals.</p>
<i>Marine Species at Risk and Species of Concern</i>	<p>65. Report sightings of species at risk or species of concern immediately to the Environmental Inspector. Implement the Onshore or Marine Wildlife Species of Concern Discovery Contingency Plan (see Appendix B of this EPP), as appropriate. The Environmental Inspector will record the location in the daily reports.</p>
<i>Invasive Marine Species</i>	<p>66. Ensure that all Project-related vessels follow the requirements for ballast water management, as outlined in the <i>Canadian Shipping Act</i> (c.26) and the <i>Canadian Ballast Water Control and Management Regulations</i> (SOR/2011-237), to reduce the risk of importing invasive marine species into the WMT area.</p>

9.0 CLEAN-UP AND RECLAMATION

Introduction

Clean-up and reclamation are important steps in returning the WMT construction site to a condition suitable for operational requirements.

The objectives of clean-up and reclamation mitigation measures at facilities are to:

- effectively use reclamation techniques that prevent topsoil/root zone material loss from wind and water erosion;
- establish a vegetative cover compatible with surrounding vegetation and land uses, where applicable;
- comply with approval conditions, including permits and commitments; and
- re-establish the construction sites to a stable condition.

The following mitigation measures may be implemented, as necessary, by Trans Mountain, its contractors and/or subcontractors during clean-up and reclamation activities.

Activity/Concern	Mitigation Measures
<i>Scheduling</i>	<ol style="list-style-type: none"> Follow activity restriction guidelines and road bans, and consider spring melt when scheduling clean-up and reclamation activities. Commence clean-up activities as soon as practical following construction. Reclaim disturbed lands within one growing season following construction, if feasible. Determine the appropriate schedule for seeding and for planting of seedlings or trees and shrubs, where applicable.
<i>Recontouring</i>	<ol style="list-style-type: none"> Recontour disturbed lands to stable profiles and to meet operational requirements.
<i>Erosion Control</i>	<ol style="list-style-type: none"> Implement appropriate erosion control measures (e.g., soil compaction, soil covers, seeding, mulch and/or tackifiers) to stabilize soil berms, grade cuts, fills and other disturbed lands in accordance with the ESC, as warranted. Establish long-term topsoil/root zone material storage berms at locations away from regular facility operations and areas with potential for overland water flow.
<i>Drainage</i>	<ol style="list-style-type: none"> Ensure that ditches and culverts are in place and free of obstructions to facilitate site drainage.
<i>Topsoil/Root Zone Material Replacement</i>	<ol style="list-style-type: none"> Replace topsoil/root zone material evenly over disturbed land surfaces where reclamation will occur.
<i>Equipment/Vehicle Travel</i>	<ol style="list-style-type: none"> Limit equipment/vehicle travel over surfaces where topsoil/root zone material has been replaced.
<i>Garbage and Debris</i>	<ol style="list-style-type: none"> Remove all garbage and debris from the facility construction site. Conduct an underwater survey to identify the presence of construction debris. Immediately remove underwater debris, if present.
<i>Seeding</i>	<ol style="list-style-type: none"> Seed disturbed lands as soon as practical following replacement of topsoil/root zone material. See recommended seed mixes for facilities by location in Appendix D of this EPP.

Activity/Concern	Mitigation Measures
<i>Seed Quality</i>	14. Use only Canada Certified No. 1 or best available agronomic seed. Do not use seed that contains Prohibited Noxious or Noxious weeds. Retain the Certificate of Analysis documentation for facility site records.
<i>Visual Barriers</i>	15. Where considered warranted, install tree and/or shrub plantings around identified building structures or fence perimeters to provide a visual screen (see example in Detail 5 provided in Appendix C of this EPP and additional information in the Reclamation Management Plan, Section 9.0 of Volume 6 of the Environmental Plans). Avoid using forage species for visual screens in unsecured areas that will attract ungulates.
<i>Fences</i>	16. Repair existing and/or install new permanent fencing and gates about the facility site to secure the area to operational requirements.
<i>Weed Control</i>	17. Maintain weed control during clean-up and reclamation activities.
<i>Equipment</i>	18. Remove all Project equipment and materials from marine areas that will not be utilized during operations of the WMT.

10.0 WESTRIDGE MARINE TERMINAL FACILITY TESTING

Introduction

Prior to the operation of the WMT expansion, systems will require a hydrostatic test, which is then followed by dry (no oil present) and wet (oil present) commissioning to facilitate final testing and calibration of facility components. The following mitigation measures will be implemented, as necessary, during hydrostatic testing where water will be used for pressure testing of terminal piping. Water will be obtained from the City of Burnaby. Trans Mountain will work with the City of Burnaby to demonstrate filing conformance. The Hydrostatic Testing Plan will be filed with the NEB pursuant to NEB Conditions 112 and 113, respectively.

Objectives

The objectives of these mitigation measures are to:

- ensure hydrostatic pressure testing activities are conducted in accordance with all approval conditions and permits; and
- reduce or avoid effects on the marine environment waterbodies used during hydrostatic testing of WMT piping and facility components.

Activity/Concern	Mitigation Measures
<i>Approvals, Authorizations, Licences and Permits</i>	<ol style="list-style-type: none"> 1. Conduct hydrostatic testing activities in accordance with the Hydrostatic Testing Plan filed with the NEB pursuant to NEB Conditions 112 and 113, respectively. Ensure that hydrostatic testing is conducted in accordance with applicable permit requirements and that all necessary approvals are obtained prior to commencing hydrostatic testing activities. Refer to permitting and notification requirements provided in Section 5.0 of this EPP. 2. Retain records (including dates) of all key hydrostatic testing activities (e.g., water withdrawal location, rates and volumes, sampling results, discharge locations, rates and volumes).
<i>Water Additives</i>	<ol style="list-style-type: none"> 3. Review potential issues associated with the testing program, including water quality and, if appropriate, identify any chemical additives (including Material Safety Data Sheets) to be used during the testing program. Obtain approval from the Environmental Inspector, if required, for the use of the additives.
<i>Discharge</i>	<ol style="list-style-type: none"> 4. Ensure that the appropriate testing and treatment measures are implemented in accordance with the BC <i>Waste Discharge Regulation</i>, BC Reg. 320/2004.
<i>Sampling</i>	<ol style="list-style-type: none"> 5. Conduct sampling of soils at discharge sites (e.g., soils and water), receiving test water, if warranted, to abide by requirements related to test water discharge and any other application/approval requirements.
<i>Hydrostatic Test Plan</i>	<ol style="list-style-type: none"> 6. Notify the Construction Manager or designate and an Environmental Inspector a minimum of 72 hours prior to commencing water withdrawal and test water discharge activities. 7. Adhere to the applicable measures outlined in the Hydrostatic Testing Plan that is filed at least 90 days prior to pressure testing any Project component as per NEB Conditions 112 and 113.
<i>Equipment and Workers</i>	<ol style="list-style-type: none"> 8. Ensure that sufficient workers and equipment are available on-site to repair any rupture, leak or erosion problem that might arise during testing.
<i>Water Trucks</i>	<ol style="list-style-type: none"> 9. Ensure that water hauling trucks for test water are clean and inspected prior to use.

Activity/Concern	Mitigation Measures
<i>Withdrawal</i>	10. Work with the City of Burnaby to demonstrate filing conformance prior to withdrawing water for hydrostatic testing.
<i>Dewatering</i>	<p>11. Follow all dewatering measures outlined in the Hydrostatic Test Plan and the Water Withdrawal and Discharge Procedures Management Plan (see Section 8.0 of Volume 6 of the Environmental Plans).</p> <p>12. Monitor discharge locations to ensure that no erosion or flooding occurs. If conditions become saturated to the extent that adequate natural filtration is no longer occurring, suspend dewatering and move the discharge to another approved location (confirm that appropriate approvals and, if warranted, soil testing have been completed) or construct a holding pond for the water and release the water when natural filtration is feasible.</p> <p>13. Ensure the areas that are to receive discharged water are approved by an Environmental Inspector in accordance with the Appropriate Government Authority guidance.</p> <p>14. Conduct testing of the test water and soils at the discharge site in accordance with applicable federal and provincial requirements.</p> <p>15. Dewater onto areas approved by the Environmental Inspector where water will be filtered through vegetation and soils before returning to a watercourse, wetland or lake. Provide scour protection (e.g., use of rock aprons, plastic sheeting, plywood and straw bales) or an energy diffuser (e.g., dissipater and protective rock, marine water quality management during rip rap removal, sheeting, tarpaulins or other equivalent materials) at the discharge site, as approved by the Environmental Inspector. The rate of discharge will be reduced if these measures are ineffective.</p>
<i>Sample Collection</i>	16. Collect samples of source water, hydrostatic test water and soil of the receiving environment prior to discharge and analyze according to the parameters listed in the Water Withdrawal and Discharge Procedures Management Plan (see Section 8.0 in Volume 6).
<i>Pigging Debris</i>	17. Collect pigging debris and dispose of it at an acceptable location (e.g., an approved landfill). Dispose of remaining construction waste in accordance with the Appropriate Government Authority.
<i>Daylighting</i>	18. Follow applicable EPP protection measures if exposure (daylighting) of below-grade sections of facility piping is necessary for inspection or repairs.

11.0 REFERENCES

11.1 Literature Cited

- British Columbia Ministry of Environment. 2004. *Waste Discharge Regulation* B.C. Reg. 320/2004. Website: http://www.bclaws.ca/Recon/document/ID/freeside/50_320_2004. Accessed: November 2016.
- British Columbia Oil and Gas Commission. 2009. British Columbia Noise Control Best Practices Guideline. Website: <http://www.bcogc.ca/node/8152/download>. Accessed: November 2016.
- Canadian Standards Association. 2015. CSA Z662-15 Oil and Gas Pipeline Systems. Mississauga, ON.
- Health Canada. 2015. Workplace Hazardous Materials Information System. Website: <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simlut/index-eng.php>. Accessed: November 2016.
- Environment and Climate Change Canada. 2017. General Nesting Periods of Migratory Birds in Canada. Website: <https://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1>. Accessed: May 2017.
- Fisheries and Oceans Canada (DFO). 2016. Golden Star Tunicate: *Botryllus schlosseri*. Available at: <http://www.dfo-mpo.gc.ca/science/environmental-environnement/ais-eae/species/golden-star-tunicate-eng.html>. Accessed: May 2017.
- Kinder Morgan Canada Inc. 2017. *Environment, Health and Safety Policy*. Calgary, AB. 1 pp.
- National Energy Board. 2011. National Energy Board Remediation Process Guide. Website: <https://www.neb-one.gc.ca/sftnvrnmnt/nvrnmnt/rmdtnprcssgd/rmdtnprcssgd-eng.pdf>. Accessed: November 2016.
- Transport Canada. 2009. Water Intakes Brochure. Website: <http://www.tc.gc.ca/publications/bil/tp14591/pdf/hr/tp14591b.pdf>. Accessed: November 2016.

11.2 GIS Data and Mapping References

This subsection includes references cited on the figures accompanying this report.

- Alberta Tourism, Parks and Recreation. 2012. Protected Areas (pashape_ocsites_10tm) (digital file). Edmonton, AB. Available: <http://albertaparks.ca/albertaparksca/library/downloadable-data-sets.aspx>. Acquired: February 2013. Last Update Check: August 11, 2015.
- AltaLIS. 2010. Alberta Settlements (digital file). Calgary, AB. Available: http://www.altalis.com/products/base/20k_base_features.html. Acquired: February 2011. Last Update Check: September 17, 2014.
- AltaLIS. 2012. Alberta Provincial Parks (digital file). Calgary, AB. Available: http://www.altalis.com/products/base/20k_base_features.html. Acquired: August 2012. Last Update Check: September 17, 2014.
- AltaLIS. 2016. Alberta Municipal Boundaries (digital file). Calgary, AB. Available: <http://www.altalis.com>. Acquired: January 2016. Last Update Check: January 4, 2016.
- BC Forests, Lands and Natural Resource Operations. 2008. Freshwater Atlas Lakes (digital file). Victoria, BC. Available: <https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: August 2011. Last Update Check: July 15, 2014.
- BC Ministry of Forests, Lands and Natural Resource Operations. 2007. Tantalus Municipalities (digital file). Victoria, BC. Available: <https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: May 2013. Last Update Check: November 20, 2014.

- BC Ministry of Forests, Lands and Natural Resource Operations. 2008. Tantalus Conservancy Areas (digital file). Victoria, BC. Available: <https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: September 2014. Last Update Check: November 20, 2014.
- BC Ministry of Forests, Lands and Natural Resource Operations. 2012. Digital Road Atlas (DRA) - Master Partially Attributed Road Data (digital file). Victoria, BC. Available: <https://apps.gov.bc.ca/pub/dwds/home.so>. Acquired: December 2015. Last Update Check: December 15, 2015.
- CH2M HILL Energy Canada, Ltd. 2015. Raptor Nests for EFDs (digital file). Calgary, AB. Mapped May 21, 2015.
- ESRI. 2005. U.S. State Boundaries (digital data). Redlands, CA. Received: via DVD with ArcGIS software, visit <http://www.esri.com/data/data-maps> for more info. Acquired: September 2006. Last update check: N/A.
- Government of Canada. 2016. Aboriginal Lands, Canada (digital file). Edmonton, AB. Available: <http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/815dd99d-4fbd-47cc-be02-7ad4b03a23ec.html>. Acquired: January 2016. Last Update Check: January 11, 2016.
- IHS Inc. 2004. IHS Hydro Line Data (digital file). Calgary, AB. Received: via DVD, visit <http://www.ihs.com> for more info. Acquired: June 2011. Last Update Check: November 16, 2015.
- IHS Inc. 2004. IHS Hydro Region Data (digital file). Calgary, AB. Received: via DVD, visit <http://www.ihs.com> for more info. Acquired: June 2011. Last Update Check: November 16, 2015.
- IHS Inc. 2016. IHS Road Segments (digital file). Calgary, AB. Received: via DVD, visit <http://www.ihs.com> for more info. Acquired: April 13, 2016. Update Interval: Monthly.
- Kinder Morgan Canada. 2012. Existing Trans Mountain Pipeline (TMPL) and TMPL Kilometre Post (digital files). Calgary, AB. Received via FTP. Acquired: May 9, 2012. Last Update Check: N/A.
- Kinder Morgan Canada. 2016. Facility Points (digital file). Calgary, AB. Received via FTP. Acquired: December 2, 2016. Last Update Check: N/A.
- Kinder Morgan Canada. 2016. Orthorectified Imagery (digital file). Calgary, AB. Received via FTP. Acquired: August 16, 2016. Last Update Check: N/A.
- Kinder Morgan Canada. 2016. Facility Fencelines (digital file). Calgary, AB. Received via FTP. Acquired: August 23, 2016. Last Update Check: N/A.
- Kinder Morgan Canada. 2016. Facility Footprints (digital file). Calgary, AB. Received via FTP. Acquired: December 2, 2016. Last Update Check: N/A.
- Kinder Morgan Canada. 2016. Project Sanctioned Access Roads (digital file). Calgary, AB. Received via FTP. Acquired: June 6, 2016. Last Update Check: N/A.
- Natural Resources Canada. 2003. Canadian Geographical Names (digital file). Ottawa, ON. Available: <http://geobase.ca/geobase/en/data/cgn/index.html>. Acquired: December 2011. Last Update Check: December 2011.
- Natural Resources Canada. 2010. North American Atlas – Hydrography (digital file). Ottawa, ON. Available: <http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/4a778c9f-00b1-5fce-aa2f-42a90d19eb24.html>. Acquired: June 2012. Last Update Check: January 6, 2015.
- Natural Resources Canada. 2012. CanVec -Transportation - 1020009 Railway (digital file). Sherbrooke, QC. Available: <http://geogratis.gc.ca/geogratis/en/download/topographic.html>. Acquired: June 2012. Last Update Check: November 2012.

Natural Resources Canada. 2016. Canada Lands Administrative Boundaries Level 1 (digital file). Ottawa, ON. Available: <http://geogratis.gc.ca/api/en/nrcan-rncan/ess-sst/eb3757cc-d08b-5e62-9a44-3a8534ff3249.html>. Acquired: January 2016. Last Update Check: January 8, 2016.

TERA Environmental Consultants. 2008. Hillshade. Derived from Natural Resources Canada, Earth Sciences Sector, Centre for Topographic Information. 2000-2008. Canadian Digital Elevation Data 250k (digital files). Sherbrooke, QC. Available: <http://www.geobase.ca/geobase/en/data/cded/index.html>. Acquired: 2008. Last Update Check: December 2010.

TERA Environmental Consultants. 2010. PNG Grid (digital files). Calgary, AB.

UPI. 2017. Proposed KPs, Centerline SSEID005 (digital files). Calgary, AB. Received via FTP. Acquired: January 10, 2017. Data Current to: January 10, 2017.

APPENDIX A

CONTACTS

TABLE A-1
EMERGENCY CONTACTS

Contact	Location	Phone Number
Emergency Assistance	Province-wide	9-1-1
Royal Canadian Mounted Police	Burnaby	1-604-294-7922
Emergency Medical Services (Ambulance)	Dispatch Cell/SAT Phone	1-800-461-9911 1-250-374-5937
Hospital/Clinic	Burnaby Hospital (Burnaby)	1-604-434-4211
Fire	Non-Emergency Burnaby	1-604-294-7190
BC MOE 24-hour Spill Line	BC	1-800-663-3456
NEB	Pipeline Emergency Other NEB operations-related emergencies Vancouver Office	1-819-997-7887 1-403-807-9473 1-604-666-3975
DFO Observe, Record and Report Hotline	BC	1-800-465-4336
Transportation Safety Board	Canada-wide	1-800-387-3557
Conservation Officer Service	BC	1-877-952-7277
BC One-Call	BC	1-800-474-6886
Western Canadian Spill Services Oil Spill Co-operative – 24-Hr Emergency	BC	1-866-541-8888
Forest Fires	BC Forest Fires Reporting Centre	1-800-663-5555
Trans Mountain – Environment, Health and Safety	Burnaby	1-604-268-3008
Trans Mountain Operations Supervisor	Burnaby	1-604-268-3040
Trans Mountain – 24-hour Emergency Line	BC	1-888-876-6711
Vancouver Traffic VHF	BC	Channels 12/11/74/16

APPENDIX B

CONTINGENCY PLANS

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1.0 CONTAMINATION DISCOVERY CONTINGENCY PLAN

1.1 Pre-Job Planning

A list of areas with moderate to high potential risk for contamination is provided in the Contamination Identification and Assessment Plan (Section 3.2 of Volume 6 of the Environmental Plans). In accordance with the Contamination Identification and Assessment Plan, a Contamination Resource Specialist will ensure the appropriate response and mitigation is carried out during construction in the identified high-risk areas. When working in areas of moderate risk, the Environmental Inspector will ensure workers are aware of the potential to encounter contamination. If unexpected contamination is encountered, this Contamination Discovery Contingency Plan will be initiated.

Recognition and Response

Identification of Contamination

Soil, surface water and groundwater contamination can generally be recognized by one or more of the following:

- unusual, hydrocarbon or chemical odour;
- visual sheen;
- visual free product (oil or other product);
- visual staining;
- high soil vapour concentrations; and/or
- asbestos or asbestos containing material (ACM) (>1% by weight of asbestos fibres and powder/dust or friable).

Contamination will be identified by way of visual field observation and field screening. Visual field indicators to identify asbestos include: serpentine rock, fibrous appearance, greasy luster; for ACMs: brake pads, cement piping, vinyl tiles, home insulation, cement siding); and for asbestos deposit areas: former landfills, asbestos dumps including other signs of waste deposition (e.g., fill, liners, surficial evidence). The microPHAZIR™, which is owned by ThermoFisher Scientific, is the tool for field screening when excavation during construction is performed and the presence of asbestos or ACMs is suspected.

The microPHAZIR™ is a handheld portable analyzer that has been demonstrated to provide non-destructive screening of six types of asbestos fibres (i.e., Chrysotile, Anthophyllite, Tremolite, Actinolite, Amosite/Crocidolite) via infrared analyses. ThermoFisher Scientific demonstrated the microPHAZIR™ detection limits are for concentrations greater than 1% asbestos fibres determined by analyzing asbestos reference standards with known concentrations.

Notification Framework

Upon the identification of contamination, work in the area will cease immediately, and the Environmental Inspector will be notified. The Environmental Inspector will immediately notify the Senior Compliance Advisor of the discovery. The Senior Compliance Advisor will ensure the timely notification to the National Energy Board (NEB) and other Appropriate Government Authorities.

A Contaminated Sites Resource Specialist with experience in contaminated sites will be contacted and required to be present at the identification site to verify the indications of potential soil and groundwater contamination (i.e., sheen and adjacent soil staining) and to assist in monitoring and mitigation.

Signage will be posted in areas with moderate to high potential risk for contamination to alert workers of the increased risk.

The Land Agents and/or Lands Group, Stakeholder Engagement and Communication Team, and the Aboriginal Engagement Team will also determine the requirement for notification of affected landowners and/or occupants, Aboriginal groups, and other municipal or regional agencies and will coordinate these notifications, as required.

Health and Safety

Upon discovery of contamination, the health and safety of personnel and the public is the first priority. Contractors and personnel on-site will suspend all work in the area, shut equipment down and immediately notify the Construction Manager or designate and an Environmental Inspector. Appropriate personal protective equipment will be worn, and all reasonable measures will be taken to ensure that health and safety of anyone in the immediate area is preserved. Personnel and Contractors will employ all measures and requirements outlined in the Construction Health and Safety Management Plan as well as any other measures or requirements.

Interim Mitigation

The Environmental Inspector and Contaminated Sites Resource Specialist must be consulted when determining the necessary mitigation measures that are to be implemented when it is safe to do so. In all instances, the migration of the contamination from the disturbed area must be minimized. Mitigation measures may include the following:

- Segregating contaminated soil for later sampling and/or analysis and disposal.
- Placing contaminated soil onto an impermeable surface.
- Covering contaminated soil with an impermeable cover in cases where precipitation may cause runoff.
- Constructing berms to control runoff, in cases where runoff is imminent.
- Stopping contaminated water discharge.
- Storing contaminated water in tanks for later sampling and/or analysis and disposal.
- If sampling is required, laboratory analytical parameters for soil and groundwater are to be based on site history and land use. Potential contaminants of concern are outlined in the Contamination Identification and Assessment Plan (Volume 6 of the Environmental Plans).
- Signage will be posted in the area of suspected contamination to alert workers of the increased risk.
- Mitigation measures will be implemented as soon as possible following the discovery of contamination. The Implementation of mitigation measures will be based on the severity and risk of the contamination that is discovered.
- If asbestos or asbestos containing materials (ACMs) are discovered through field screening during construction:
 - Excavation activities are to cease; and engineering controls are to be enacted to mitigate dust. Mitigation will include soaking the area of suspected asbestos with water.
 - If necessary to continue work, personnel in the area affected by asbestos will wear appropriate PPE including half mask or full mask respirators with HEPA filters for which they have previously been fit-tested. Personnel air sampling will be required to demonstrate engineering control enacted to mitigate dust are effective.
 - Soils containing, or suspected to contain asbestos will be segregated, wetted, and covered until appropriate disposal is determined, following receipt of laboratory analyses.

Contamination Management Requirements

Contaminated material will be disposed of at approved facilities in accordance with provincial and federal regulations and follow the measures outlined in the NEB's Remediation Process Guide. Facilities for disposal must be pre-approved by Trans Mountain. This includes third party waste brokers, transporters, consultants and contractors. A list of Alberta and BC approved waste landfills for disposing of contaminated material are provided in Appendices D and E, respectively of the Waste Management Plan". The updated plan will be submitted to the Board prior to construction.

Excavations in which contaminated soil and/or groundwater has been discovered must not be backfilled until authorization has been given by the Construction Manager and Environmental Inspector. Soil brought on-site to fill excavations must be approved by the Environmental Inspector prior to use.

Contaminated soil and water must not be transported off-site or disposed of until analytical results have been received as per applicable federal and provincial regulations and as outlined in the Contamination Identification Assessment Plan (Section 3.0 of Volume 6 of the Environmental Plans). The Construction Manager and the Environmental Inspector will provide notification as to when excavations can be backfilled.

2.0 FIRE CONTINGENCY PLAN

The Contractor will develop a Fire Contingency Plan (Volume 4C, Section 5.2.7) and a Fire Prevention Plan (Volume 4C, Section 5.2.8) that will include, at a minimum, the guidelines in the TMEP Health and Safety Management Plan. This plan will be used in conjunction with the Fire Contingency Plan and the Fire Prevention Plan during all phases of construction.

In the Event of a Wildfire

- The following response measures will be implemented, as warranted, in the event of a fire.
- Commence fire suppression measures immediately upon detection of a fire, provided that current fire behaviour allows personnel to safely proceed.
- Report location of fire as well as size, wind direction, fuels burning and immediate values at risk to the Fire Boss.
- The Fire Boss will report all wildfires immediately and relay general fire information to the Senior Compliance Advisor, who will advise the appropriate provincial, municipal or federal authorities.
- All equipment and personnel shall be made available to control the fire. Suppression efforts will take into consideration fire behaviour, safety, training and fitness of personnel, as well as equipment availability.
- The Fire Boss will inspect the fire as soon as possible and take charge of directing suppression measures until relieved by a responding authority official.
- Moveable material, particularly explosive or flammable materials and/or vehicles, will be promptly moved to a safe location whenever there is a possibility of being endangered by fire.
- Fire suppression efforts shall continue until the fire is extinguished, until it is no longer safe for Project personnel to respond to the fire, or until otherwise notified by the appropriate jurisdictional authority (*i.e.*, BC MFLNRO).
- The Fire Boss will ensure that all burning embers are extinguished and will monitor burn area for smouldering material. If available, employ infrared scanning equipment to detect any residual hot spots.

To Report a Wildfire:

BC - 800-663-5555 (or *5555 on most cellular networks).

General Fire Information

When a fire is encountered adjacent to or within the vicinity of the facility footprint, make note of the following fire and site conditions prior to reporting the fire:

- crew contact information;
- location of the fire;
- fuel the fire is burning in (trees, grass, etc.);
- approximate size of the fire;
- how quickly the fire is spreading;
- colour of the smoke;
- values at risk (lives, structures, etc.); and
- local weather (temperature, local wind speed and direction, etc.).

3.0 HERITAGE RESOURCES DISCOVERY CONTINGENCY PLAN

*****Note: Personnel are NOT permitted to collect and/or keep any artifacts.***

The following procedures provide contingency measures for the discovery of heritage resources and during construction of the Project.

Heritage Resource Discovery during Construction

In the event that suspected heritage resource sites are discovered during construction, implement the measures listed below.

- The Environmental Inspector will notify the Construction Manager, Trans Mountain Environment (who will determine if the services of a Heritage Resource Specialist may be necessary) and the Senior Compliance Advisor, who will notify the appropriate regulatory authority as required.
- Prohibit the collection of any historical, archaeological or palaeontological resources by Project personnel, except for qualified Heritage Resource Specialists acting as authorized by the appropriate regulator/permit.
- Suspend work immediately in the vicinity (*i.e.*, within 30 m) of any newly identified archaeological, palaeontological or historical resource sites (*e.g.*, modified bone, pottery fragments and fossils). Work at that location may not resume until the measures below are implemented. Clearly mark the site using fencing and flagging to secure avoidance, where appropriate.
- As and where required, a Heritage Resource Specialist will develop, if warranted, an appropriate mitigation plan in consultation with the Environmental Inspectors, the Construction Manager, the appropriate regulatory authority, as well as the applicable Aboriginal communities. The mitigation measure options available include those measures for site avoidance, systematic data recovery and monitoring/surveillance.

Human Remains Discovered During Construction

In the event that suspected human remains are discovered during construction, implement the mitigation measures listed below.

- Suspend work immediately in the vicinity (*i.e.*, within 30 m) of the newly identified human remains. Work at that location may not resume until the measures below have been implemented.
- The Environmental Inspector will notify the Construction Manager, the Chief Activity Inspector, Trans Mountain Environment (who will determine if the services of a Heritage Resource Specialist may be necessary) and the Senior Compliance Manager, who will, if warranted, notify the local police and appropriate regulatory authorities.
- If there is potential for disturbance to the site due to trafficability or high public visibility, assign employees to stand watch until the Heritage Resource Specialist arrives.
- Stake or flag off the location to secure avoidance.
- Cover any exposed remains with clean plastic sheeting, tarpaulin, a blanket or other covering until the Heritage Resource Specialist is present.
- Do not backfill. If excavated fill has been loaded into a truck, empty the excavated fill at a nearby secure location for the Heritage Resource Specialist to inspect.
- The Contractor will only resume work in that area once the archaeological and forensic studies are complete, clearance has been granted by the appropriate regulatory authority and Trans Mountain has been advised that work can continue.

4.0 MARINE SPILL CONTINGENCY PLAN

4.1 Introduction

The Marine Spill Contingency Plan has been prepared for construction activities being completed at the WMT. This plan demonstrates that Trans Mountain has appropriate response capabilities and measures in place to effectively address potential releases during construction at the WMT.

Purpose and Scope

Spill reporting procedures are applicable to all Trans Mountain construction activities. These procedures are specific to the WMT and will be followed in the event of a spill or release, within this facility or contamination of coastal waters during construction activities associated with the Project.

The purpose of this plan is to provide direction on how to quickly, safely and effectively respond to a construction phase marine spill at the WMT to ensure the protection of the public, employees and Contractors, the environment and company property. In addition, this plan will ensure that all releases of hazardous materials are reported to the appropriate authority, as required. As a federally regulated company, Trans Mountain is responsible for reporting any volume of spill at the WMT to the NEB.

This Marine Spill Contingency Plan identifies the lines of authority and responsibility, establishes proper reporting and communication procedures and outlines an action plan, to be implemented in the event of a marine spill. This Marine Spill Contingency Plan applies to fuel, hydrocarbons, chemicals and other potentially harmful substance released at the WMT.

It should be noted that the WMT is currently operational and has an existing operational-phase ERP, which already addresses most potential spills that could occur during future construction activities. However, a few construction-specific activities may result in spills, such as:

- spills from on-land construction vehicles/equipment that drain into the ocean;
- spills from vessels engaged in construction activities (e.g., tugs and workboats); and
- spills from construction equipment on barges (e.g., drill rigs, pile drivers, dredgers and front-end loaders).

4.2 Response Organization

All spills into or threatening a body of water are considered reportable through the Emergency Response Line process, as a reportable incident, to the Senior Compliance Advisor. The Senior Compliance Advisor must report any incident of a spill or release at the WMT directly to the NEB, as soon as practical, and take appropriate measures to remediate the contamination. The NEB also requires notification of the contamination, in writing, to the Secretary of the Board (NEB 2011). Details regarding the reporting and notification requirements are contained in Section 7.0 of this Appendix.

Emergency spill response equipment will be located, as a responsibility of the contractor, in the TMEP WMT Oil Spill Containment and Recovery location. The location and contents of the emergency spill response equipment will be discussed intermittently during daily safety meetings. Further information regarding this equipment can be obtained from the Contractor.

Immediate notification of a spill to the WMT Supervisor is crucial. Immediately contact local emergency response in the event of a spill involving danger to human life.

For marine pollutant or spills in Vancouver harbour, call Vancouver Traffic VHF 12/11/74/16 immediately. For a spill to the marine environment, immediate notification to Canadian Coast Guard Marine Communications and Traffic Services (MCTS) is required (see <http://www.ccg-gcc.gc.ca/e0003876>). All accidental over side discharges should be reported immediately to the Operations Centre (1-604-665-9086). If the discharges contain oil or other deleterious substances, the vessel must immediately notify the MCTS and activate its pollution response plan. The Port Information Guide

(VFPA 2016) provides more information and clarification regarding reporting requirements (see <https://www.portvancouver.com/marine-operations/port-information-guide/>).

Westridge Marine Terminal Contractor Responsibilities

WMT Contractors will be responsible for prevention, preparedness, response and reporting on their work sites during the construction phase of the Project. WMT Contractors must maintain an up-to-date inventory and location knowledge of response materials at the worksite. The Contractor must provide training, prior to work, and implement regular emergency response exercises to enable TMEP workers and subcontractors to perform their designated emergency response responsibilities. It will be the Contractor's responsibility to immediately inform the WMT Supervisor, TMEP management and the Senior Compliance Advisor in the event of a spill or release.

Equipment

Emergency response equipment and materials will be provided to WMT Contractors to be stored on-site, as close to the area of work as feasible. These materials will include, but are not be limited to: booms; skimmers and other collection devices; sea-water pumps; hoses; sorbents; fire nozzles; containment vessels; spill kits; and personal protective equipment. Any concerns regarding additional response equipment should be directed to the WMT Supervisor, who will be able to source supplementary equipment through local service providers in the area.

Initial Assessment

In the event of any incident, the location and circumstances will be assessed to determine the safety hazards, human and environmental resources at risk of adverse effect and potential of the incident escalating into a greater incident. This assessment will be conducted by the Environmental Inspector or the WMT Supervisor, depending on the circumstances. The priorities of the Environmental Inspector in the event of a release incident are to:

- protect people and environment;
- stop the source, if safe to do so; and
- contain the release.

Recovery

After the initial assessment is complete, recovery of free product or materials with high concentrations of spilled product should be performed as soon as feasible to reduce the extent of effects to the shoreline, sediment and water.

Detailed Assessment

After the initial assessment and recovery activities are complete, a detailed assessment of effects resulting from the spill is required. This assessment will: investigate the effects to the shoreline, sediment, water and wildlife in detail; provide comparisons of concentrations of parameters of concern with applicable guideline concentrations; and provide recommendations for remedial activities, if warranted.

Remediation

Remedial activities recommended in the detailed assessment should be implemented as soon as feasible following the spill to bring sediment and water conditions into compliance with regulations. Long-term monitoring may be required as a result of certain spills. A remediation report is required to be submitted to the appropriate bodies.

Closure

Once the site has been brought back into compliance with applicable regulations and monitoring activities are complete, a closure report is required to be submitted to the appropriate bodies.

5.0 RARE ECOLOGICAL COMMUNITIES OR RARE PLANT SPECIES DISCOVERY CONTINGENCY PLAN

In the event that previously unidentified potential ecological communities or rare plants (vascular plant or bryophyte [moss or liverwort]), or lichens are discovered on or within 30 m of the facility construction and/or associated components prior to or during construction (*i.e.*, borrow sites, temporary access roads and temporary workspace footprint), follow the measures outlined below.

- Note the location of the potential rare plant, lichen or ecological community relative to the facility.
- Notify the Environmental Inspector. The Environmental Inspector will contact Trans Mountain Environment to discuss the need for a Vegetation Resource Specialist.
- Send a photograph of the potential rare element and any additional details regarding the element and the site to a qualified Vegetation Resource Specialist.
- Avoid further disturbance to the location or within 10 m of the location until a qualified Vegetation Resource Specialist has been consulted.
- If warranted, the Vegetation Resource Specialist will be required to attend the site and will determine if site-specific mitigation measures are required.
- The Vegetation Resource Specialist will then develop an appropriate site-specific mitigation plan in consultation with Trans Mountain following the Rare Ecological Community and Rare Plant Population Management Plan (see Section 5.0 of Volume 6 of the Environmental Plans); this site-specific plan will be developed in consultation with the Environmental Inspector.

6.0 SOIL EROSION AND SEDIMENT CONTROL CONTINGENCY PLAN

Where soil erosion by wind or water is evident during the construction phase of the WMT and associated components (e.g., access roads), all necessary Contractor equipment and personnel will be made available to control the erosion. During the construction phase, the Chief Activity Inspector in consultation with the Environmental Manager will determine appropriate procedures to be implemented to control soil erosion and other soil handling problems encountered. The Senior Compliance Advisor must be notified, who will notify the Appropriate Government Authorities (*i.e.*, BC MOE and NEB), as warranted and as soon as practical, that contingency measures are being/have been implemented (see Contacts provided in Appendix A of this EPP). A record will be made of the location, timing, reason for implementation and measures implemented.

One or more of the following water/wind erosion control options listed below may be implemented, if warranted, where soil erosion is observed. Similar procedures to control erosion will be followed during the operational phase.

Soil Erosion by Water

- Shut down construction until the risk of erosion has been reduced or conditions improve.
- Install sediment fences near the base of slopes, if adjacent to a watercourse or wetland.
- Construct and/or install temporary berms of subsoil, coir logs or sandbags during construction activities on slopes where the risk of erosion is high.
- Salvage topsoil/root zone material and store away from the marine environment, if required.
- Replace salvaged topsoil/root zone material, if practical.
- Implement one or a combination of the following long-term mitigation techniques in terrestrial areas, as warranted.
 - Construct cross ditches or berms decreasing the spacing on steeper slopes or on more erodible soils.
 - Armour the upslope face of berms with coir matting or an erosion control blanket, logs or sandbags.
 - Apply an erosion control blanket, mulch or tackifier to hold soil.
 - Reseed and hand rake an annual cover crop or apply seed and install erosion control blankets.

Soil Erosion by Wind

Topsoil/Root Zone Material

- Temporarily shut down construction at the location where erosion is occurring until the risk of erosion has been reduced or conditions improve; the decision to shut down construction will be made following a discussion involving the Contractor, the Construction Manager and an Environmental Inspector.
- Consider using the following techniques, if wind erosion of the topsoil/root zone material windrow is of concern.
 - Apply water or tackifier (at rate recommended by the distributor) the topsoil/root zone material windrow.
 - Tamp the topsoil/root zone material windrow with suitable equipment.

- Consider using the following techniques if wind erosion of the topsoil/root zone material windrow is of concern after topsoil/root zone material replacement.
 - Seed with an annual or biannual cereal or short-lived perennial grass cover crop species.
 - Apply hydromulch or tackifier.
 - Install wind fences.

Soil Erosion/Sedimentation of Marine Riparian Areas

One or more of the following water/wind erosion control options listed below may be implemented, if warranted, where soil erosion is observed:

- plant rooted stock plants in the spring;
- transplant dormant shrubs and trees from areas adjacent to or within the vicinity of the WMT;
- seed the disturbed area with the appropriate approved native or non-native perennial grass seed mix and cover with erosion control blanket, where warranted; and
- reinforce sloping terrain/shoreline with rock riprap arming or rock gabions.

In the Event of Potential Sedimentation to a Waterbody

The Environmental Inspector will notify the Senior Compliance Advisor that contingency measures have been initiated and will maintain a record of the location, timing and reason for implementation of the contingency plan, if warranted. The Senior Compliance Advisor will notify the NEB that contingency measures have been implemented during the construction of the WMT, as soon as practical.

The procedures outlined below will be implemented progressively or individually as warranted, should an extreme precipitation event threaten the sediment control measures, or other circumstances occur that may render the existing sediment control measures inadequate:

- prohibit the operation of construction equipment close to the shoreline where there is a risk of sloughing, flooding of the work area or damage to sensitive aquatic species and/or habitat;
- install additional sediment fencing to prevent sediment-laden water from entering the marine environment;
- construct berms of sandbags, rock or coir logs on approach slopes to divert runoff from the development zone and onto well-vegetated lands or sediment retention ponds; the location and the composition of the sediment control structures will be approved by the Environmental Inspector; and
- implement one or a combination of the following mitigation techniques for long-term protection measures:
 - plant rooted stock plants in the spring;
 - transplant dormant shrubs and trees from areas adjacent to or within the vicinity of the construction area; or
 - reinforce the shoreline with rock riprap/cobble armouring or rock gabions.

7.0 SPILL CONTINGENCY PLAN

7.1 Introduction

Guidelines for the safe handling, storage, use and disposal of potentially hazardous materials, as well as spill prevention measures and guidelines for the refuelling and servicing of equipment, are provided in Trans Mountain's Waste Management Standard. The Contractor is to report all spills to an Environmental Inspector and the Environmental Manager. The Construction Manager or an Environmental Inspector will immediately notify Trans Mountain via the 24-hour Emergency Line that a spill has occurred. The Senior Compliance Advisor will notify the appropriate provincial and/or federal authorities, as required.

The timeline in which the reporting is to take place is dependent on the size of the spill. An immediately reportable spill is defined as a release of a substance that is likely to be an imminent environmental or human health hazard and/or meets or exceeds reportable volumes listed below, with more information provided in the CMP (Volume 10 of the Environmental Plans). Such spills will be immediately reported to the appropriate federal and/or provincial authorities. Spills with volumes that are not immediately reportable or the substance is not likely to be an imminent environmental or human health hazard are not required to be reported to the applicable federal and/or provincial authorities. Rather, these spills will be tracked and documented by the Environmental Inspectors and submitted to Trans Mountain for inclusion in their spill-tracking databases.

If there is any doubt that the quantity spilled exceeds reportable levels, the spill will be reported to Trans Mountain via the 24-hour Control Centre Emergency Line. The Trans Mountain RCT will determine if the spill should be reported to the appropriate provincial and/or federal authorities. Crucial information that will be provided to the 24-hour Control Centre Emergency Line includes name and telephone number of the caller, date and time of the call, material(s) spilled, location of the spill, estimated quantity spilled, cause of spill, actions taken to-date, assistance required, injuries and weather conditions (KMC 2017).

In BC, a reportable spill is defined by the BC *Environmental Management Act* as:

- a release of 100 L or more of: hydraulic oil, engine/lube oil, gasoline, diesel or solvents;
- a release of 25 L or more of waste oil;
- a release of 5 L or more of engine coolant;
- a release of 25 kg or more of contaminated soils; and/or
- any release to a waterbody or watercourse (see the Spill Scene Checklist in Attachment B2).

For marine pollutant or spills in Vancouver harbour, call Vancouver Traffic VHF 12/11/74/16 immediately. For a spill to the marine environment, immediate notification to the MCTS is required (see <http://www.ccg-gcc.gc.ca/e0003876>). All accidental over side discharges should be reported immediately to the Operations Centre (1-604-665-9086). If the discharges contain oil or other deleterious substances, the vessel must immediately notify the MCTS and activate its pollution response plan. The Port Information Guide (VFPA 2016, page 95) provides more information and clarification regarding reporting requirements (see <https://www.portvancouver.com/marine-operations/port-information-guide/>). All spills, no matter what size or type material, will be reported to the Environmental Inspector by the worker discovering the spill.

Any sites contaminated by a spill will be assessed, remediation will be designed and disposal sites will be identified in accordance with the NEB Remediation Process Guide (NEB 2011). This document will be provided to the Construction Manager or designate and the Environmental Inspectors as part of the Environmental Education Program. Emergency contacts are presented in Appendix A.

7.2 General Measures

The following general measures are to be adhered to during construction of the TMEP.

- Maintain appropriate spill equipment at all work sites based on risk. The risk potential for site-specific spills will be used to determine the appropriate type of response equipment to be stored on-site and a suitable location for storage.
- Post specific instructions regarding applicable contacts and appropriate response actions to be taken in the event of a spill in the field construction offices.

7.3 Initial Response

The following actions will be taken upon detection of a **construction spill** specific to the TMEP.

- Ensure personal safety and the safety of others on-site and don appropriate personal protective equipment.
- The first person on the scene will execute the actions presented in the Spill Scene Checklist (Attachment B2).
- Report the spill to an Environmental Inspector and Chief Activity Inspector.
- When notified of a reportable spill, an Environmental Inspector or designate will immediately ensure that the following actions are taken, where applicable.
 - Action is taken to ensure safety of workers and the public.
 - An on-site Emergency Response Coordinator is designated.
 - The necessary equipment and personnel are mobilized, and measures are being implemented to stop the source of the spill, if safe to do so, and commence clean-up.
 - Trans Mountain Management are immediately notified of the spill.
 - Trans Mountain Management notifies the Senior Compliance Advisor, who will immediately notify the applicable provincial and federal agencies, and the NEB, of the spill if it meets the reporting threshold.
- The Contractor will make all resources available to contain and clean-up the spill.

In the event of an **oil spill associated with the existing Trans Mountain pipeline (TMPL)**, the Contractor must immediately notify Trans Mountain via the 24-hour Control Center Emergency Line (1-888-876-6711). In addition, the following actions will be taken:

- ensure action is taken to ensure safety of workers and the public; and
- attempt to contain the spill to the greatest possible extent without endangering the welfare of workers as directed by Trans Mountain until TMPL emergency spill responders arrive.

The Contractor will make all resources available to TMPL emergency spill responders to facilitate the containment and clean-up the spill.

In the event of a **spill associated with a third-party foreign pipeline**, the Contractor must immediately notify Trans Mountain via the 24-hour Control Center Emergency Line (1-888-876-6711). In addition, the following actions will be taken:

- ensure that action is taken to ensure the safety of workers and the public; and

- coordinate the containment of the spill to the greatest possible extent without endangering the welfare of workers until the third-party pipeline owner's emergency spill responders arrive.

The Contractor will, upon request of the third-party pipeline owner, make resources available to facilitate the containment and clean-up the spill.

7.4 General Spill Containment Procedures

The successful containment of a spill on land or water depends on a variety of factors including: ground cover and topography; hydrogeology; solubility of the material; viscosity of the liquid; water currents; soil permeability; and weather conditions.

The following general guidelines will be followed for containment of spills of hazardous materials.

- Ensure personal safety and safety of others on-site. The first person on the scene will execute the actions listed in the Spill Scene Checklist. This includes a review of the Material Safety Data Sheets.
- Assess the safety hazards of the situation and don appropriate personal protective equipment.
- Remove sources of ignition, if safe to do so.
- Identify the product, stop the source and physically contain the spill as soon as safe to do so.
- Avoid the use of water or fire extinguishing chemicals on non-petroleum product spills since many chemicals react violently with water and chemical extinguishing agents may release toxic fumes. In addition, chemicals may be soluble in water and dispersal makes containment and clean-up more difficult.
- Minimize traffic on contaminated soils.
- Use berms constructed with materials and equipment in proximity to the site to physically contain a spill on land. Deployment of booms will be necessary to contain a spill and prevent contamination spread on water.
- Clean-up will not be attempted without advice from the Environmental Inspector and Trans Mountain.

7.4.1 Spot Spills

Effects from small spot spills can generally be minimized and will not result in the suspension of activities if the appropriate actions listed below are promptly implemented. All small spills of fuels, hydraulic fluids or hazardous materials must be contained, cleaned up and reported immediately to an Environmental Inspector.

- An Environmental Inspector will approve methods to remove or reclaim contaminated soils, in consultation with a qualified specialist, if warranted. Heavily contaminated soil and vegetation will be disposed of at an approved facility s outlined in the Waste Management Plan (Section 3.0 of Volume 6 of the Environmental Plans).
- Locations where spot spills occur are to be recorded.
- All efforts will be made to clean up the release, if residual impacts remain, the steps to further assessing and remediating the contamination will be developed in accordance with the guidance set out in the NEB Remediation Process Guide.

7.4.2 *Spills Occurring During On-site Transportation*

The general guidelines listed below will be followed for the containment of materials spilled during transportation.

- Contain spilled product.
- Pump tanker truck or transportation vessel dry (into appropriate containers or alternative tanker truck).
- Remove tanker truck or transportation vessel from the site.
- Recover spilled product.
- Clean up contaminated area.
- Dispose of contaminated materials at an approved facility in accordance with the Waste Management Plan (Section 3.1 of Volume 6 of the Environmental Plans). All efforts will be made to clean up the release, if residual impacts remain, the steps to further assessing and remediating the contamination will be developed in accordance with the guidance set out in the NEB Remediation Process Guide.

7.4.3 *Spills Adjacent to or into a Watercourse or Wetland*

The general guidelines listed below will be followed for spills adjacent to or into a watercourse or wetland. Refer to Section 4.0 of this Appendix for contingency measures in the event of a spill to the marine environment.

- Construct berms and/or trenches to contain spilled product prior to entry into a watercourse or wetland.
- Deploy booms, skimmers and/or sorbents, if feasible, to contain and recover spilled material from a watercourse or wetland.
- Collect spilled product.
- Clean up the contaminated area, including downstream shorelines.

Dispose of contaminated materials at an approved facility in accordance with the Waste Management Plan (Section 3.1 of Volume 6 of the Environmental Plans). All efforts will be made to clean up the release, if residual impacts remain, the steps to further assessing and remediating the contamination will be developed in accordance with the guidance set out in the NEB Remediation Process Guide.

8.0 WET SOILS CONTINGENCY PLAN

Trans Mountain will assign Environmental Inspectors with sufficient training and soils-related experience to identify soils that are too wet for a particular activity and when the soils are sufficiently dry to allow the activity to resume. The decision to continue or suspend particular construction activities on lands with excessively wet soils will be made by the Construction Manager in consultation an Environmental Inspector. A record of the location, timing and reason for implementation of the Wet Soils Contingency Plan will be maintained by the Environmental Inspectors. In the event that activities are suspended, the Environmental Inspectors will notify the Senior Compliance Advisor as soon as practical, who will notify the NEB, if warranted.

The Environmental Inspectors will be responsible for monitoring ground conditions and ensuring that all suitable protection measures are implemented. Trans Mountain believes that it is critical to maintain effective communication between the Contractor, the Environmental Inspectors and the regulators (*i.e.*, the NEB, via the Senior Compliance Advisor). Therefore, if necessary, a meeting will be held in the field to ensure that all parties involved mutually understand the concerns associated with working in wet conditions.

Soils are considered to be excessively wet when the planned activity could cause: damage to soils either due to rutting by traffic through the surface material into the subsoil; soil structure damage during soil handling; or compaction and associated deformation of surface material due to heavy traffic.

Contingency measures will be implemented, if warranted, if one of the following indicators occurs:

- rutting of topsoil/root zone material to the extent in which admixing may occur;
- soil becomes deformed;
- excessive wheelslip;
- excessive build-up of mud on tires and cleats;
- formation of puddles; and/or
- tracking of mud as vehicles leave the WMT.

In order to avoid terrain disturbance and soil structure damage through rutting or compaction due to wet soil conditions, construction alternatives will be employed, when warranted, in the event of excessively wet surface. The contingency measures listed below will be implemented individually or in combination, as necessary, based on site-specific conditions.

Wet Soil Contingency Measures

- Salvage topsoil/root zone material from the WMT footprint to prevent mixing and rutting (note that topsoil/root zone material salvage cannot be conducted when soils are excessively wet).
- Delay construction until soils dry out.
- Restrict construction traffic, where feasible, to equipment with low ground-pressure tires or wide pad tracks.
- Prevent rubber-tired traffic from driving on areas of the WMT and associated components construction footprint with unsalvaged topsoil.
- Postpone work in highly sensitive areas and shift effort to low sensitivity areas.
- Restrict work to non-problem areas, such as well-drained soils, until conditions improve.
- Install geotextiles or matting in problem areas.

- Suspend construction activities and traffic in areas (outside of the development zone) with wet soil conditions until the soils dry out. Suspension of construction activities on the WMT and/or associated components construction footprint will be based on discussions between the Construction Manager and the Lead Activity Inspector and the Environmental Inspector, the Contractor, and, if warranted, the NEB. Recommencement of work once soils dry out must be authorized by the Construction Manager, in consultation with the Lead Activity Inspector.

Partial Suspension of Construction Activities and Traffic

The primary concern during wet soil conditions is the potential for rutting, compaction and loss of soil structure in the topsoil/root zone material. Criteria to be used in determining how to mitigate for wet or thawed soil conditions or to allow for a mutual decision by the Contractor, the Construction Manager and an Environmental Inspector to suspend activities until soils dry out are provided in Table B-1.

TABLE B-1

**CRITERIA FOR THE SUSPENSION OF ACTIVITIES DUE TO
EXCESSIVELY WET SOIL CONDITIONS OUTSIDE OF THE DEVELOPMENT ZONE**

Topsoil/Root Zone Material Salvage Status	Construction Activity	Suspend Activity for Environmental Issue?
No salvage conducted	Soils handling (topsoil/root zone material - salvage/replacement)	Yes
Topsoil/Root Zone Material salvage in all areas outside of the development zone that will require grading	Materials storage and staging area	No
Topsoil/Root Zone Material replacement	Clean-up	Yes, heavy traffic not permitted; No, quad traffic likely acceptable

9.0 WILDLIFE SPECIES OF CONCERN DISCOVERY AND ENCOUNTER CONTINGENCY PLAN

9.1 Terrestrial or Marine Wildlife Species at Risk or Species of Concern

The following procedures provide contingency measures for the discovery of terrestrial or marine wildlife species prior to and during construction of the WMT and associated components (e.g., access roads). A wildlife species at risk refers to wildlife species listed as Special Concern, Threatened or Endangered on Schedule 1 of the SARA and/or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and are Red or Blue-listed in BC or listed under the *Wildlife Act* (BC). Species of concern refers to wildlife species that have increased potential to be affected by Project activities due to spatial or temporal overlap with the Project during sensitive life stages and therefore may have identified setbacks and timing windows.

Terrestrial or Marine Wildlife Species at Risk or Species of Concern Discovery Prior to Construction

In the event that terrestrial or marine wildlife species at risk or species of concern or their site-specific habitat is discovered during wildlife or other studies at the WMT or other associated components (e.g., access roads) the discovery will be assessed and appropriate mitigation measures will be determined by an Environmental Inspector in consultation with Trans Mountain Environment and a Wildlife Resource Specialist/Marine Wildlife Resource Specialist, as necessary, and as identified on the WMT Environmental Facility Drawing (see Appendix E). The wildlife or habitat will be assessed based on the following criteria:

- the location of the onshore or marine wildlife or habitat feature with respect to the proposed area of development;
- the presence of the topographic environment feature or terrestrial/marine riparian vegetation to effectively screen the wildlife or habitat from construction activities;
- the timing of construction versus the critical timing constraints for the identified species; and
- the potential for an alteration of construction activities to reduce or avoid sensory disturbance.

The mitigation measures to be implemented will be determined by a Wildlife Resource Specialist/Marine Wildlife Resource Specialist and may include the following:

- abide by seasonal timing constraints and the recommended setback distances (as provided by regulatory guidelines, where feasible);
- abide by daily timing restrictions on construction activities, where feasible;
- reduce the proposed area of disturbance and protect the site using fencing or clearly mark the site using flagging when located in the non-marine environment;
- alter or delay construction activities to avoid/reduce sensory disturbance; and
- inform all users of access restrictions in the vicinity of marked, flagged or fenced sites.

The locations of identified important terrestrial and marine wildlife and wildlife habitat encountered within the WMT and appropriate mitigation to be implemented at each known site that have been identified in the WMT Environmental Facility Drawing.

Terrestrial or Marine Wildlife Species at Risk or Species of Concern Discovery during Construction

Wildlife species at risk or species of concern and their habitat that have the potential to occur in the WMT construction footprint or associated components will be identified through the Environmental and Compliance Education Program. The Environmental Inspectors will be provided with detailed information on identifying wildlife species of concern and their site-specific habitat.

In the event of an observation of a wildlife species at risk or species of concern, the mitigation will vary depending on the species. For example, observations of songbirds and/or large mammals, where no associated habitat feature (e.g., an active nest or mammal den) is present, may not warrant mitigation given their ability to move away from the construction area. For other species that may be restricted to a discrete area, mitigation measures (e.g., salvage of individuals in compliance with the appropriate permit) will be reviewed and implemented as required.

In the event that wildlife species at risk or species of concern or their site-specific habitat is discovered during construction, the discovery will be assessed and appropriate mitigation measures will be determined. Upon discovery of a wildlife species of concern or habitat feature during construction, the following will occur.

- Suspend work immediately in the vicinity of any newly discovered wildlife species at risk or species of concern. Do not resume work at that location until the measures below are implemented.
- Notify an Environmental Inspector who will complete the appropriate record keeping/reporting and notify the Construction Manager.
- The Environmental Inspector will assess the discovery and, in consultation with the Construction Manager, will either allow construction to resume or, in the event of a confirmed or potential discovery, proceed by notifying:
 - Trans Mountain's Regulatory and Compliance Team; and
 - a Wildlife Resource Specialist.

A qualified Wildlife Resource Specialist will assess the discovery and determine the appropriate mitigation measures to be implemented in consultation with an Environmental Inspector, the Construction Manager and the appropriate government authority. The Wildlife Resource Specialist, in consultation with the Environmental Inspector and Trans Mountain Environment, will determine if site-specific mitigation is required and if it is necessary to visit the site.

9.1.1 Wildlife Encounter Contingency Plan

In the event of an encounter with wildlife during construction either at the construction site or on the commute to and from the construction site, follow the measures provided below.

- Report any incidents (e.g., aggressive behaviour, nuisance behaviour and obtained food or garbage) with wildlife to an Environmental Inspector who will complete the appropriate record keeping/reporting and immediately notify the Senior Compliance Advisor. The Senior Compliance Advisor will notify the Appropriate Government Authority and, if warranted, the local Fish and Wildlife detachment (see Appendix A of this EPP).
- Report any trapped, injured or dead animals on-site to an Environmental Inspector, who, if warranted, will notify Trans Mountain's Regulatory and Compliance Team so the Appropriate Government Authority can be contacted to consult on appropriate action.
- Report the location and details of collisions with wildlife to an Environmental Inspector, who will notify the appropriate government authority and, if warranted, the local conservation officer, if applicable (see Appendix A of this EPP).

- Once the preceding contacts have been made, the Environmental Inspector will communicate the information to the Construction Manager.

The Environmental Inspectors will document all wildlife encounters during construction in a detailed record. This record will include, at a minimum: date; weather conditions; location; wildlife species encountered; the type of encounter (e.g., passive, aggressive, etc.); and, if applicable, any actions taken by Project staff to address the situation. Wildlife encounter records will be kept on file by Trans Mountain and provided to the Appropriate Government Authority and Aboriginal groups upon request.

Wildlife Sighting Information

Name of Observer: _____ Date of Observation: _____

Location of Observation (KP): _____ Location Name (if applicable): _____

UTM Zone: _____ Easting: _____ Northing: _____

Wildlife Observation:

Species	
Observation Type (e.g., visual, heard animal, observed sign, etc.)	
Age (adult, young, unknown)	
Sex (male, female, unknown)	
Number observed (include numbers of males/females if known)	
Habitat Description (e.g., foreshore)	
Behaviour of Animal (describe what the animal was doing)	
Aggressive Behaviour (Yes or No; if yes describe)	
Additional Comments	

Name of Environmental Inspector Card Submitted to: _____

Date of Submission: _____

10.0 TRADITIONAL LAND USE SITES DISCOVERY CONTINGENCY PLAN

10.1 Traditional Land Use Sites Identified Prior to Construction

In the event that TLU sites are identified during supplemental studies with Aboriginal communities prior to WMT construction, the sites will be assessed and appropriate mitigation measures will be determined. The TLU sites will be assessed based on the criteria as follows:

- the location of the TLU site with respect to the area of development;
- the relative importance of the TLU site to the applicable First Nation community; and
- the potential for an alteration of construction activities to reduce or avoid sensory disturbance.

The mitigation measures listed below have been successful in mitigating effects on TLU sites. Alternative site-specific mitigation strategies may also be recommended by Aboriginal communities, or the Aboriginal Monitor(s) for the construction site. The mitigation measures that may be implemented will be dependent on the type of site identified and its proximity to the construction footprint.

Trapping

Common species of birds and eggs harvested include goldeneye, canvasback, ruddy duck, wood duck, American wigeon, northern pintail, mallard, northern shoveler, green-winged teal, grebe and murre. Traditional harvests of sea mammals may include the hunting of seals, sea lions and whales.

Successful and proven mitigation for potential impacts on trapping sites include:

- adhering to measures to reduce collisions and acoustic impacts to wildlife; and
- effective prevention of spills.

Additional site-specific mitigation measures will be refined and optimized in the field and through community discussions, as warranted.

Fishing

Activities in the inter-tidal areas may include harvesting of shellfish (e.g., clams, mussels, cockles) while deeper waters may include harvest collection of crabs, crustaceans and fish stocks of herring and halibut.

The practice of traditional fisheries relates to the species harvested (inclusive of shellfish and crustaceans) at various life cycle stages (e.g., eggs, juvenile, adult), fishing techniques, and the nature of specific bays and inlets. Fishing methods may include but are not limited to angling, gigging, spear-fishing, dip netting, gill netting, and the construction and use of fish traps and weirs. While fishing activities vary with changes in seasonal water flow and variation in fish stocks, fisheries often exhibit habitual repeated use. Secondary fishing activities relate to the processing of harvests, and may include processing yards, smokehouses, drying racks, and fish-grease rendering features.

Successful and proven mitigation for potential impacts on fishing sites include:

- adhering to species-specific timing constraints, to the extent feasible;
- obtaining applicable permits and approvals prior to construction; and
- effective prevention of spills.

Additional site-specific mitigation measures will be refined and optimized in the field and through community discussions, as warranted.

Plant Gathering

Plant gathering activities extend to marine and freshwater plants, including kelp, marine flowering plants, benthic and detached algae, brown algae, red algae, green algae, and phytoplankton.

Successful and proven mitigation for potential impacts on plant gathering sites include:

- obtain all applicable permits and approvals for weed control;
- harvest plants prior to construction; and
- effective prevention of spills.

Additional site-specific mitigation measures will be refined and optimized in the field and through community discussions, as warranted.

Trails and Travelways

Trails and travelways activities extend through Burrard Inlet and the Westridge Marine Terminal area.

Successful and proven mitigation for potential impacts on trails and travelways include:

- early notification of activities;
- confinement of all activities to the designated workspace; and
- allow for safe passage and navigation through the area.

Additional site-specific mitigation measures will be refined and optimized in the field and through community discussions, as warranted.

Habitation Sites

Habitation sites include traditional campsites, cabins and settlements. Campsites typically have defined hearths (fire rings), de-limbed trees, tent frames and/or miscellaneous cached or discarded camping supplies and equipment. Cabin structures represent a more permanent occupation of the land and include central log or timber-framed structures, traditional activity areas such as drying racks and smoking tents, and ancillary equipment storage areas. A group of cabins or campsites may signify a long-term or intermittent occupation. A settlement may have been used seasonally or throughout the year, depending on location or necessity. The relative size and nature of habitation sites continuously evolve based on how families and communities grow and often expand from campsites to cabins and possibly to settlements.

Successful and proven mitigation measures for potential impacts on habitation sites include:

- avoidance of the site;
- detailed mapping and a photographic recording of the location; and/or
- implementation of detailed recording and controlled excavations.

Gathering Places

Aboriginal people often gather to share in ceremonial activities, exchange items of trade, arrange and celebrate marriages, and for other activities. Additionally, indigenous grave sites are sometimes recorded in the general area of large gathering places. Such gathering places have historical, ceremonial, cultural and economic significance to Aboriginal groups.

Potential effects on gathering places may be mitigated through:

- avoidance of the site; and
- detailed recording and mapping.

However, the visual effect will be assessed in the field and site-specific mitigation measures will be refined and optimized, as warranted.

Sacred Areas

Sacred areas include burials, vision quest locations, rock art panels, birth locations and ceremonial places, among others. A particular element is often only a small component of a larger spiritual complex, which can encompass topographic features and may be, by its very nature in the context of Aboriginal spirituality, inestimable and irreplaceable.

Mitigation measures for potential impacts on sacred areas may include:

- avoidance of the site; and
- detailed recording and mapping.

However, additional site-specific mitigation measures will be refined and optimized in the field and through community discussions, as warranted.

10.2 Traditional Land Use Sites Discovered During Construction

Possible indications that a location might be a previously unidentified TLU site may include the observation of manufactured materials or alteration of natural materials, which appear to be derived from the activities of traditional land users. In the event that previously unidentified TLU sites are identified during construction of the pipeline, the following measures will be implemented, as warranted.

- Flag or fence off the previously unidentified TLU site. Work at that location may not resume until the following measures are conducted. Notify an Environmental Inspector, who will notify the Construction Manager or designate, the Aboriginal Monitor and the Heritage Resource Specialist.
- The Heritage Resource Specialist and the Aboriginal Monitor will assess the site and develop an appropriate mitigation plan using the information listed above.
- The potentially affected Aboriginal group(s) will be informed of the discovery and the mitigation measures to be implemented.

ATTACHMENT B1

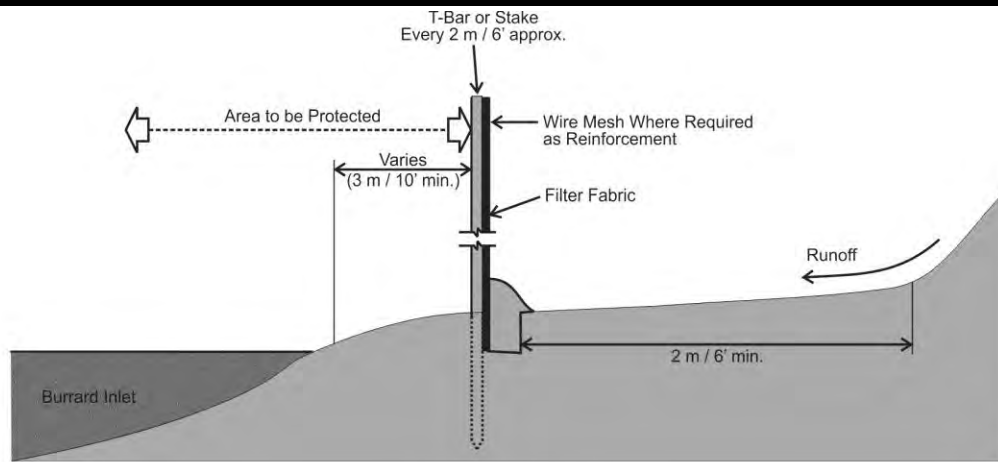
SPILL SCENE CHECKLIST

Note: The following activities will be taken by the first person on the scene of a hazardous material spill or release or a spill of other potentially deleterious material into a watercourse or wetland or environmentally sensitive area, if feasible.

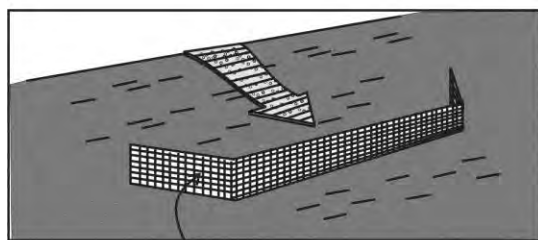
- (a) Ensure personal safety and safety of others on-site and don appropriate personal protective equipment. _____
- (b) If possible without further assistance, assess the safety hazards of the situation, ensure safety of workers and the public and identify the composition (see Spill Report Form - next page) of the spilled material via the Material Safety Data Sheets that are available for each controlled substance. _____
- (c) If feasible and safe to do so, remove any sources of ignition, cut off the source of the spill and initiate a release response plan (*i.e.*, control, contain and clean up). While efforts have been initiated to contain the spill, immediately notify the Trans Mountain Construction Manager, or designate and Environmental Inspector. If the Environmental Compliance Manager, or designate, cannot be immediately contacted, notify Trans Mountain's 24-hour Emergency Line. These people will, as required, contact the appropriate authority as well as applicable federal and provincial agencies and the NEB. _____
- (d) Once the source has been cut off, attempt to contain the spilled material. Seek qualified assistance if necessary. _____
- (f) Take note of details such as time, location, material, volume, corrective actions, for reporting criteria. _____
- (g) In BC, Trans Mountain will provide an immediate verbal report to the BC Ministry of Environment 1-800-663-3456 (24-hour emergency line). Where requested to do so by an environment officer, a written report shall also be filed with the department. In BC, a spill of 100 L or greater must be reported for all Class 3 (Flammable Liquids) spills. _____

APPENDIX C

DRAWINGS/DETAILS

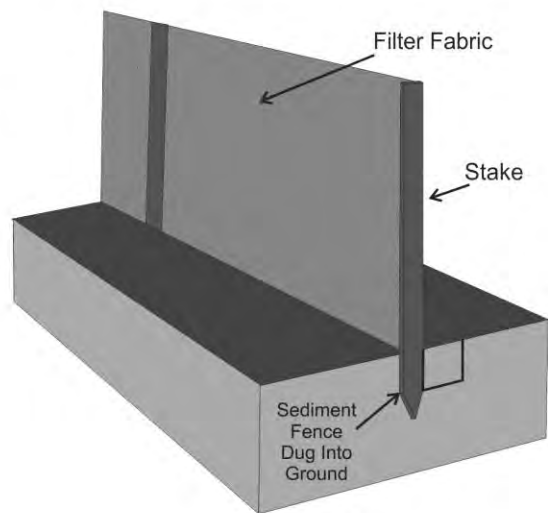


Profile View
(Not to Scale)



Filter Fabric
with Wire Mesh

Oblique View
(Not to Scale)



Oblique View
(Not to Scale)

Representation Only

Notes:

1. Install sediment fences at the base of cut/fill areas to reduce sediment discharge into the marine environment, where warranted.
2. Place sediment fences a minimum 2 m (6 feet), if feasible, from the toe of the slope in order to increase ponding volume.
3. Install sediment fences as soon as practical following clearing if it is determined by the Environmental Inspector that the sediment filtering properties of the cleared vegetation have been affected.
4. In areas with frequent traffic, install two or more sediment fences in a staggered and overlapped configuration to allow vehicle passage without removal or opening of the sediment fence.
5. Ensure sediment fence is keyed into the substrate. Excavate a narrow trench, place the base of the sediment fence in the trench and place the fill back into the trench, securing the sediment fence in place.
6. Maintain sediment fences in place at the base of the approach slopes until revegetation of the construction site is complete.
7. Ensure that sediment fences, if removed or damaged, are reinstalled or repaired prior to the end of the work day.
8. Remove synthetic sediment fences after the disturbed area is stabilized.

TRANS MOUNTAIN EXPANSION PROJECT

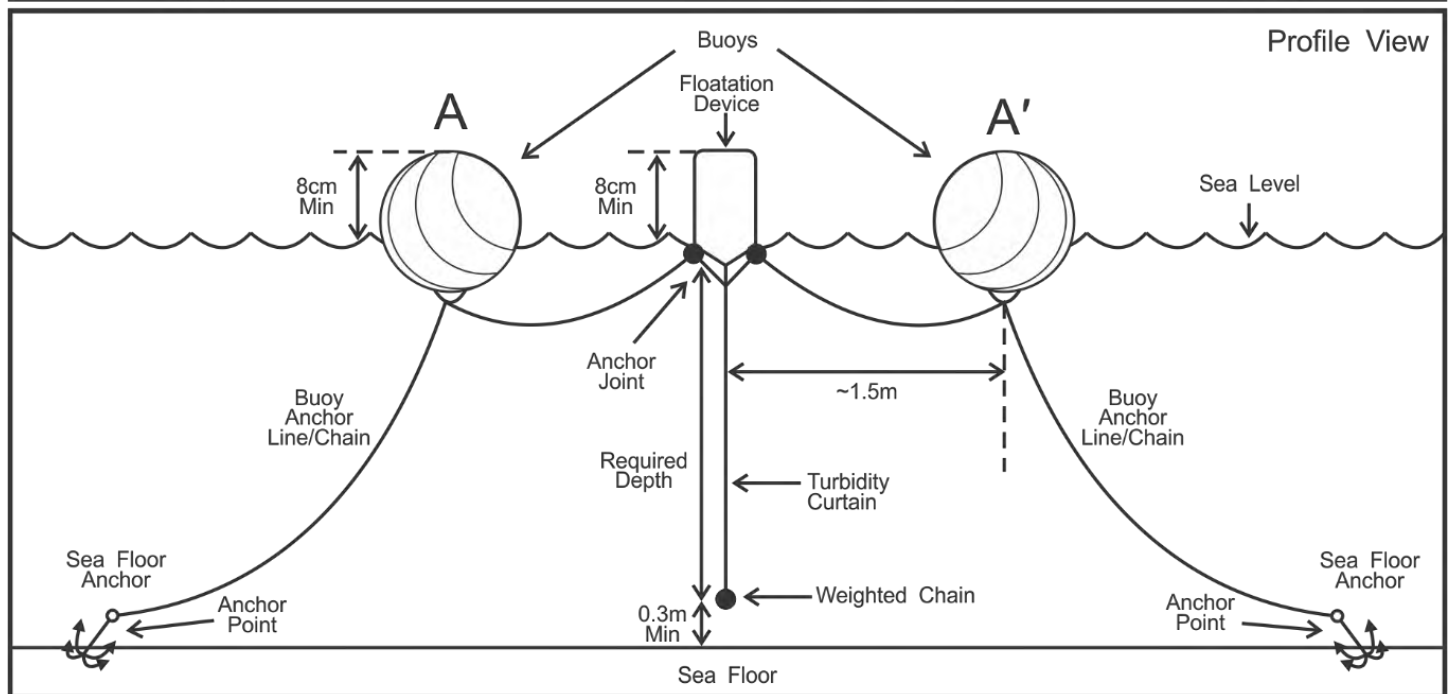
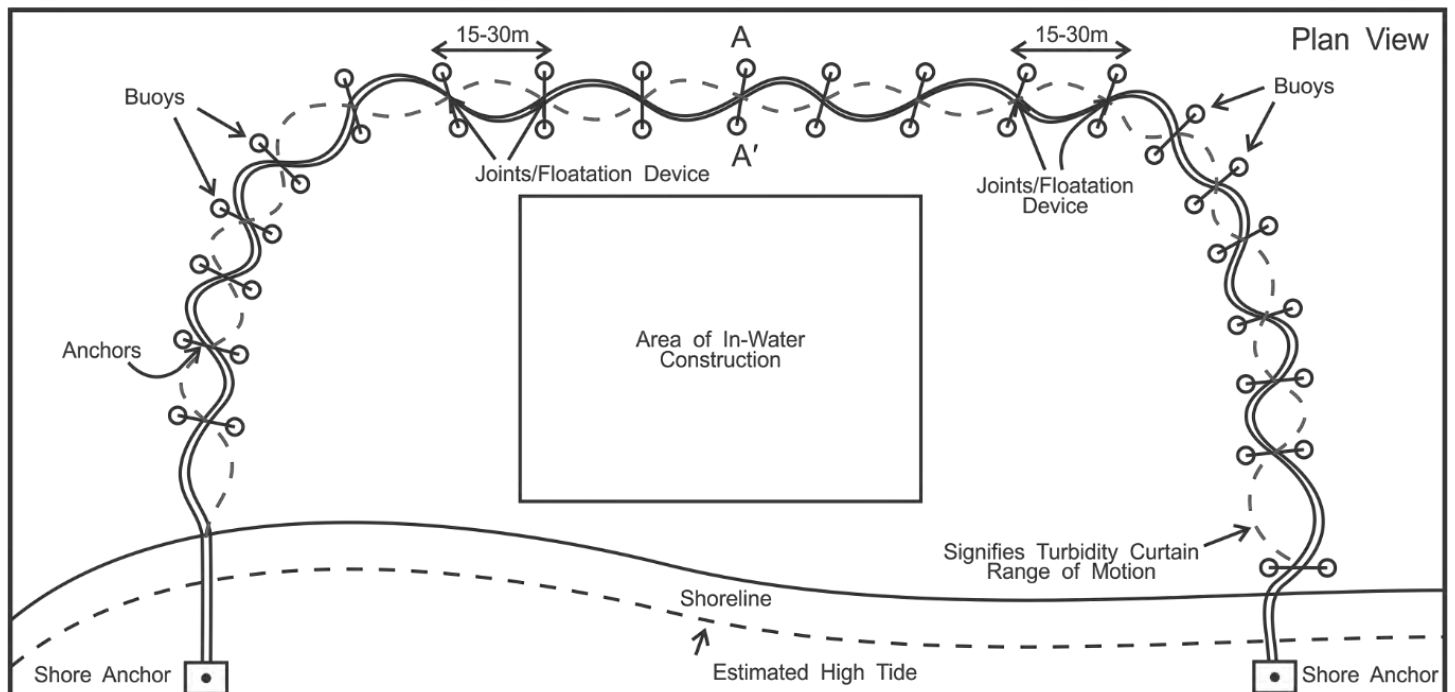


SEDIMENT FENCE

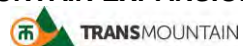
687945

March 2018

Drawing 1



TRANS MOUNTAIN EXPANSION PROJECT



TURBIDITY CURTAIN INSTALLATION (TIDAL CONDITIONS)

687945

March 2018

Drawing 2
Page 1 of 2

Notes:**Design, Construction and Installation Considerations**

1. Proper placement and design is critical and qualified specialists should be involved. Ensure all required permits and approvals are in place prior to installation.
2. Install turbidity curtains parallel to the direction of flow, where practical.
3. Prior to installation, determine the appropriate required length (based on tidal conditions and water depth) of the turbidity curtain required to achieve maximum effective depth. Typically, turbidity curtains that are installed in waters deeper than 3-4 m cause increased load and strain on the mooring system, resulting in reduced effective depth.
4. Prior to installation, determine the appropriate sized gap (minimum 0.3 m) required between the sea floor and the bottom of the turbidity curtain (determined during mean low tide conditions). This gap is designed to prevent increased turbidity, resulting from contact between the curtain and the sea floor during tidal flows. In the event that the curtain must be extended to the sea floor, a heavy woven pervious filter fabric should be used as a replacement for standard turbidity curtain material (*i.e.*, an impervious geotextile). Heavy woven pervious filter fabric allows water to penetrate the fabric surface, reducing pressure on the curtain during tidal activity.
5. When determining the amount of required material, an additional 20% of total length should be acquired in order to ensure enough material is available to reduce stress on the system during tidal activities. Ensure that the total enclosed area accounts for periods of high tide.
6. Prior to installation, ensure any seams in the turbidity curtain fabric are appropriately enclosed to ensure full strength and effectiveness is achieved.
7. Determine/set appropriate shoreline anchor points (*i.e.*, an existing pile).
8. Set appropriate anchor points and joints that have sufficient holding power to retain the turbidity curtain under typical tidal conditions for the area. Ensure anchors are positioned to be on both sides of the turbidity curtain to minimize movement and reduce the risk of the curtain overrunning and pulling out the anchors during tidal fluctuations. Maintain a 15-30 m continuous gap between anchor points/joints. Ensure anchors are installed above the high tide mark.
9. Install appropriate bottom anchors (*i.e.*, grappling hook, plow, fluke type) required for the sea floor conditions in the work area. Bottom anchors should be installed to hold the turbidity curtain in the appropriate position without affecting the turbidity curtain. Anchor lines should be attached to the buoys, as opposed to the turbidity curtain, to prevent submersion of the floatation device during tidal activity or increased strain on the turbidity curtain. Slack in the anchor line should be sufficient to allow the buoy and curtain to adjust with tidal changes without causing restrictions in the buoy or turbidity curtain, or submerging/pulling the turbidity down. Regular maintenance checks should take place to ensure anchor lines remain intact and to remove any entangled debris.
10. Select bright coloured (*e.g.*, orange, yellow) buoys and floatation devices that will attract the attention of boaters and other water-users within the vicinity of construction. All floatation devices and buoys will be flexible, buoyant units, contained in an individual sleeve or collar attached to the curtain. Required buoyancy of the floatation device will be sufficient enough to support the weight of the turbidity curtain and maintain a freeboard of at least 8 cm above the water surface.
11. Following anchor placement, secure the furled turbidity curtain (floatation upper and weighted lower) firmly to one of the onshore anchor points and move sequentially through all anchor points until the entire turbidity curtain is in position. If required, make any adjustments to the anchor placement, as deemed necessary, to ensure proper installation is achieved. Once secure, the furling lines may be loosened to allow the turbidity curtain to drop. Ensure turbidity curtains reach the appropriate predetermined depth and, if required, ensure an appropriate gap exists between the bottom of the curtain and the sea floor.

Removal Considerations

1. Prior to removal, ensure all sediment has sufficiently settled within the contained area. Allow at least 6 to 12 hours (minimum) following in-water activity for sediment to settle. If required, remove sediment to restore the original depth/contour or to achieve the planned elevation. Any excavated materials that will not be returned to the sea floor (spoils) must be taken to an upland area to be stored and stabilized or disposed of properly.
2. Remove all components related to the installation of the turbidity curtain in such a manner as to minimize turbidity.
3. Furl the turbidity curtain prior to removal from the water to reduce the risk of damage to the geotextile material.
4. Ensure the shore is free of debris (*i.e.*, sharp rock, garbage, etc.) prior to removal of the turbidity curtain in order to minimize damage to the geotextile material.

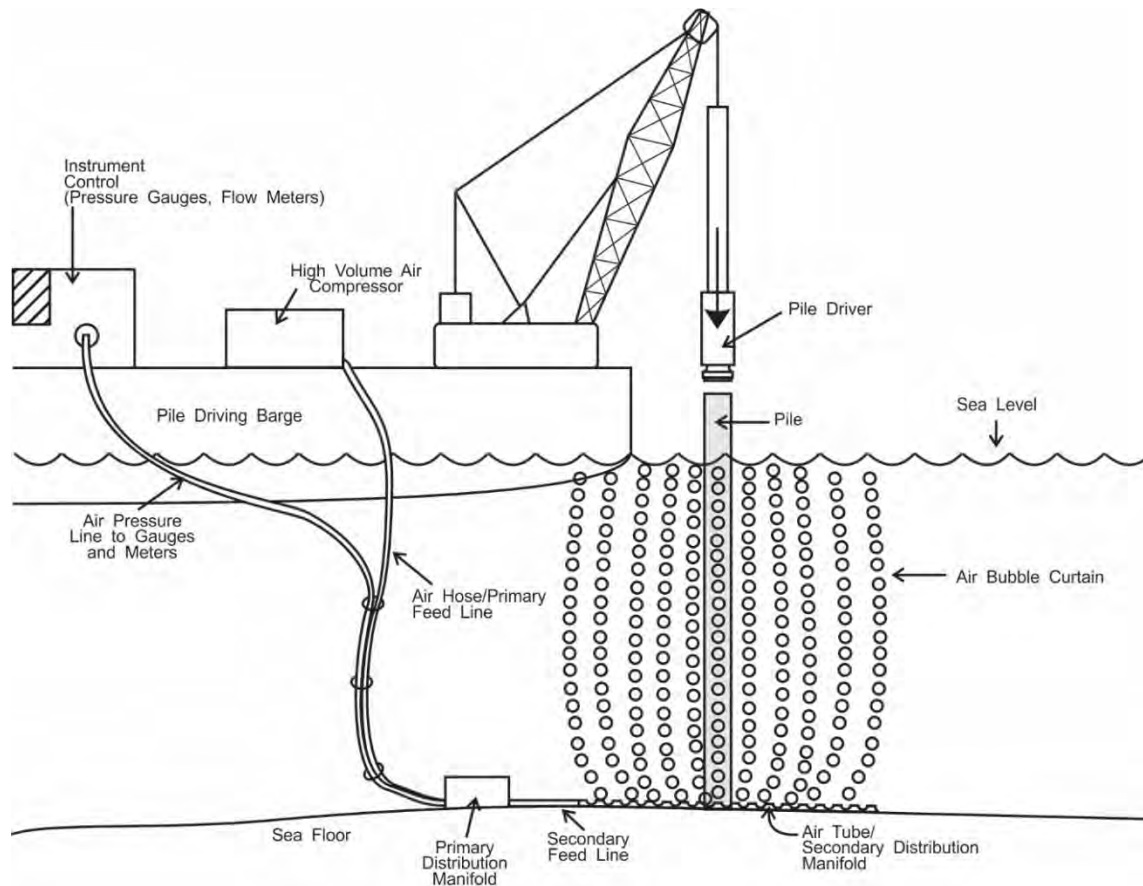
TRANS MOUNTAIN EXPANSION PROJECT**TURBIDITY CURTAIN INSTALLATION (TIDAL CONDITIONS)**

687945

March 2018

Drawing 2

Page 2 of 2



Notes:

1. Proper placement and design is critical and qualified specialists be involved in designing and implementing this mitigation measure. Ensure appropriate deployment hardware is available for the installation of the designed air bubble curtain.
2. Determine the number of layers and secondary distribution manifolds required for proper installation (*i.e.*, if the water column is deeper than 10.5 m, a second layer of secondary distribution manifolds will be required. If the water column is deeper than 21 m, a third layer of secondary distribution manifolds will be required). Larger manifolds, or multiple manifolds, will be required if the pile is inclined in order to obtain 100% coverage.
3. Determine the total length of secondary feed line required to carry an appropriate volume of air to the secondary distribution manifold(s). Keep secondary feed line lengths as short as possible to reduce wear on the lines during recovery and installation. Back pressure at the exit point, in-line friction and fitting losses should be considered when determining an appropriate length and inside diameter of the secondary feed lines. The appropriate number of supply lines required will be based on inside diameter of the secondary feed line and the total number of holes within the secondary distribution manifold(s).
4. Determine an appropriate sized compressor and primary feed line. The primary feed line should be sized to carry the total required capacity of the compressor to the primary distribution manifold.
5. Install the primary distribution manifold between the primary feed line and the secondary feed line(s). The primary distribution manifold will accept air from the primary feed line and redistribute it to the secondary feed line(s). Ensure valves are installed on the primary distribution manifold for each feed line. The primary distribution manifold should be easily accessible to allow for adjustments of air flow, if required.
6. Install appropriate meters and gauges for the primary feed line and each secondary feed line in an instrument control area, in order to monitor flow and pressure and ensure effectiveness of the system is maintained at all times.
7. Following installation of all required components, ensure that the bubble curtain covers 100% of the circumference of the pile. It is preferable to have multiple small bubbles surrounding the pile than a few large bubbles.
8. Monitoring of flow, pressure, coverage and effectiveness will continue for the duration of the pile installation or in-water activity.

TRANS MOUNTAIN EXPANSION PROJECT



AIR/BUBBLE CURTAIN INSTALLATION (PILE INSTALLATION)

APPENDIX D
RESOURCE-SPECIFIC MITIGATION TABLE

TABLE D-1

RESOURCE-SPECIFIC MITIGATION MEASURES FOR ENVIRONMENTAL FEATURES ENCOUNTERED WITHIN THE WMT

Facility/Terminal Location	General Description	Wildlife and Wildlife Habitat	Vegetation Rare Plants/Weeds/Timber	Wetlands	Watercourses	Soils	Other	Archaeology
Westridge Terminal d-047-D/092-G-07	<ul style="list-style-type: none">The WMT is located within the municipal boundaries of the City of Burnaby. All Project activities will occur on reclaimed foreshore lands owned by Trans Mountain with the exception of a small portion of land located between the railway and the shoreline, which is leased from the Canadian Pacific Railway. The current land use at this facility site is industrial with some previously disturbed and undisturbed lands. The eastern and southeastern sides of the terminal boundaries are treed land.	<ul style="list-style-type: none">Refer to mitigation measures under the heading "Species at Risk or Species of Concern" and "Wildlife (Terrestrial or Marine)" in Section 6.0 of this EPP.Initiate clearing and construction activities outside of the migratory bird nesting period (March 26 to August 16), where feasible. Refer to mitigation measures for migratory birds provided in Section 6.0 of this EPP.A bald eagle nest was recorded adjacent to the southeast boundary of the WMT (WILD-172).Determine if any active stick nests (<i>e.g.</i>, bald eagle and great blue heron) are located in the area to be cleared or adjacent to the WMT immediately prior to clearing. Follow the measures outlined in the Bald Eagle Nest Management Plan: Westridge Marine Terminal for mitigation measures to be implemented prior to construction. These measures include:<ul style="list-style-type: none">Install nest deterrent within the known bald eagle nest at the WMT upon confirmation that the nest is inactive and the bald eagles have dispersed from the area. Adhere to the conditions of the <i>Wildlife Act</i> Permit (Permit SU17-264155) issued for the installation of the nest deterrent.Install artificial nests within two alternate nest trees to reduce the risk of lost nesting opportunities.The nest deterrent and artificial nests will be installed by a qualified arborist upon confirmation that the nest is inactive and the eagles have dispersed from the area. The installation will be completed prior to October 2017 (when nest evaluation and territory establishment is expected to occur).	<ul style="list-style-type: none">No rare plant concerns identified.Knotweed and Himalayan blackberry have been recorded at the WMT.Ensure that all vehicles will arrive and leave the site clean of soil and debris to prevent the transfer of weeds. Refer to mitigation measures for weeds provided in Section 6.0 of this EPP in the event that weeds are encountered during construction.Timber disposal – no burning	<ul style="list-style-type: none">No wetlands present.	<ul style="list-style-type: none">One unnamed channel (S6), BC-789, is located within the Westridge Marine Terminal. Implement the appropriate measures for non-fish-bearing watercourses outlined in Section 14 of the Pipeline EPP and Section 7.0 of the Westridge Delivery Lines Resource-Specific Mitigation Tables. Water quality monitoring is not required, given the lack of direct connectivity with fish habitat downstream and the absence of fish habitat within the immediate zone of influence	<ul style="list-style-type: none">No topsoil salvage or root zone material salvage is required in areas of disturbed land.Salvage topsoil/root zone material (minimum 15 cm, maximum 40 cm) from undisturbed areas where construction activities will take place. Refer to mitigation measures for soils handling provided in Section 8.0 of this EPP and the Soil Handling Contingency Plan (Appendix B of this EPP).If off-site movement of salvaged topsoil/root zone material or subsoil is required, adhere to conditions specified in the applicable permits.	<ul style="list-style-type: none">Seed temporarily disturbed areas with the following seed mix at the prescribed rate:<ul style="list-style-type: none">turf-type tall fescue – 40%;hard fescue – 40%;turf-type perennial ryegrass – 20%;broadcast seeding rate: 25 kg/ha;drill seeding rate: 10 kg/ha; andhydroseeding: 50-75 kg/ha.In areas with ongoing maintenance constraints (<i>e.g.</i>, high slopes or where access for vegetation maintenance is restricted), an alternative seed mix with low-growth plants may be warranted. Consult with an Environmental Inspector to confirm the appropriate seed mix and suitable locations.	<ul style="list-style-type: none">Should Project activities involve ground disturbance within the area of archaeological potential identified by the AOA (<i>i.e.</i>, under the existing railbed) archaeological monitoring will follow the methods outlined in HIP 2017-0167. That work will be documented in the final report, to be reviewed and approved by BC MFLNRO.

APPENDIX E

WESTRIDGE MARINE TERMINAL ENVIRONMENTAL FACILITY DRAWING

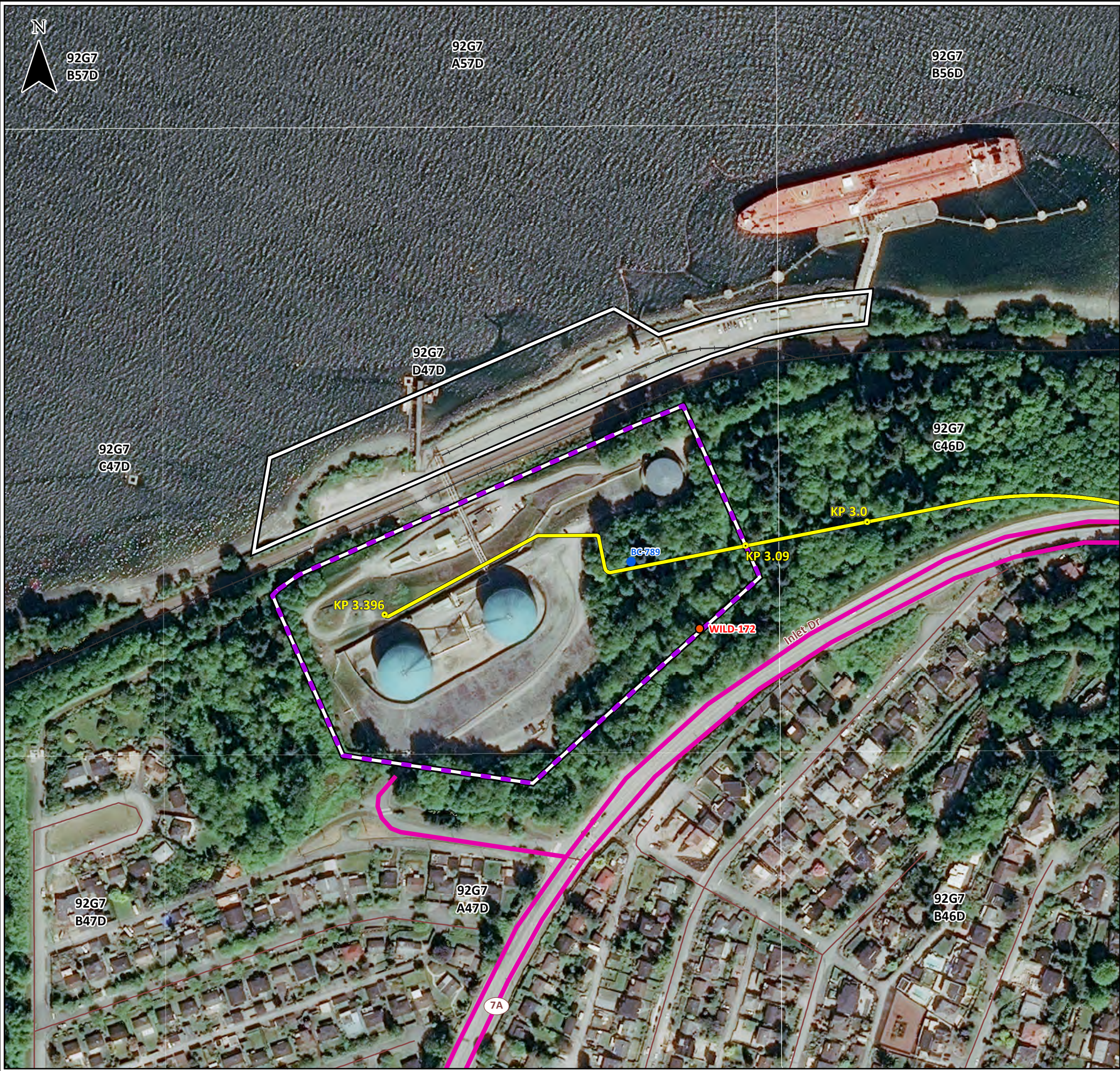


FIGURE EFD-17

ENVIRONMENTAL FACILITY DRAWING FOR THE WESTRIDGE MARINE TERMINAL

TRANSMOUNTAIN EXPANSION PROJECT

Kilometre Post (KP)

Proposed Pipeline

Facility Fenceline

Facility Footprint

Raptor Nest

Watercourse Crossing

Project Sanctioned Access Road

Road

Highway

Railway

General Information:
The Westridge Marine Terminal is located within the municipal boundaries of the City of Burnaby. All Project activities will occur on reclaimed foreshore lands owned by Trans Mountain with the exception of a small portion of land located between the railway and the shoreline, which is leased from the Canadian Pacific Railway (CPR). The current land use at this facility site is industrial with some previously disturbed and undisturbed lands, the eastern and southeastern sides of the terminal boundaries are treed land.

Archaeology:
Further Archaeological Evaluation is recommended for the foreshore area of WMT. Archaeological Evaluation complete for the remainder of WMT. Refer to the mitigation measures in Section 6.0 of this EPP if historical resources are discovered during construction.

Reclamation:
Seed temporarily disturbed areas with the following seed mix at the prescribed rate.
Turf-type tall fescue – 40%
Hard fescue – 40%
Turf-type perennial ryegrass – 20%

Broadcast seeding rate: 25 kg/ha
Drill seeding rate: 10 kg/ha
Hydroseeding: 50-75 kg/ha

In areas with ongoing maintenance constraints (e.g., high slopes, or where access for vegetation maintenance is restricted), an alternative seed mix with low growth plants may be warranted. Consult with an Environmental Inspector to confirm the appropriate seed mix and suitable locations.

Soils:
No topsoil salvage or root zone material salvage is required in areas of disturbed land.
Salvage topsoil/root zone material (minimum 15 cm, maximum 40 cm) from undisturbed areas where construction activities will take place. Refer to mitigation measures for soils handling provided in Section 8.0 of this EPP and the Soil Handling Contingency Plan (Appendix B of this EPP).
If offsite movement of salvaged topsoil/root zone material or subsoil is required, adhere to conditions specified in the applicable permits.

Vegetation Rare Plants / Weeds / Timber:
No rare plant concerns identified.
Knotweed and himalayan blackberry have been recorded at the Westridge MarineTerminal.
Ensure all vehicles will arrive and leave the site clean of soil and debris to prevent the transfer of weeds. Refer to mitigation measures for weeds provided in Section 6.0 of this EPP in the event that weeds are encountered during construction.
Timber disposal – no burning

Watercourses and Fish Habitat:
One unnamed channel (S6), BC-789, is located within the Westridge Marine Terminal. Implement the appropriate measures for non-fish-bearing watercourses outlined in Section 14 of the Pipeline EPP and Section 7.0 of the Westridge Delivery Lines Resource Specific Mitigation Tables. Water quality monitoring is not required, given the lack of direct connectivity with fish habitat downstream and the absence of fish habitat within the immediate zone of influence.

Wetlands:
No wetlands present.

Wildlife:
Initiate clearing and construction activities outside of the migratory bird nesting period (March 26 to August 16), where feasible. Refer to mitigation measures for migratory birds provided in Section 6.0 of this EPP.
A bald eagle nest was recorded adjacent to the southeast boundary of the WMT (WILD-172).
Determine if any active stick nests (e.g., bald eagle, great blue heron) are located in the area to be cleared or adjacent to the WMT immediately prior to clearing. Note, a Nest Management Plan is being prepared for the Project for those nests that have been identified. This includes a bald eagle nest (an active heron colony has not been identified within the area). The measures in the Bald Eagle Nest Management Plan have been developed in consultation with BC MFLNRO and will be implemented prior to Project activity at the WMT.

687945

Rev 5, March 2018

SCALE: 1:3,000

(All Locations Approximate)

Projection: NAD 1983 UTM Zone 18N
Orthorectified aerial imagery & Facility footprints provided by KMC 2016; Proposed Pipeline SSEID005.1 & KPs provided by UPI April 3, 2017; Transportation: Transportation: BC MFLNRO 2012; MFLNRO 2015.
Watercourse Crossings: GeoMarine Environmental Consultants February 28, 2018.
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Mapped By: SMZ

Checked By: DJN

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APPENDIX F

CONSULTATION AND ENGAGEMENT

Consultation and engagement activities related to the mitigation measures in the WMT EPP were completed with Appropriate Government Authorities and potentially affected Aboriginal groups. Opportunities to discuss the mitigation measures and identify issues or concerns were also provided to public stakeholders during meetings, workshops and ongoing engagement activities.

Consultation and engagement opportunities began in May 2012 with the Project announcement and are ongoing.

1.0 CONSULTATION AND ENGAGEMENT OVERVIEW: DRAFT PLAN DEVELOPMENT

Reports on activities completed between May 2012 and June 30, 2015 were filed with the NEB and are available in the Application (Volume 3A: Stakeholder and Volume 3B: Aboriginal; Filing ID [A55987](#)) as well as in Consultation Update No. 1 and Errata, Technical Update No. 1 (Filing ID [A59343](#)) / Consultation Update 2 (Filing IDs [A62087](#) and [A62088](#)), Consultation Update 3 (Filing IDs [A4H1W2](#) through [A4H1W8](#)) and Consultation Update 4 (Filing ID [A72224](#)). These reports the results of consultation conducted to June 30, 2015, identification of issues and concerns as well as Trans Mountain's response are included below. Where appropriate, Trans Mountain's response has been updated to reflect information developed since the original response was provided during the NEB proceeding for the Project.

Consultation and engagement activities completed between July 1, 2015 and February 2017 have not been filed on the public record with the NEB. Any new issues, concerns regarding mitigation measures identified during this period, as well as Trans Mountain's response, are also described below.

2.0 CONSULTATION AND ENGAGEMENT OVERVIEW: DRAFT PLAN

A draft of the updated WMT EPP was released on November 17, 2016 for review. Feedback was requested by February 24, 2017. Email or mail notification regarding the Plan was sent to 141 public stakeholders, 17 regulatory authorities, and 17 Aboriginal groups. The notification included a summary description of the Plan, a request for review, the timing of the comment period and contact information. Aboriginal groups were offered the opportunity for an in-person meeting to review the Plan. See Appendix F-1 for a complete list of notified stakeholders.

In addition to direct notification, the online posting of each Plan was promoted through Trans Mountain's weekly e-newsletter, Trans Mountain Today, which provides Project updates, regulatory information, stories and interviews to more than 6,000 subscribers. Each week Trans Mountain Today included a focus on a specific plan, or group of plans, as well as a reminder of all plans available for review.

2016:

- September 22 - Wildlife Mitigation and Habitat Restoration Plans;
- September 29 - Pipeline EPPs;
- October 6 - Air Quality Management Plans;
- October 13 - Watercourse and Water Ecosystems Plans;
- October 20 - Vegetation Management Plans;
- October 27 - Air Quality Plans;
- November 3 - Socio-Economic Effects Monitoring Plan;

- November 10 - Access Management Plan;
- December 22 - General promotion all plans; and
- December 29 - General promotion all plans.

2017:

- January 5 - General promotion all plans; and
- January 12 - General promotion all plans.

Trans Mountain is committed to ongoing engagement throughout the life of the Project. The start and end date for the review and comment period for each environmental management plan is defined. These timelines are required to allow time for preparation of the final Plan in order to meet regulatory requirements and NEB submission dates.

3.0 CONSULTATION AND ENGAGEMENT: ACTIVITIES AND FEEDBACK

Consultation and engagement activities completed with identified stakeholder groups are described below, including: public stakeholders and 17 Appropriate Government Authorities (Section 3.1); and Aboriginal groups (Section 3.2).

Feedback on the draft WMT EPP, Trans Mountain's response, and where each issue or concern is addressed in the WMT EPP has been outlined in each section according to stakeholder group.

3.1 Public and Appropriate Government Authority Consultation

3.1.1 Consultation Summary – May 2012 to June 2015

Feedback regarding mitigation measures in the WMT EPP received during public and Appropriate Government Authority consultation and engagement activities between May 2012 and June 30, 2015 is included in the Project Application.

3.1.2 New Interests, Issues, Concerns and Response – July 2015 to February 2017

Table F-1 includes new interests, issues and concerns, as well as Trans Mountain's response with respect to mitigation measures in the WMT EPP identified through public consultation and engagement activities between July 2015 and February 2017.

TABLE F-1

NEW INTERESTS, ISSUES, CONCERNS AND COMMON TRANS MOUNTAIN RESPONSES

Invited Stakeholder Group/Agency Name	Method of Contact	Date of Consultation Activity	Comments	Where Addressed
<ul style="list-style-type: none"> • Glorious Organic Co-Op* • Langley Environmental Partners Society * • Metro Vancouver Regional District * • BC Chicken Marketing Board * • City of Abbotsford * • Fraser Valley Regional District * • Agricultural Lands Commission * • Van Belle Nursery * • Invasive Species Council of BC * • BC Hot House • Fraser Valley Invasive Plant Council • BC Chicken Growers Association • University of the Fraser Valley • City of Chilliwack • BC Young Farmers Association • Whatcom Farm Friends • Whatcom Conservation District • Fraser Valley Indo Canadian Business Association • Abbotsford Agricultural Advisory Committee • Abbotsford Chamber of Commerce • Rosegate Dairy Farms • BC Greenhouse Growers Association • BC Landscape Nursery Association • BC Dairy Association • Certified Organic Association of BC • Ministry of Agriculture • Yarrow Eco Village • Clearbrook Waterworks District • BC Broiler Hatching Egg Producers Association • Langley Environmental Partners Society • BC Nursery Association • Fraser Valley Conservancy • Metro Vancouver Regional District • Township of Langley • BC MOE • BC Milk Marketing Board • Abbotsford Soil Conservation Association • Kato's Nursery • Delta Farmland and Wildlife Trust • Chilliwack Chamber of Commerce • BC Cranberry Growers Association • Clearview Horticulture 	Abbotsford EPP Workshop	September 10, 2015	<ul style="list-style-type: none"> • Request for TMEP to have independent (third-party) inspectors for environmental mitigation or reimbursement for local governments to hire third party inspectors 	<ul style="list-style-type: none"> • Trans Mountain's approach to environmental compliance, including environmental inspection and monitoring, is detailed in the CMP (Volume 10 of the Environmental Plans).

TABLE F-1 Cont'd

Invited Stakeholder Group/ Agency Name	Method of Contact	Date of Consultation Activity	Comments	Where Addressed
<ul style="list-style-type: none"> Nicola Stock Breeder's Association* Thompson Rivers University* Southern Interior Weed Management Committee* Ministry Forest Land Natural Resources Operations* Kamloops Ministry of Environment* Land Resource Management* Fraser Basin Council* Kamloops Naturalist Club* City of Kamloops* Tranquille Livestock Association Kamloops Stockmen's Association BC Wildlife Park BC Conservation Federation BC Parks Department of Fisheries and Oceans Ducks Unlimited Nicola Naturalist Society Freshwater Fisheries Society of BC Thompson Okanagan – Trout Unlimited Habitat Conservation Trust Foundation Wells Grey World Heritage 	Kamloops EPP Workshop	September 15, 2015	<ul style="list-style-type: none"> Request to involve independent experts in the identification of criteria for reclamation success. Concern includes addressing landowner disputes regarding full reclamation. 	<ul style="list-style-type: none"> Trans Mountain's approach to reclamation and monitoring are discussed in the Reclamation Management Plan (Section 9.0 of Volume 6 of the Environmental Plans).
<ul style="list-style-type: none"> VFPA 	Email	January 16, 2017	<p>Preliminary feedback on the draft WMT EPP referred to as the Construction Environmental Management Plan in the VFPA application contained within the Project description document submitted to the VFPA on December 6, 2016:</p> <ul style="list-style-type: none"> Page 4-5 Additional dust mitigation: wheel wash if trucks are leaving the construction site and travelling on roads not subject to wash-down Page 4-7 Weed control: Spraying is cited as an example of a weed growth control method. VFPA prefers that non-chemical means of weed control are used wherever feasible Pages 4-8, 4-9 Marine sediment and water quality: Use only clean (washed, free of mud or other fines) rock for reef construction, and use sediment curtains for rock placement. 	<ul style="list-style-type: none"> Feedback received has been incorporated into the WMT EPP as appropriate. See Sections 6.0, 7.0, and 8.0 of this EPP

TABLE F-1 Cont'd

Invited Stakeholder Group/ Agency Name	Method of Contact	Date of Consultation Activity	Comments	Where Addressed
<ul style="list-style-type: none"> VFPA (cont'd) 	See above	See above	<ul style="list-style-type: none"> Page 4-10 Marine fish and fish habitat: Reference to barge anchoring and spudding should include a prohibition of grounding (unless authorized by VFPA) Page 4-10 Marine mammals: Mitigations overlap with those for birds; suggest that mitigations for marine mammals not mention birds to minimize confusion Page 4-13 Marine birds: Similarly, mitigation measures probably shouldn't mention marine mammals Page 6-1 Tsunamis: The text mentions the existence in Indian Arm of a number of alluvial fans that were built up over time through the gradual deposition of sediments. In fact, debris flows do occur occasionally, which can result in the deposition of large amounts of material very rapidly. One such event occurred on the west shore of Indian Arm in recent memory, which resulted in significant damage to a boat club out-station and a migration of the alluvial fan-front outwards into deeper water. Such events, if large enough, could conceivably generate waves. However, we acknowledge that the discussion for landslides suggests that it is extremely unlikely that such waves could be large enough to cause damage away from the debris flow site. 	See above

TABLE F-1 Cont'd

Invited Stakeholder Group/ Agency Name	Method of Contact	Date of Consultation Activity	Comments	Where Addressed
<ul style="list-style-type: none"> Reed Point Marina Education Centre* 	WMT/BT Workshops	November 24, 2016	<ul style="list-style-type: none"> Golden star tunicate is a huge invasive on new construction (can manual scraping be used?) Get more knowledge on how to manage and maintain the combi-wall 	<ul style="list-style-type: none"> Intertidal biophysical surveys conducted within the existing water lot at the WMT in 2012 did not encounter the golden star tunicate. If the species is found to colonize the bulkhead wall, the tunicate may be removed by manual scraping, with little harm to surrounding fauna and algae. As per DFO's (2016) guidance, the tunicate can be frozen and then reported to DFO by providing the GPS location and date. The comment regarding obtaining more knowledge on the management and maintenance of the combi-wall (now a sheet-pile cell bulkhead wall) was related to methods for the control of this invasive species. Manual scraping following identification, as per DFO's guidance, is considered the least invasive method for management should the tunicate colonize the structure. Trans Mountain would seek the advice of DFO if colonization of the bulkhead wall by the golden star tunicate were to become an issue at the WMT.

TABLE F-1 Cont'd

Invited Stakeholder Group/ Agency Name	Method of Contact	Date of Consultation Activity	Comments	Where Addressed
<ul style="list-style-type: none"> Fraser Health Authority* 	WMT/BT Workshops	November 24, 2016	<ul style="list-style-type: none"> This would be a good time to do tissue sampling on fish species and you might be able to show that you are actually making an improvement to the environment (samples now vs. samples later) 	<ul style="list-style-type: none"> Trans Mountain does not anticipate that contamination of local waters and/or sediments will occur during construction or operation of the Project. As such, there is no rationale for undertaking comparative tissue sampling prior to and after fish habitat offsetting has occurred.

Note: * Attended EPP Workshop

3.2 Aboriginal Engagement

Since April 2012, Trans Mountain has engaged with Aboriginal communities that might have an interest in the Project or have Aboriginal interests potentially affected by the Project, based on the proximity of their community and their assertion of traditional and cultural use of the land along the pipeline corridor to maintain a traditional lifestyle. The objectives of Aboriginal engagement are to:

- have an open, transparent and inclusive process that seeks to exchange information in a respectful manner;
- address concerns shared by those who might have an interest in the Project or have Aboriginal interests potentially affected by the Project;
- incorporate feedback into Project planning and execution; and
- provide opportunities to maximize Project benefits to Aboriginal communities and Aboriginal groups.

A comprehensive Aboriginal engagement process is lead by experienced engagement advisors in Alberta and BC, specialized in the areas of Aboriginal relations, law, economic development, education, training, employment and procurement. Trans Mountain's engagement process for the Project is flexible, allowing each community and group to engage in meaningful dialogue in the manner they choose and in a way to meet their objectives and values.

Each community had the opportunity to engage with Trans Mountain, depending on Project interests and potential effects. The following opportunities to engage have been provided:

- Project announcement;
- initial contact with Aboriginal community or Aboriginal group;
- meetings with Chief and Council and meetings with staff;
- host community information session(s);
- conduct TLU studies and socio-economic interviews;

- identify interests and concerns; and
- identify mitigation options.

Issues and concerns related to the WMT EPP raised during Aboriginal engagement from between early 2012 to February 2017 are summarized in Table F-2.

TABLE F-2
SUMMARY OF ABORIGINAL CONCERNS REGARDING THE WMT EPP

Issue or Concern		Summary Trans Mountain Response	Where Addressed
Summary	Aboriginal Community		
Concerns regarding the effects of 24-hour lighting on migratory birds and on fish, such as herring, which may come to the surface at night becoming more susceptible to artificial prey opportunities and less available to traditional fishing practices that use light as an attractant.	Lyackson First Nation	<p>Trans Mountain will implement the following mitigation measures pertaining to lighting that are provided in Section 6.0 of the WMT EPP (Volume 4 of the Environmental Plans):</p> <ul style="list-style-type: none"> • Design lighting requirements at the WMT to meet the <i>Canada Occupational Health and Safety Regulations</i> and the <i>International Ship and Port Facility Security Code</i> (for compliance), for worker safety and terminal security during construction, while minimizing environmental and socio-economic effects. Refer to the Lighting Emissions Management Plan for the WMT (NEB Condition 82). • Where feasible, prevent sky-lighting which may lead to bird disorientation and/or collisions by: using low level and low intensity lighting; using no lighting in areas where no work is planned; using downturned shaded fixtures in light standards; and using a higher lumen/watt (light out to power in) ratio, such as metal halide lighting. • During migratory bird periods and/or during extreme weather events, bird strike warnings will be issued to marine construction vessels with a request to reduce deck lighting. • Install lighting control systems in the facility site that permit the reduction of the amount of lighting during periods of low activity. • Use lighting in the yellow spectrum, where feasible, to reduce disruption to nocturnal fish activities and bird strikes. <p>NEB Condition 82 (Light Emissions Management Plan for the WMT) requires Trans Mountain to file with the NEB, at least three months prior to commencing construction at the WMT, a Light Emissions Management Plan for the WMT that includes a description of the mitigation and best practice measures considered for the terminal lighting design and how the proposed design and operation will minimize the impacts from light on land-based residents and marine users.</p>	<p>Section 6.0 of the WMT EPP (Volume 4 of the Environmental Plans)</p> <p>NEB Condition 82 (Light Emissions Management Plan for the WMT)</p>
Potential for seismic activity (e.g., earthquake) leading to equipment failure at the WMT resulting in pollution and damage of resources used by Aboriginal groups.	Lyackson First Nation Squamish First Nation Stz'uminus First Nation	<p>NEB Condition 68 (Seismic Reports – Liquefaction Potential) requires Trans Mountain to file with the NEB, at least three months prior to commencing construction, a final report that identifies all sites along the Project, that have "Very High," "High," and "Moderate" liquefaction-triggered ground movement potential, and that describes how the potential for liquefaction-triggered ground movement will be mitigated at each site.</p> <p>NEB Condition 69 (Fault Studies) requires Trans Mountain to file with the NEB, at least three months prior to commencing construction, the results of fault-mapping studies that were ongoing during or undertaken after the OH-001-2014 proceeding, for use in the detailed design of the Project. This filing must include conclusions regarding possible seismic activity during the Holocene epoch for Sumas Fault, Vedder Mountain Fault, Fraser River-Straight Creek Fault and Rocky Mountain Trench, and other possible hidden faults, as well as the potential for compounding risks due to the proximity of the Vedder Mountain and Sumas Faults.</p>	<p>NEB Condition 68 (Seismic Reports – Liquefaction Potential)</p> <p>NEB Condition 69 (Fault Studies)</p>
Effects of dredging around the WMT on fish and fish habitat, including resuspension of sediments.	Squamish Nation	In the event that dredging is determined to be required, Trans Mountain will implement the Water Quality Management Plan During Rip Rap Removal (Appendix H of this EPP).	Section 8.0 of the WMT EPP (Volume 4 of the Environmental Plans)

TABLE F-2 Cont'd

Issue or Concern		Summary Trans Mountain Response	Where Addressed
Rehabilitation efforts in Burrard Inlet will be undermined by the Project.	Squamish Nation	Mitigation measures to avoid or reduce potential adverse environmental effects associated with the marine component of the WMT construction activities (including in-water excavation of existing rip- rap; installation of sheet piles and king piles associated with the foreshore extension; installation of cylindrical pipe piles for the marine trestle and berths; and overwater construction of dock infrastructure) are provided in Section 8.0 of the WMT EPP (Volume 4 of the Environmental Plans).	Section 8.0 of the WMT EPP (Volume 4 of the Environmental Plans)
Achievement of the objectives of the Marine Stewardship Program will be slowed or denied.	Tsleil-Waututh Nation		
Ability to harvest resources near the WMT will be affected, including the ability to harvest at preferred harvesting locations.	Tsleil-Waututh Nation	Mitigation measures to avoid or reduce potential adverse environmental effects associated with the marine component of the WMT construction activities (including in-water excavation of existing rip- rap; installation of sheet piles and king piles associated with the foreshore extension; installation of cylindrical pipe piles for the marine trestle and berths; and overwater construction of dock infrastructure) are provided in Section 8.0 of the WMT EPP (Volume 4 of the Environmental Plans).	Section 8.0 of the WMT EPP (Volume 4 of the Environmental Plans)
Decreased opportunities to eat safe and abundant wild foods from Burrard Inlet.	Tsleil-Waututh Nation		

Trans Mountain continues to liaise with Indigenous and Northern Affairs Canada, the Government of Canada's Major Projects Management Office, the BC Ministry of Aboriginal Relations and Reconciliation, and the Alberta Ministry of Aboriginal Affairs to provide updates regarding Trans Mountain's engagement activities with Aboriginal groups.

3.2.1 Identifying Aboriginal Groups for Consultation

Trans Mountain used the First Nations Consultative Area Database Public Map Service to identify the Aboriginal groups with traditional territories encountered by the Project. Appendix G lists the Aboriginal groups identified for consultation.

3.2.2 Consultation Activities

A letter was sent in November 2016 to the Aboriginal groups listed in Appendix G with a copy of the draft EPP. Where appropriate and upon request, a follow-up meeting was arranged to discuss this EPP in more detail and address any concerns.

No feedback on the draft WMT EPP was received. It should be noted that although the engagement process also provided for opportunity for general discussion about Project construction and associated Aboriginal issues and opportunities, only feedback/issues directly related to construction mitigation measures will be provided in this EPP. Other issues and topics raised have been captured in the corresponding mitigation plan as appropriate.

This final WMT EPP will be shared with the Aboriginal groups at the same time as it is filed with the NEB in 2017.

APPENDIX F-1

RECORD OF STAKEHOLDER NOTIFICATIONS OF PLAN

Records of stakeholder notifications can be found in Table F1-1 below.

TABLE F1-1

RECORD OF NOTIFICATION

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Landowners	N/A	September 11, 2016	Letter
Aboriginal Groups	N/A	November 2016	Letter
VFPA	Tim Blair	December 22, 2016	Email
Jasper National Park of Canada	Mayabe Dia	December 22, 2016	Email
Alberta Environment and Parks	Corinee Kristensen	December 22, 2016	Email
Ministry of Transportation and Infrastructure	Lisa Gow	December 22, 2016	Email
BC Parks	Ken Morrison	December 22, 2016	Email
BC OGC	Brian Murphy	December 22, 2016	Email
Ministry of Natural Gas Development	Linda Beltrano	December 22, 2016	Email
BC MFLNRO	Andrea Mah	December 22, 2016	Email
BC MFLNRO	Susan Fitton	December 22, 2016	Email
FVAQC	Roger Quan	October 21, 2016	Email
ECCC	Phil Wong	October 21, 2016	Email
ECCC	Rachel Mayberry	October 28, 2016	Email
ECCC	Coral Deshield	December 21, 2016	Email
ECCC	Phil Wong	December 21, 2016	Email
VFPA	Patrick Coates	January 31, 2017	Email
DFO	Sandra Hollick-Kenyon	December 3, 2016	Email
DFO	Alston Bonamis	December 3, 2016	Email
City of Edmonton	N/A	November 29, 2016	Letter
City of Spruce Grove	N/A	November 29, 2016	Letter
Municipality of Jasper	N/A	November 29, 2016	Letter
Parkland County	N/A	November 29, 2016	Letter
Strathcona County	N/A	November 29, 2016	Letter
Town of Edson	N/A	November 29, 2016	Letter
Town of Hinton	N/A	November 29, 2016	Letter
Town of Stony Plain	N/A	November 29, 2016	Letter
Village of Wabamun	N/A	November 29, 2016	Letter
Yellowhead County	N/A	November 29, 2016	Letter
City of Kamloops	N/A	November 29, 2016	Letter
City of Kamloops RCMP Detachment	N/A	November 29, 2016	Letter
City of Merritt	N/A	November 29, 2016	Letter
City of Merritt RCMP Detachment	N/A	November 29, 2016	Letter
Clearwater Chamber of Commerce	N/A	November 29, 2016	Letter
District of Clearwater	N/A	November 29, 2016	Letter
District of Clearwater RCMP Detachment	N/A	November 29, 2016	Letter
Interior Health	N/A	November 29, 2016	Letter
Merritt Chamber of Commerce	N/A	November 29, 2016	Letter
Northern Health	N/A	November 29, 2016	Letter
Regional District of Fraser Fort George	N/A	November 29, 2016	Letter
Thompson Nicola Regional District	N/A	November 29, 2016	Letter
Town of Blue River	N/A	November 29, 2016	Letter

TABLE F1-1 Cont'd

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Venture Kamloops	N/A	November 29, 2016	Letter
Village of Valemount	N/A	November 29, 2016	Letter
Village of Valemount RCMP Detachment	N/A	November 29, 2016	Letter
Nicola Stock Breeder's Association - on behalf of the BC Cattlemen's Association	N/A	November 29, 2016	Letter
Grassland's Conservation Council	N/A	November 29, 2016	Letter
Thompson Rivers University	N/A	November 29, 2016	Letter
Southern Interior Weed Management Committee	N/A	November 29, 2016	Letter
Fraser Basin Council	N/A	November 29, 2016	Letter
Northwest Invasive Plant Council		November 29, 2016	
Grassland's Conservation Council	N/A	November 29, 2016	Letter
Abbotsford Chamber of Commerce	N/A	November 29, 2016	Letter
Abbotsford Police Department	N/A	November 29, 2016	Letter
ASCA	N/A	November 29, 2016	Letter
BC Invasive Species	N/A	November 29, 2016	Letter
BC Ministry of Children and Family Development	N/A	November 29, 2016	Letter
BC Ministry of Social Development	N/A	November 29, 2016	Letter
BC Nature	N/A	November 29, 2016	Letter
BC Wildlife Federation	N/A	November 29, 2016	Letter
Burnaby Board of Trade	N/A	November 29, 2016	Letter
Burnaby RCMP Detachment	N/A	November 29, 2016	Letter
Chilliwack Chamber of Commerce	N/A	November 29, 2016	Letter
Chilliwack Economic Partners	N/A	November 29, 2016	Letter
City of Abbotsford	N/A	November 29, 2016	Letter
City of Burnaby	N/A	November 29, 2016	Letter
City of Chilliwack	N/A	November 29, 2016	Letter
City of Coquitlam	N/A	November 29, 2016	Letter
City of New Westminster	N/A	November 29, 2016	Letter
City of Port Coquitlam	N/A	November 29, 2016	Letter
City of Port Moody	N/A	November 29, 2016	Letter
City of Surrey	N/A	November 29, 2016	Letter
Coquitlam RCMP Detachment	N/A	November 29, 2016	Letter
Corporation of Delta	N/A	November 29, 2016	Letter
District of Hope	N/A	November 29, 2016	Letter
Eagle Creek	N/A	November 29, 2016	Letter
Fraser Valley Invasive Plant Council	N/A	November 29, 2016	Letter
Fraser Valley Regional District	N/A	November 29, 2016	Letter
Glen Valley Watershed Society	N/A	November 29, 2016	Letter
Hope Chamber of Commerce	N/A	November 29, 2016	Letter
Hope Community Policing Office	N/A	November 29, 2016	Letter
Langley Chamber of Commerce	N/A	November 29, 2016	Letter
LEPS	N/A	November 29, 2016	Letter
LFVAQCC	N/A	November 29, 2016	Letter
Metro Vancouver	N/A	November 29, 2016	Letter
Newton RCMP Detachment	N/A	November 29, 2016	Letter
RCMP Division 'E'	N/A	November 29, 2016	Letter
Sapperton Fish and Game	N/A	November 29, 2016	Letter
Stoney Creek	N/A	November 29, 2016	Letter
Surrey Board of Trade	N/A	November 29, 2016	Letter
Surry Environmental Partners	N/A	November 29, 2016	Letter

TABLE F1-1 Cont'd

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Surrey RCMP Detachment	N/A	November 29, 2016	Letter
Township of Langley	N/A	November 29, 2016	Letter
Township of Langley RCMP Detachment	N/A	November 29, 2016	Letter
TriCities Chamber of Commerce	N/A	November 29, 2016	Letter
Upper Fraser Valley Regional Detachment	N/A	November 29, 2016	Letter
Village of Anmore	N/A	November 29, 2016	Letter
Village of Belcarra	N/A	November 29, 2016	Letter
Yorkson	N/A	November 29, 2016	Letter
ACGI Shipping	N/A	November 29, 2016	Letter
Barnett Marine Park	N/A	November 29, 2016	Letter
BC Ambulance	N/A	November 29, 2016	Letter
BC Chamber of Shipping	N/A	November 29, 2016	Letter
BC Coast Pilots	N/A	November 29, 2016	Letter
BROKE (Burnaby Residents Opposed to Kinder Morgan Expansion)	N/A	November 29, 2016	Letter
Canadian Pacific (CP) Rail	N/A	November 29, 2016	Letter
Canexus- Ero- Newalta-Univar Community Advisory Panel	N/A	November 29, 2016	Letter
Canexus Chemicals	N/A	November 29, 2016	Letter
Chevron	N/A	November 29, 2016	Letter
CN Rail	N/A	November 29, 2016	Letter
Council of Marine Carriers	N/A	November 29, 2016	Letter
District of North Vancouver	N/A	November 29, 2016	Letter
Empire Shipping	N/A	November 29, 2016	Letter
Erco Worldwide	N/A	November 29, 2016	Letter
First Nation Emergency Services Society	N/A	November 29, 2016	Letter
First Nation Health Authority	N/A	November 29, 2016	Letter
Fraser Health Authority	N/A	November 29, 2016	Letter
Inchcape Shipping	N/A	November 29, 2016	Letter
Island Tug and Barge	N/A	November 29, 2016	Letter
Kask Brothers	N/A	November 29, 2016	Letter
Ledcor Resources and Transportation Limited Partnership	N/A	November 29, 2016	Letter
Mason Agency (Shipping Service)	N/A	November 29, 2016	Letter
MLA- Burnaby Lougheed	N/A	November 29, 2016	Letter
MLA- Burnaby North	N/A	November 29, 2016	Letter
MLA- Coquitlam – Burke Mountain	N/A	November 29, 2016	Letter
MLA- North Vancouver Lonsdale	N/A	November 29, 2016	Letter
MLA- North Vancouver Seymour	N/A	November 29, 2016	Letter
MLA- Port Moody- Coquitlam	N/A	November 29, 2016	Letter
MP- Delta	N/A	November 29, 2016	Letter
MP- North Burnaby Seymour	N/A	November 29, 2016	Letter
MP- North Vancouver	N/A	November 29, 2016	Letter
MP- Vancouver Centre	N/A	November 29, 2016	Letter
MP- Vancouver East	N/A	November 29, 2016	Letter
MP- Vancouver Quadra	N/A	November 29, 2016	Letter
MP- West Vancouver – Sunshine Coast – Sea to Sky Country	N/A	November 29, 2016	Letter
North Shore NOPE	N/A	November 29, 2016	Letter
North Vancouver Chamber of Commerce	N/A	November 29, 2016	Letter

TABLE F1-1 Cont'd

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Pacific Coast Terminal	N/A	November 29, 2016	Letter
Pacific Pilotage Authority	N/A	November 29, 2016	Letter
Pacific Wildlife Foundation	N/A	November 29, 2016	Letter
Peter Kiewit Infrastructure Co.	N/A	November 29, 2016	Letter
Seaspan	N/A	November 29, 2016	Letter
Shell Terminal	N/A	November 29, 2016	Letter
Simon Fraser University	N/A	November 29, 2016	Letter
SMIT Marine	N/A	November 29, 2016	Letter
Suncor Terminal	N/A	November 29, 2016	Letter
UBC Stellar Sea Lion (Marine Mammal) Research Centre	N/A	November 29, 2016	Letter
Vancouver Aquarium	N/A	November 29, 2016	Letter
Vancouver Board of Trade	N/A	November 29, 2016	Letter
Vancouver Coastal Health Authority	N/A	November 29, 2016	Letter
Vancouver Pile and Dredge	N/A	November 29, 2016	Letter
West Vancouver Chamber of Commerce	N/A	November 29, 2016	Letter
Westward Shipping	N/A	November 29, 2016	Letter
Wild Bird Trust	N/A	November 29, 2016	Letter
Metro Vancouver Regional District	Ali Ergudenler	November 29, 2016	Email
Metro Vancouver Regional District	Roger Quan	November 29, 2016	Email


APPENDIX G

ABORIGINAL GROUPS ENGAGED ON THE WESTRIDGE MARINE TERMINAL ENVIRONMENTAL PROTECTION PLAN

- Aitchelitz First Nation (Stó:lō)
- Cowichan Tribes
- Halalt First Nation (CNA)
- Kwikwetlem First Nation
- Lake Cowichan First Nation
- Leq'a:mel First Nation (Stó:lō)
- Lyackson First Nation
- Musqueam Indian Band
- Penelakut First Nation
- Popkum First Nation (Stó:lō)
- Skawahlook First Nation (Stó:lō)
- Skowkale First Nation (Stó:lō)
- Squamish Nation
- Stu'zuminus First Nation (Chemainus)
- Tsleil-Waututh Nation
- Tzeachten First Nation (Stó:lō)
- Yakweakwioose Band (Stó:lō)

APPENDIX H

MARINE WATER QUALITY MANAGEMENT PLAN DURING RIP RAP REMOVAL

	Trans Mountain Expansion Project Marine Water Quality Management During Rip Rap Removal Plan	Contractor Revision Date:	2017-08-17
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Trans Mountain Expansion Project

MARINE WATER QUALITY MANAGEMENT PLAN DURING RIP RAP REMOVAL

KMC Document # 01-13283-TW-WT00-MD-RPT-0014 R1

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MARINE WATER QUALITY MANAGEMENT PLAN DURING RIP RAP REMOVAL FOR THE TRANS MOUNTAIN PIPELINE ULC TRANS MOUNTAIN EXPANSION PROJECT

August 2017

KMC Doc No.: 01-13283-TW-WT00-MD-RPT-0014 R1

Prepared for:



TRANSMOUNTAIN

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1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) submitted a Facilities Application (the Application) to the National Energy Board (NEB) in December 2013 for the proposed Trans Mountain Expansion Project (“the Project” or “TMEP”). A Certificate of Public Convenience and Necessity allowing the Project to proceed, subject to 157 Conditions, was issued on December 1, 2016. The Project involves expansion of the existing Westridge Marine Terminal (WMT) and construction of a new dock complex. The Project will require removal of intertidal and subtidal rip rap along the shoreline of the existing WMT. Although no dredging will be required, removal of rip rap is likely to disturb some marine sediment, elevating turbidity in the surrounding water. Contaminants potentially present in sediment may also be mobilized during rip rap removal.

This Marine Water Quality Management Plan During Rip Rap Removal (Plan) provides details on the proposed in-water excavation of rip rap at the WMT and describes the mitigation and monitoring measures that will be implemented to protect marine water quality. This Plan was originally released as the Marine Sediment Management Plan (NEB Condition 35), which was submitted to Appropriate Government Authorities and potentially affected Aboriginal groups on November 22, 2016 for review and feedback. Once the decision was made that dredging was not necessary at the WMT, the draft Marine Sediment Management Plan was no longer required. However, since the draft Marine Sediment Management Plan did discuss the in-water excavation of rip rap and the proposed associated mitigation measures, the relevant content was retained, along with any feedback received during consultation, and the Plan renamed. The Plan now forms an appendix to the Westridge Environmental Protection Plan (NEB Condition 81).

Since the November 22, 2016 release of the draft Marine Sediment Management Plan, engineering design has continued to progress and there have been changes, as detailed in TMEP Fall 2016 Project Updates (www.transmountain.com/environmental-plans). All of the changes have been reviewed, and the relevant Project design updates have been incorporated into this Plan. This Plan was also updated to reflect the change in the foreshore design from a combi-wall to sheet pile cells.

1.1 Objectives and Measurable Goals

The objective of this Plan is to describe the mitigation and monitoring measures that will be implemented to protect marine water quality during in-water excavation of rip rap at the WMT. The measurable goals are based on the federal and provincial water quality guidelines provided in Section 1.4.

1.2 Links to other Trans Mountain Environmental Plans

Information from other environmental plans prepared for the Project that are related to marine water quality has been considered in this Plan. The links between this Marine Water Quality Management Plan During Rip Rap Removal and other Trans Mountain plans are provided in Table 1.

Table 1 Trans Mountain Plans Linked to this Plan

Environmental Plan	Description of the Environmental Plan	Linkage to this Plan
Westridge Marine Terminal EPP (NEB Condition 81, Volume 4 of the Environmental Plans)	The Westridge Marine Terminal EPP contains Trans Mountain's environmental procedures and mitigation measures to be implemented during construction of the Westridge Marine Terminal to avoid, reduce or mitigate potential adverse environmental effects.	The EPP includes general mitigation measures related to waste disposal and to working in or near water.

1.3 Commitments Management

Trans Mountain made a number of commitments regarding the Project during the OH-001-2014 proceedings and engagement activities up to May 2016. Commitments were made to improve and optimize Project planning and mitigation measures. As Trans Mountain has consolidated its commitments into a Commitments Tracking Table in accordance with NEB Condition 6, the Table of Commitments in each plan has been removed. Information Requests (IRs) and engagement activities that raised discussion, but did not result in a commitment, are not included in the Commitments Tracking Table.

The Commitments Tracking Table has been filed with the NEB and is available on Trans Mountain's web site at www.transmountain.com. Trans Mountain continues to monitor and track compliance with its commitments and will update, post to its website and file with the NEB updated versions of the Commitments Tracking Table according to the timeframes outlined in NEB Condition 6. Commitments with specific relevance to this Plan have been considered and addressed.

1.4 Regulatory Guidance

The Water Protection and Sustainability Branch of the British Columbia (BC) Ministry of the Environment & Climate Change Strategy (MOECCS) sets turbidity guidelines for the protection of aquatic life in British Columbia (BC MOECCS 2017). The federal Canadian Council of Ministers of the Environment (CCME) also sets water quality guidelines for turbidity (CCME 2017), which are the same for clear flow and clear water and slightly different for high flow and turbid water. Because it is not practical to measure total suspended solids (TSS) in real-time (due to turnaround time at an analytical laboratory), it is common practice to monitor turbidity during construction activities. The turbidity guideline for freshwater, marine and estuarine habitats (measured in nephelometric turbidity units, or NTU) is as follows:

- Change from background of 8 NTU at any one time for a duration of 24 hours in all waters during clear flows or in clear waters (BC MOECCS and CCME)
- Change from background of 2 NTU at any one time for a duration of 30 days in all waters during clear flows or in clear waters (BC MOECCS and CCME)
- Change from background of 5 NTU at any time when background is 8–50 NTU during high flows or in turbid waters. Change from background of 10% when background is greater than 50 NTU at any time during high flows or in turbid waters (BC MOECCS)
- Maximum increase of 8 NTU from background levels at any one time when background levels are between 8 and 80 NTU. Should not increase more than 10% of background levels when background is greater than 80 NTU (CCME)

The monitoring program employed during marine excavation will use the BC MOECCS turbidity guidelines as a management goal for water outside (i.e., seaward) of the turbidity curtains during rip rap removal. Water quality within the active work area will exceed these guidelines but will be isolated from the rest of Burrard Inlet by the turbidity curtain (see Section 5.0).

2.0 CONSULTATION AND ENGAGEMENT

Consultation and engagement activities related to marine water and sediment quality were conducted between May 2012 and February 2017 with Appropriate Government Authorities and potentially affected Aboriginal groups. Opportunities to discuss marine water and sediment quality and identify issues or concerns were provided to public stakeholders through the Trans Mountain website, workshops, meetings, and ongoing engagement activities during the reporting period. Appendix A includes a comprehensive record of these engagement activities, stakeholder feedback and Trans Mountain responses.

Engineering design changes were issued in the TMEP Fall 2016 Project Update document (www.transmountain.com/environmental-plans), along with a request for feedback. All of the design updates up to April 1, 2017 have been reviewed, and the Project design updates that are relevant have been incorporated into this Plan.

3.0 DESCRIPTION OF RIP RAP REMOVAL ACTIVITY

The foreshore extension at the WMT will require the excavation of approximately 24,000 m³ of rip rap (rock material) along the shoreline, in intertidal and shallow subtidal areas. The rip rap will be removed from a total area of approximately 8,800 m² to allow for the installation of sheet pile cells (Figure 1). Removal of the existing rip rap will also be required to allow for ground improvements to be made within the sheet pile cells. The rip rap will be removed using a combination of a barge-mounted crane with an orange peel bucket and a shore-based excavator. The excavated rock material will be disposed of on land at an offsite location, or reused for construction of marine fish habitat offsets (i.e., artificial rock reefs) if the material does not require costly storage, rehandling and sorting and if approval is granted by Fisheries and Oceans Canada (DFO) and the Vancouver Fraser Port Authority.

10094_sediment_fig_01_01_construction_area_and_monitoring_sites.mxd

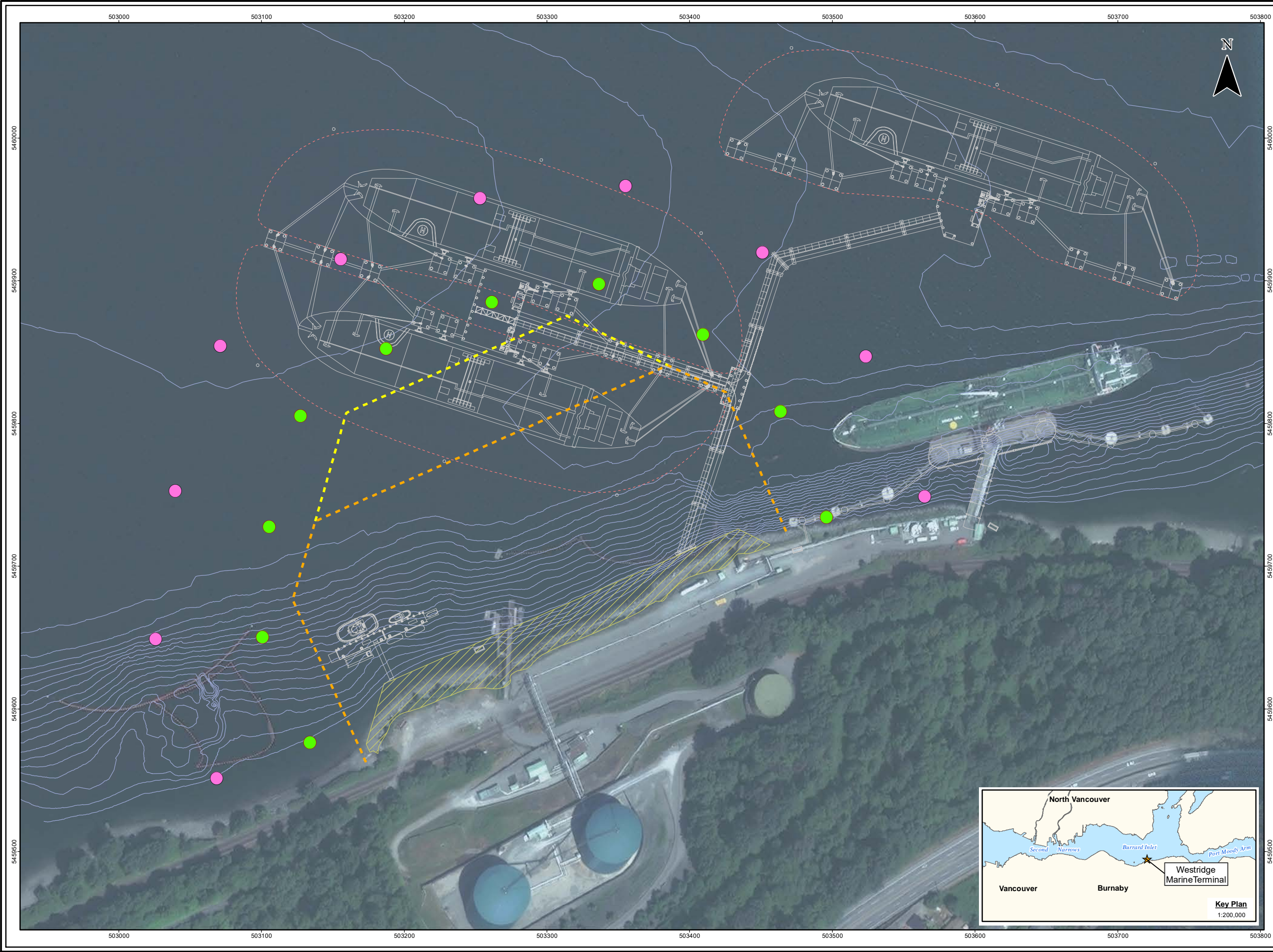









FIGURE: 1

**PROPOSED RIP RAP REMOVAL AREA
AND EXAMPLE OF PROPOSED
WATER QUALITY MONITORING
STATIONS AT THE WESTRIDGE
MARINE TERMINAL**

MARINE WATER QUALITY MANAGEMENT
PLAN DURING RIP RAP REMOVAL

**TRANS MOUNTAIN
EXPANSION PROJECT**

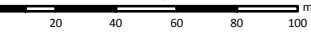
-  Bathymetry (m CD)
-  Containment Boom
-  Primary Turbidity Curtain
-  Secondary Turbidity Curtain
-  Rip Rap Removal Area
-  Water Quality Monitoring Station
30 m from Silt Curtain
-  Water Quality Monitoring Station
100 m from Silt Curtain

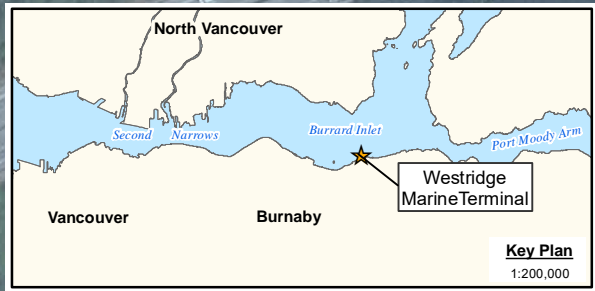
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Projection: NAD 83 UTM Zone 10N; Satellite Imagery: I-cubed, 2010; Bathymetry: Canadian Hydrographic Service, 2011; Existing and Proposed Westridge Water Lease: Moffatt & Nichol, 2012; Footprint (Marine): CH2M Hill, 2014; Fill Slope of Land Reclamation: CH2M Hill, 2014; Land Reclamation: CH2M Hill, 2014.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER		PAGE	
10494_SEDIMENT_FIG 01_01		SHEET 1 OF 1	
DATE	May 2017	REVISION	0
SCALE	1:2,500	PAGE SIZE	11x17
DRAWN	SS	CHECKED	BT
		DESIGN	BT

SCALE: 1:2,500

ALL LOCATIONS APPROXIMATE



4.0 EXISTING MARINE SEDIMENT CONDITIONS

Although no dredging of soft sediment will be required at the WMT, in-water excavation of rip rap is expected to disturb existing sediments. This will result in elevated turbidity in the surrounding water, and may result in the resuspension of existing contaminants. Information on existing marine sediment conditions at the WMT is provided in the Project's Environmental and Socio-Economic Assessment (Volume 5A, Section 7.6.8; and Volume 5C-12 – *Marine Sediment and Water Quality: Westridge Marine Terminal Technical Report*). This includes data from a subtidal sediment sampling program conducted in May 2013, as well as data from past studies in the area. Additional sediment sampling to characterize sediment in and adjacent to the area of rip rap removal was conducted in October 2014 and November 2016. The sampling programs showed that levels of cadmium and lead were higher than the disposal at sea screening criteria in the top 0.5 m of sediment in isolated locations. Levels of copper were higher than the screening criteria down to 2.5 m depth in core samples, suggesting naturally elevated levels. Arsenic levels were above screening criteria down to 2 m depth at the existing berth, suggesting naturally elevated levels; however, concentrations were not elevated near the foreshore. Levels higher than the screening criteria were noted for polycyclic aromatic hydrocarbons (PAHs), primarily in some surface samples but also in isolated core samples to 0.5 m depth (up to 14.5 mg/kg total PAH, compared to disposal at sea screening criterion of 2.5 mg/kg).

5.0 MITIGATION MEASURES

The following mitigation measures will be implemented to protect marine water quality and reduce potential effects to marine life during in-water excavation of rip rap.

- In-water excavation of rip rap will be conducted during a timing window between August 16 and March 15. The expected duration of the rip rap removal if completed in a continuous manner is approximately one month. This scheduling will reduce potential exposure of sensitive species and life stages to elevated levels of suspended sediment.
- A turbidity curtain will be deployed around the work area to limit the spatial extent of elevated levels of suspended sediment. Turbidity curtains are effective in shallow depth, low current conditions, such as those found at the WMT. The turbidity curtain will be secured with a system of anchors, buoys and a weighted chain, and will extend around the entire work area where excavation will occur (Figure 1). If a barge is required for removal of the excavated material, this vessel will be contained within a separate turbidity curtain outside the in-water works area (Figure 1). This approach will allow passage of the barge to and from the site without opening the turbidity curtain surrounding the work site.

6.0 MONITORING MEASURES

Water quality will be monitored outside of the turbidity curtain during in-water excavation of rip rap. Turbidity levels will be measured outside of the turbidity curtain to determine the effectiveness of the curtain at containing suspended sediments. Results will be compared to the BC MOECCS turbidity guidelines for the protection of aquatic life.

The preliminary monitoring plan is as follows:

- Sample 10 monitoring sites in an arc 30 m from the turbidity curtain
- Sample an additional 10 monitoring sites in an arc 100 m from the turbidity curtain
- Collect water samples at the surface at all sites and 2 m from bottom at deeper sites (i.e., greater than 5 m depth)

- Collect samples a minimum of two times per day during the first week of work: prior to start-up and mid-morning, prioritizing test locations directly across from the rip rap removal location and in reference areas
- Collect samples every second day at the same two times of day when the onsite-spatial and temporal variations in water quality are well-understood, from the second week of work until completion. The number of monitoring locations will be adjusted based on initial findings and site conditions.

Background conditions, for comparison to the BC MOECCS turbidity guideline, will be established in two ways. The samples taken prior to start-up each day will reflect undisturbed conditions in Burrard Inlet, as will samples taken 100 m away on the up-current side of the excavation activity (depending on direction of tidal currents). The number and location of sampling sites is preliminary and may require refinement based on final construction methods and site conditions. Additional samples may be required to confirm the effectiveness of water quality mitigation measures, or to identify the need to adjust construction activities.

The monitoring sites will move if the turbidity curtain is moved. Figure 1 shows an example of sampling site locations. If water quality guideline exceedances are detected outside the turbidity curtains, the Water Quality Monitor will inform the excavation Contractor. Depending on the duration, extent, and magnitude of the exceedance, a temporary halt or adjustment to the excavation activity will be considered.

A decision tree for turbidity monitoring that refers to thresholds from the BC MOECCS turbidity guideline and identifies corrective actions to be implemented if a threshold is exceeded is provided in Figure 2.

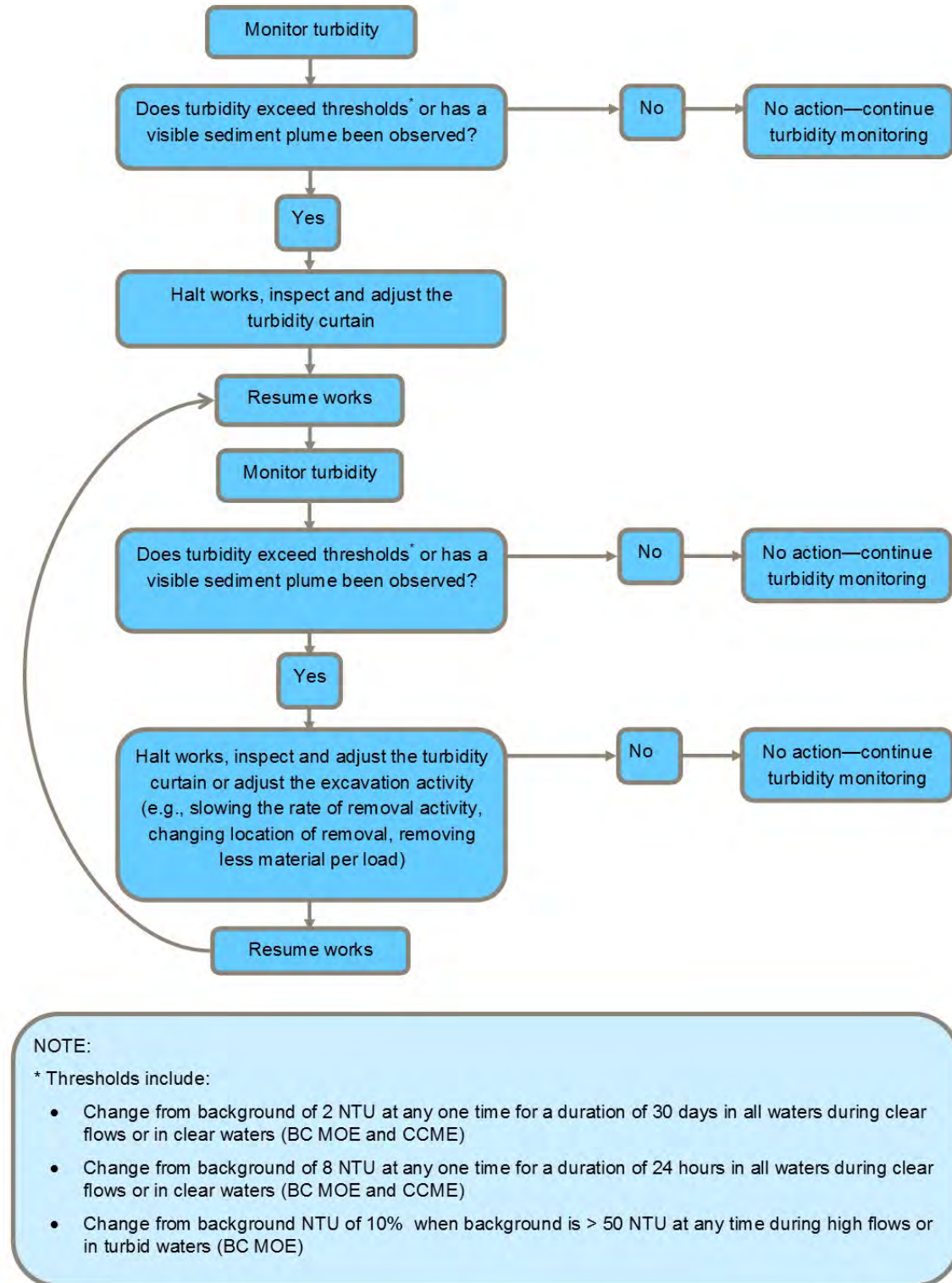


Figure 2 Decision Tree for Turbidity Monitoring During Rip Rap Removal

7.0 CONCLUSION

The mitigation measures outlined in this Plan are industry standards with a well-established record of effective use. As such, they are expected to successfully mitigate the effects of in-water excavation of rip rap on marine water quality, and reduce potential effects to marine life.

Measures to reduce the residual effects of in-water excavation of rip rap on marine water quality have been implemented during Project planning and will continue through the remaining phases of the Project with guidance from relevant government policies and management objectives and consultation.

8.0 REFERENCES

- British Columbia Ministry of Environment. 2016. British Columbia Ambient Water Quality Guidelines for Turbidity. Website: <http://www.env.gov.bc.ca/wat/wq/BCguidelines/turbidity/turbidity.html>. Accessed: November 2016.
- Canadian Council of Ministers of the Environment. Water Quality for the Protection of Aquatic Life. Website: http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=218#aql_marine_concentration. Accessed: March 2017.

APPENDIX A

CONSULTATION AND ENGAGEMENT

Consultation and engagement activities related to marine water and sediment quality were completed with Appropriate Government Authorities and potentially affected Aboriginal groups. Opportunities to discuss marine water and sediment quality and identify issues or concerns were also provided to public stakeholders during meetings, workshops and ongoing engagement activities.

Consultation and engagement opportunities began in May 2012 with the Project announcement and are ongoing.

1.0 Consultation and Engagement Overview: Draft Plan Development

Reports on public consultation activities completed between May 2012 and June 30, 2015 were filed with the National Energy Board (NEB) and are available in the Application (Volume 3A: Stakeholder and Volume 3B: Aboriginal; Filing ID [A55987](#)) as well as in Consultation Update No. 1 and Errata, Technical Update No. 1 (Filing ID [A59343](#)) / Consultation Update 2 (Filing IDs [A62087](#) and [A62088](#)), Consultation Update 3 (Filing IDs [A4H1W2](#) through [A4H1W8](#)) and Consultation Update 4 (Filing ID [A72224](#)). These reports include results of consultation conducted to date, identification of issues and concerns as well as Trans Mountain's response and are included below. Where appropriate, Trans Mountain's response has been updated to reflect information developed since the original response was provided during the NEB proceeding for the Project.

Consultation and engagement activities completed between July 1, 2015 and February 24, 2017 have not been filed on the public record with the NEB. Any new issues and concerns identified during this period, as well as Trans Mountain's response, are described below.

2.0 Consultation and Engagement Overview: Draft Plan

The draft Marine Sediment Management Plan, which has been revised and renamed to this Plan, was released for review and feedback on November 22, 2016. The comment period closed on February 24, 2017. Email or mail notification regarding the Plan was sent to 141 public stakeholders, 17 regulatory authorities, 17 Aboriginal groups and all affected landowners. The notification included a summary description of the Plan, a request for review, the timing of the comment period and contact information. Aboriginal groups were offered the opportunity for an in-person meeting to review the Plan. See Appendix B for a complete list of notified stakeholders.

In addition to direct notification, the online posting of each Plan was promoted through Trans Mountain's weekly e-newsletter, Trans Mountain Today, which provides Project updates, regulatory information, stories and interviews to more than 6,000 subscribers. Each week Trans Mountain Today included a focus on a specific plan, or group of plans, as well as a reminder of all plans available for review.

- 2016
 - September 22—Wildlife Mitigation and Habitat Restoration Plans
 - September 29—Pipeline Environmental Protection Plans
 - October 6—Air Quality Management Plans
 - October 13—Watercourse and Water Ecosystems Plans
 - October 20—Vegetation Management Plans

- October 27—Air Quality Plans
- November 3—Socio-Economic Effects Monitoring Plan
- November 10—Access Management Plan
- December 22—General promotion all plans
- December 29—General promotion all plans
- 2017
 - January 5—General promotion all plans
 - January 12—General promotion all plans

Trans Mountain is committed to ongoing engagement throughout the life of the Project. The start and end date for the review and comment period for each environmental management plan is defined. These timelines are required to allow time for preparation of the final Plan in order to meet regulatory requirements and NEB submission dates.

3.0 Consultation and Engagement: Activities and Feedback

Consultation and engagement activities completed with identified stakeholder groups are described below, including: public stakeholders (Section 3.1); and Aboriginal groups (Section 3.2).

Feedback on this Plan, Trans Mountain's response, and where each issue or concern is addressed in this Plan, has been outlined in each section according to stakeholder group.

3.1 Public Consultation

3.1.1 Public Consultation Summary—May 2012 to June 2015

Feedback regarding marine water and sediment quality received during public consultation and engagement activities between May 2012 and June 2015 is summarized in Table A-1.

Table A-1 Summary of Public Consultation—May 2012 to June 2015 ¹

Issue or Concern	Summary Trans Mountain Response	Where Addressed
Dredging of Burrard Inlet (i.e., is it necessary and whose decision would it be)	The exact configuration of the new docks has yet to be determined and depending on their location some near shore dredging might be necessary to accommodate construction of the new docks. Piles will be driven to support the new dock structures. Once the docks are constructed, berthing and mooring structures will be constructed. In addition, top-side equipment will be installed, such as piping systems, loading arms, vapour control systems and fire protection systems. The number of piles and other structures will depend on the results of ongoing planning and engineering.	Volume 8A, Section 2.0 – Description of Marine Transportation Activities
Impacts of dredging on tides and on West Vancouver's shoreline near Ambleside	There is no proposed dredging of First or Second Narrows. Limited dredging will only be required for the expansion of Westridge Marine Terminal in Burnaby. Maintenance and dredging concerns to First Narrows fall within the stringent regulations and requirements of PMV (PMV) who would ultimately undertake a maintenance dredging program to ensure that oil tankers navigate local waters safely.	Volume 8A, Section 4.0 - ESA

Issue or Concern	Summary Trans Mountain Response	Where Addressed
Dredging requirements for the Project	Dredging of the Second Narrows to accommodate larger ships is not required for the Project. Dredging will be required in the area of Westridge (marine terminal) dock as part of the dock expansion and improvements. PMV manages the dredging program for Burrard Inlet and the Fraser River. More information can be found on their website at http://www.portmetrovancover.com/docs/default-source/Projects-	Volume 8A, Section 2.0 - Description of Marine Transportation Activities

NOTE:

¹ Table B-1, which was included in NEB Project proceedings, does not reflect current Project plan of no dredging of marine sediment.

3.1.2 New Interests, Issues, Concerns and Response—July 2015 to February 2017

No new issues or concerns with respect to marine water or sediment quality were identified by public stakeholders through engagement and communication opportunities between July 2015 and February 2017.

3.2 Regulatory Consultation

3.2.1 Regulatory Consultation Summary—May 2012 to June 2015

No feedback specific to this Plan was received between May 2012 and June 2015.

3.2.2 Feedback Regarding the Draft Plan—July 2015 to April 2017

Table A-2 includes new interests, issues and concerns, as well as Trans Mountain's response with respect to marine water quality during rip rap removal identified through public consultation and engagement activities between July 2015 and April 2017.

Table A-2 Summary of Public Consultation—July 2015 to April 2017

Stakeholder Name	Method of Contact	Date of Consultation Activity	Issue or Concern	Trans Mountain Response	Where Addressed in the Plan
BC MOECCS	Email	April 13, 2017	The in-water excavation component of the Westridge Marine Terminal Environmental Protection Plan outlined in Section 8 includes mitigation for reducing the remobilization of fine sediment during the removal of rip-rap from the intertidal and subtidal foreshore. Section 8.28 includes a commitment to monitor water quality during in-water excavation; however, no information is provided about which parameters will be measured, the frequency of monitoring, where monitoring will occur, which guidelines will be used to determine efficacy of mitigation and to trigger management actions, and an explanation of management actions that will be used to restore water quality to levels below guidelines. I recommend including a diagram showing monitoring locations (for example, Figure 1 in the Marine Sediment Management Plan). These deficiencies in the plan should be corrected in advance of in-water excavation activities	The Marine Water Quality Management Plan During Rip Rap Removal provides details on water quality monitoring, including parameters to be measured, frequency and location of monitoring, guidelines for screening, mitigation measures, and a figure showing sampling locations. The Westridge Marine Terminal Environmental Protection Plan was updated to include reference to the Marine Water Quality Management Plan During Rip Rap Removal.	Water quality guidelines are presented in Section 1.4, mitigation measures in Section 5.0, monitoring details in Section 6.0, and Figure 1 shows monitoring locations.

3.3 Aboriginal Engagement

Since April 2012, Trans Mountain has engaged with Aboriginal groups who might have an interest in the Project or have Aboriginal interests potentially affected by the Project, based on the proximity of their community and their assertion of traditional and cultural use of the land along the pipeline corridor to maintain a traditional lifestyle. The objectives of Aboriginal engagement are to:

- Have an open, transparent and inclusive process that seeks to exchange information in a respectful manner
- Address concerns shared by those who might have an interest in the Project or have Aboriginal interests potentially affected by the Project
- Incorporate feedback into Project planning and execution
- Provide opportunities to maximize Project benefits to Aboriginal communities and Aboriginal groups

A comprehensive Aboriginal engagement process is led by experienced engagement advisors in Alberta and BC, specialized in the areas of Aboriginal relations, law, economic development, education, training, employment and procurement. Trans Mountain's engagement process for the Project is flexible, allowing each community and group to engage in meaningful dialogue in the manner they choose and in a way to meet their objectives and values.

Each community has the opportunity to engage with Trans Mountain, depending on Project interests and potential effects. The following opportunities to engage have been provided:

- Project announcement
- Initial contact with Aboriginal community or Aboriginal group
- Meetings with Chief and Council and meetings with staff
- Host community information session(s)
- Conduct TLU studies and socio-economic interviews
- Identify interests and concerns
- Identify mitigation options

Issues and concerns specific to marine water and sediment quality raised during Aboriginal engagement between early 2012 and February 2017 are summarized in Table A-3.

Table A-3 Summary of Aboriginal Concerns Regarding Marine Water and Sediment Quality

Issue or Concern		Summary Trans Mountain Response	Where Addressed
Summary	Aboriginal Group		
More information is requested on actions taken in event that water quality samples or turbidity measurements exceed guidelines or thresholds.	Halalt	If water quality guideline exceedances are detected outside the silt curtains, the environmental monitor will inform the excavation contractor. Depending on the duration, extent, and magnitude of the exceedance, a temporary halt or adjustment of rip rap removal will be considered.	Section 2.0 and 3.0 of the Water Quality Management Plan During Rip Rap Removal

Trans Mountain continues to liaise with Indigenous and Northern Affairs Canada, the Government of Canada's Major Projects Management Office, the BC Ministry of Aboriginal Relations and Reconciliation, and the Alberta Ministry of Aboriginal Affairs to provide updates regarding Trans Mountain's engagement activities with Aboriginal groups.

Identifying Aboriginal Groups for Consultation

Trans Mountain used the First Nations Consultative Area Database Public Map Service to identify the Aboriginal groups with traditional territories that overlap with the Westridge Marine Terminal. Listed below are the Aboriginal groups identified for consultation. Throughout regular engagement with TMEP, any Aboriginal groups were added to the list if they identified marine water or sediment quality as a concern.

- Aitchelitz First Nation (Stó:lō)
- Cowichan Tribes
- Halalt First Nation (CNA)
- Kwikwetlem First Nation
- Lake Cowichan First Nation
- Leq'a:mel First Nation (Stó:lō)
- Lyackson First Nation
- Musqueam Indian Band
- Penelakut First Nation
- Popkum First Nation (Stó:lō)
- Skawahlook First Nation (Stó:lō)
- Skowkale First Nation (Stó:lō)
- Squamish Nation
- Stu'zuminus First Nation (Chemainus)
- Tsleil-Waututh Nation
- Tzeachten First Nation (Stó:lō)
- Yakwekwioose First Nation (Stó:lō)

Consultation Activities

A letter was sent to the Aboriginal groups listed above with a copy of the draft Plan in December 2016. Where appropriate and upon request, a follow up meeting was arranged to discuss this Plan in more detail and address any concerns..

Trans Mountain has summarized the feedback received through Trans Mountain's engagement on this Plan in Tables A-1, A-2 and A-3 and the summary includes how Trans Mountain responded to and addressed the concern or issue. It should be noted that although the engagement process also provided for opportunity for general discussion about Project construction and associated Aboriginal issues and opportunities; only feedback/issues directly related to marine water and sediment quality are provided in this Plan. Other issues and topics raised have been captured in the corresponding mitigation plan as appropriate.

This final Plan will be shared with the Aboriginal groups at the same time as the Plan is filed with the NEB in 2017.

APPENDIX B

RECORD OF STAKEHOLDER NOTIFICATIONS OF PLAN

Table B-1 Record of Notification

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Landowners	N/A	September 11, 2016	Letter
Aboriginal Groups	N/A	December 2016	Letter
Vancouver Fraser Port Authority	Tim Blair	December 22, 2016	Email
Jasper National Park of Canada	Mayabe Dia	December 22, 2016	Email
Alberta Environment and Parks	Corinee Kristensen	December 22, 2016	Email
Ministry of Transportation and Infrastructure	Lisa Gow	December 22, 2016	Email
BC Parks	Ken Morrison	December 22, 2016	Email
BC Oil and Gas Commission	Brian Murphy	December 22, 2016	Email
Ministry of Natural Gas Development	Linda Beltrano	December 22, 2016	Email
Forests, Lands and Natural Resource Operations	Andrea Mah	December 22, 2016	Email
Forests, Lands and Natural Resource Operations	Susan Fitton	December 22, 2016	Email
FVAQC	Roger Quan	October 21,, 2016	Email
ECCC	Phil Wong	October 21, 2016	Email
ECCC	Rachel Mayberry	October 28, 2016	Email
ECCC	Coral Deshield	December 21,, 2016	Email
ECCC	Phil Wong	December 21, 2016	Email
Vancouver Fraser Port Authority	Patrick Coates	January 31, 2017	Email
Department of Fisheries and Oceans	Sandra Hollick-Kenyon	December 3, 2016	Email
Department of Fisheries and Oceans	Alston Bonamis	December 3, 2016	Email
City of Edmonton	N/A	November 29, 2016	Letter
City of Spruce Grove	N/A	November 29, 2016	Letter
Municipality of Jasper	N/A	November 29, 2016	Letter
Parkland County	N/A	November 29, 2016	Letter
Strathcona County	N/A	November 29, 2016	Letter
Town of Edson	N/A	November 29, 2016	Letter
Town of Hinton	N/A	November 29, 2016	Letter
Town of Stony Plain	N/A	November 29, 2016	Letter
Village of Wabamun	N/A	November 29, 2016	Letter
Yellowhead County	N/A	November 29, 2016	Letter
City of Kamloops	N/A	November 29, 2016	Letter
City of Kamloops RCMP Detachment	N/A	November 29, 2016	Letter
City of Merritt	N/A	November 29, 2016	Letter
City of Merritt RCMP Detachment	N/A	November 29, 2016	Letter
Clearwater Chamber of Commerce	N/A	November 29, 2016	Letter
District of Clearwater	N/A	November 29, 2016	Letter

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
District of Clearwater RCMP Detachment	N/A	November 29, 2016	Letter
Interior Health	N/A	November 29, 2016	Letter
Merritt Chamber of Commerce	N/A	November 29, 2016	Letter
Northern Health	N/A	November 29, 2016	Letter
Regional District of Fraser Fort George	N/A	November 29, 2016	Letter
Thompson Nicola Regional District	N/A	November 29, 2016	Letter
Town of Blue River	N/A	November 29, 2016	Letter
Venture Kamloops	N/A	November 29, 2016	Letter
Village of Valemount	N/A	November 29, 2016	Letter
Village of Valemount RCMP Detachment	N/A	November 29, 2016	Letter
Nicola Stock Breeder's Association - on behalf of the BC Cattlemen's Association	N/A	November 29, 2016	Letter
Grassland's Conservation Council	N/A	November 29, 2016	Letter
Thompson Rivers University	N/A	November 29, 2016	Letter
Southern Interior Weed Management Committee	N/A	November 29, 2016	Letter
Fraser Basin Council	N/A	November 29, 2016	Letter
Northwest Invasive Plant Council (NWIPC)		November 29, 2016	
Grassland's Conservation Council	N/A	November 29, 2016	Letter
Abbotsford Chamber of Commerce	N/A	November 29, 2016	Letter
Abbotsford Police Department	N/A	November 29, 2016	Letter
ASCA	N/A	November 29, 2016	Letter
BC Invasive Species	N/A	November 29, 2016	Letter
BC Ministry of Children and Family Development	N/A	November 29, 2016	Letter
BC Ministry of Social Development	N/A	November 29, 2016	Letter
BC Nature	N/A	November 29, 2016	Letter
BC Wildlife Federation	N/A	November 29, 2016	Letter
Burnaby Board of Trade	N/A	November 29, 2016	Letter
Burnaby RCMP Detachment	N/A	November 29, 2016	Letter
Chilliwack Chamber of Commerce	N/A	November 29, 2016	Letter
Chilliwack Economic Partners	N/A	November 29, 2016	Letter
City of Abbotsford	N/A	November 29, 2016	Letter
City of Burnaby	N/A	November 29, 2016	Letter
City of Chilliwack	N/A	November 29, 2016	Letter
City of Coquitlam	N/A	November 29, 2016	Letter
City of New Westminster	N/A	November 29, 2016	Letter
City of Port Coquitlam	N/A	November 29, 2016	Letter
City of Port Moody	N/A	November 29, 2016	Letter
City of Surrey	N/A	November 29, 2016	Letter
Coquitlam RCMP Detachment	N/A	November 29, 2016	Letter
Corporation of Delta	N/A	November 29, 2016	Letter
District of Hope	N/A	November 29, 2016	Letter

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Eagle Creek	N/A	November 29, 2016	Letter
Fraser Valley Invasive Plant Council	N/A	November 29, 2016	Letter
Fraser Valley Regional District	N/A	November 29, 2016	Letter
Glen Valley Watershed Society	N/A	November 29, 2016	Letter
Hope Chamber of Commerce	N/A	November 29, 2016	Letter
Hope Community Policing Office	N/A	November 29, 2016	Letter
Langley Chamber of Commerce	N/A	November 29, 2016	Letter
LEPS	N/A	November 29, 2016	Letter
LFVAQCC	N/A	November 29, 2016	Letter
Metro Vancouver	N/A	November 29, 2016	Letter
Newton RCMP Detachment	N/A	November 29, 2016	Letter
RCMP Division 'E'	N/A	November 29, 2016	Letter
Sapperton Fish and Game	N/A	November 29, 2016	Letter
Stoney Creek	N/A	November 29, 2016	Letter
Surrey Board of Trade	N/A	November 29, 2016	Letter
Surry Environmental Partners	N/A	November 29, 2016	Letter
Surrey RCMP Detachment	N/A	November 29, 2016	Letter
Township of Langley	N/A	November 29, 2016	Letter
Township of Langley RCMP Detachment	N/A	November 29, 2016	Letter
TriCities Chamber of Commerce	N/A	November 29, 2016	Letter
Upper Fraser Valley Regional Detachment	N/A	November 29, 2016	Letter
Village of Anmore	N/A	November 29, 2016	Letter
Village of Belcarra	N/A	November 29, 2016	Letter
Yorkson	N/A	November 29, 2016	Letter
ACGI Shipping	N/A	November 29, 2016	Letter
Barnett Marine Park	N/A	November 29, 2016	Letter
BC Ambulance	N/A	November 29, 2016	Letter
BC Chamber of Shipping	N/A	November 29, 2016	Letter
BC Coast Pilots (BCCP)	N/A	November 29, 2016	Letter
BROKE (Burnaby Residents Opposed to Kinder Morgan Expansion)	N/A	November 29, 2016	Letter
Canadian Pacific (CP) Rail	N/A	November 29, 2016	Letter
Canexus- Ero- Newalta-Univar Community Advisory Panel (CAP)	N/A	November 29, 2016	Letter
Canexus Chemicals	N/A	November 29, 2016	Letter
Chevron	N/A	November 29, 2016	Letter
CN Rail	N/A	November 29, 2016	Letter
Council of Marine Carriers	N/A	November 29, 2016	Letter
District of North Vancouver	N/A	November 29, 2016	Letter
Empire Shipping	N/A	November 29, 2016	Letter
Erco Worldwide	N/A	November 29, 2016	Letter
First Nation Emergency Services Society (FNESS)	N/A	November 29, 2016	Letter
First Nation Health Authority	N/A	November 29, 2016	Letter
Fraser Health Authority	N/A	November 29, 2016	Letter

Regulator/Stakeholder Group	Contact Name (if applicable)	Date	Method of Contact
Inchcape Shipping	N/A	November 29, 2016	Letter
Island Tug and Barge	N/A	November 29, 2016	Letter
Kask Brothers	N/A	November 29, 2016	Letter
Ledcor Resources and Transportation Limited Partnership	N/A	November 29, 2016	Letter
Mason Agency (Shipping Service)	N/A	November 29, 2016	Letter
MLA- Burnaby Lougheed	N/A	November 29, 2016	Letter
MLA- Burnaby North	N/A	November 29, 2016	Letter
MLA- Coquitlam – Burke Mountain	N/A	November 29, 2016	Letter
MLA- North Vancouver Lonsdale	N/A	November 29, 2016	Letter
MLA- North Vancouver Seymour	N/A	November 29, 2016	Letter
MLA- Port Moody- Coquitlam	N/A	November 29, 2016	Letter
MP- Delta	N/A	November 29, 2016	Letter
MP- North Burnaby Seymour	N/A	November 29, 2016	Letter
MP- North Vancouver	N/A	November 29, 2016	Letter
MP- Vancouver Centre	N/A	November 29, 2016	Letter
MP- Vancouver East	N/A	November 29, 2016	Letter
MP- Vancouver Quadra	N/A	November 29, 2016	Letter
MP- West Vancouver – Sunshine Coast – Sea to Sky Country	N/A	November 29, 2016	Letter
North Shore NOPE	N/A	November 29, 2016	Letter
North Vancouver Chamber of Commerce	N/A	November 29, 2016	Letter
Pacific Coast Terminal	N/A	November 29, 2016	Letter
Pacific Pilotage Authority	N/A	November 29, 2016	Letter
Pacific Wildlife Foundation	N/A	November 29, 2016	Letter
Peter Kiewit Infrastructure Co.	N/A	November 29, 2016	Letter
Seaspan	N/A	November 29, 2016	Letter
Shell Terminal	N/A	November 29, 2016	Letter
Simon Fraser University	N/A	November 29, 2016	Letter
SMIT Marine	N/A	November 29, 2016	Letter
Suncor Terminal	N/A	November 29, 2016	Letter
UBC Stellar Sea Lion (Marine Mammal) Research Centre	N/A	November 29, 2016	Letter
Vancouver Aquarium	N/A	November 29, 2016	Letter
Vancouver Board of Trade	N/A	November 29, 2016	Letter
Vancouver Coastal Health Authority	N/A	November 29, 2016	Letter
Vancouver Pile and Dredge	N/A	November 29, 2016	Letter
West Vancouver Chamber of Commerce	N/A	November 29, 2016	Letter
Westward Shipping	N/A	November 29, 2016	Letter
Wild Bird Trust	N/A	November 29, 2016	Letter
Metro Vancouver Regional District	Ali Ergudenler	November 29, 2016	Email
Metro Vancouver Regional District	Roger Quan	November 29, 2016	Email

APPENDIX B

Waste Discharge Permit #3678



March 25, 2014

Tracking Number: 291308
Authorization Number: 3678

REGISTERED MAIL

TRANS MOUNTAIN PIPELINE ULC
Suite 2700, 300 - 5th Ave SW
Calgary AB T2P 5J2

Dear Permittee:

Enclosed is Amended Permit 3678 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the permit. An annual fee will be determined according to the Permit Fees Regulation.

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

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

Administration of this permit will be carried out by staff from the South Coast Region. Plans, data and reports pertinent to the permit are to be submitted to the Regional Director, Environmental Protection, at Ministry of Environment, Regional Operations, South Coast Region, 2nd Floor, 10470 - 152 Street, Surrey, BC V3R 0Y3.

Yours truly,

Shelley Metcalfe, P.Ag.
for Director, *Environmental Management Act*
South Coast Region

Enclosure

cc: Environment Canada

Ministry of Environment

Environmental Protection
Division

2nd Floor, 10470 - 152 Street
Surrey, BC V3R 0Y3

South Coast Region
Telephone: (604) 582-5200
Facsimile: (604) 584-9751



MINISTRY OF
ENVIRONMENT

PERMIT

3678

Under the Provisions of the Environmental Management Act

TRANS MOUNTAIN PIPELINE ULC

Suite 2700, 300 - 5th Ave SW
Calgary AB T2P 5J2

is authorized to discharge effluent to Burrard Inlet from a jet fuel storage facility located at Westridge Terminal, 7065 Bayview Drive, Burnaby, British Columbia, subject to the terms and conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may lead to prosecution.

This Permit supersedes and amends all previous versions of Permit 3678 issued under Part 2, Section 14 of the *Environmental Management Act*.

1. **AUTHORIZED DISCHARGES**

1.1 This section applies to the discharge of effluent from a **dyked tank farm**. The site reference number for this discharge is E213525.

1.1.1 The maximum annual average rate of discharge is 26 cubic metres per day.

1.1.2 The maximum rate of discharge is 415 cubic metres per day.

1.1.3 The authorized discharge period is continuous.

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)

Shelley Metcalfe, P.Ag.
for Director, *Environmental Management Act*
South Coast Region

- 1.1.4 The characteristics of the discharge must be equivalent to or better than:

Total extractable hydrocarbons

Maximum: 5 mg/L

Toxicity, Rainbow Trout, 96-hour Single-concentration Test

Maximum: 50% mortality*

*In a static bioassay on Rainbow Trout, there must be no more than 50% fish mortality in 100% (undiluted) effluent within 96 hours.

- 1.1.5 The authorized works are a discharge sump, a manually controlled discharge pump, a siphon with hydrocarbon spill detector and a siphon-break/discharge-stop device which is automatically activated in the event of a spill, an outfall, any other works required to meet the effluent characteristics specified in Section 1.1.4 above, and related appurtenances approximately located as shown on the Site Plan.

- 1.1.6 The location of the facilities from which the discharge originates and the point of discharge is Lot 186 PL: 38021 DL: 216 LD: 37 New Westminster Group 1 PID 008-448-922.

- 1.2 This section applies to the discharge of effluent from a **dyked tank farm**. The site reference number for this discharge is E258155.

- 1.2.1 The maximum annual average rate of discharge is 26 cubic metres per day.

- 1.2.2 The maximum rate of discharge is 415 cubic metres per day.

- 1.2.3 The authorized discharge period is continuous.

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)



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for Director, *Environmental Management Act*
South Coast Region

1.2.4 The characteristics of the discharge must be equivalent to or better than:

Total extractable hydrocarbons

Maximum: 5 mg/L

Toxicity, Rainbow Trout, 96-hour Single-concentration Test

Maximum: 50% mortality*

*In a static bioassay on Rainbow Trout, there must be no more than 50% fish mortality in 100% (undiluted) effluent within 96 hours.

1.2.5 The authorized works are a discharge sump, a manually controlled discharge pump, a siphon with a hydrocarbon spill detector and a siphon-break/discharge-stop device which is automatically activated in the event of a spill, an outfall, any other works required to meet the effluent characteristics specified in Section 1.2.4 above, and related appurtenances approximately located as shown on the Site Plan.

1.2.6 The location of the facilities from which the discharge originates and the point of discharge is the same as Section 1.1.6 above.

2. **GENERAL REQUIREMENTS**

2.1 **Maintenance of Works and Emergency Procedures**

The authorized works must be inspected regularly and maintained in good working order. In the event of an emergency or condition beyond the control of the Permittee which prevents effective operation of the authorized works or leads to an unauthorized discharge, the Permittee must take appropriate remedial action and notify the Director immediately. The Director may reduce or suspend operations to protect the environment until the authorized works has been restored and/or corrective steps have been taken to prevent unauthorized discharges.

2.2 **Bypasses**

Any bypass of the authorized works is prohibited unless the approval of the Director is obtained and confirmed in writing.

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)



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for Director, *Environmental Management Act*
South Coast Region

2.3 **Process Modifications**

The Director must be notified prior to implementing changes to any process that may adversely affect the quality and/or quantity of the discharge. Despite notification under this section, permitted levels must not be exceeded.

3. **SAMPLING REQUIREMENTS**

3.1 **Sampling Procedures**

Sampling is to be carried out in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samphyrles, 2013 Edition", or most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html.

3.2 **Analytical Procedures**

Analyses are to be carried out in accordance with procedures described in the "British Columbia Environmental Laboratory Manual, 2013 Edition", or the most recent edition, or by suitable alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)



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for Director, *Environmental Management Act*
South Coast Region

3.3 **Quality Assurance**

- a) The Permittee must obtain from the analytical laboratory (ies) their precision, accuracy and blank data for each sample set submitted as well as an evaluation of the data acceptability, based on the criteria set by the laboratory.
- b) During each monitoring period, replicate and blank samples must be prepared and submitted for analysis for each parameter for every 10 monitoring sites, with a minimum of one replicate and blank sample where the number of monitoring sites sampled is less than 10. Corrective measures must be taken if the blanks, duplicates or reference standards are outside acceptable ranges.
- c) The Permittee must participate in the split sample analysis for performance evaluation under the Environmental Data Quality Assurance Regulation.
- d) For each test method, the Permittee must use analytical laboratory(ies) that:
 - 1. Participate in the Proficiency Testing Program operated by CALA (Canadian Association for Laboratory Accreditation);
 - 2. Are listed in the Ministry's Directory of Qualified Laboratories, available online at http://www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html; or
 - 3. Are accredited to ISO 17025 standards for that test method(s).

3.4 **Grab Sampling**

A suitable sampling facility must be installed and a grab sample of the effluent specified in Sections 1.1 and 1.2 must be obtained once each month on days when discharges occur. Proper care must be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)



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for Director, *Environmental Management Act*
South Coast Region

3.5 Analysis

Obtain analysis of the sample for the following:

<u>Sampling Sites</u> <u>(as shown in Site Plan)</u>	<u>Frequency</u> <u>Total Extractable Hydrocarbon</u>	<u>Toxicity</u>
West Discharge Sump (01)	Monthly	Annually
East Discharge Sump (02)	Monthly	Annually
West Groundwater Site (W)	Monthly	
East Groundwater Site (E)	Monthly	

4. OPERATIONAL REQUIREMENTS FOR EFFLUENT DISCHARGES

4.1 Sludge Disposal

Sludge from the sumps must be disposed of to a site and in a manner approved by the Director, or as authorized by regulation under the *Environmental Management Act*.

5. REPORTING REQUIREMENTS

5.1 Data Reporting

Maintain data of analyses and lab quality assurance data for inspection and submit the data, suitably tabulated, to the Director, for the previous year. All reports must be submitted within 31 days of the end of the year.

Each report must include a statement outlining the number of exceedances of permitted levels that occurred during the reporting period. The dates of the exceedances must be clearly identified in the data submission and an explanation as to the cause of the exceedances and a description of the measures taken to rectify the situation must be provided. Should no exceedances have occurred over the reporting period, a statement to that effect must be included.

Sample analysis data must be submitted in an electronic format and entered into the provincial database system known as EMS (Environmental Monitoring System) within 30 days after the sampling date.

Date issued: October 18, 1974
Date amended: March 25, 2014
(most recent)



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for Director, *Environmental Management Act*
South Coast Region

5.2 **Non-compliance Reporting**

The Permittee must immediately notify the Director or designate of any non-compliance with the requirements of this Permit and take appropriate remedial action. Written confirmation of all non-compliance events, including available test results is required within 24 hours of the original notification unless otherwise directed by the Director, Environmental Protection.

Within 30 days of the non-compliant event, the Permittee must submit to the Director, Environmental Protection, a written report including, but not necessarily limited to, the following:

- a. all relevant test results related to the noncompliance,
- b. an explanation of the most probable cause(s) of the noncompliance, and
- c. remedial action planned and/or taken to prevent similar noncompliance(s) in the future.

5.3 **Noncompliance Reporting of Toxicity**

Immediately notify the Director of any toxicity failures.

5.4 **Spill Reporting**

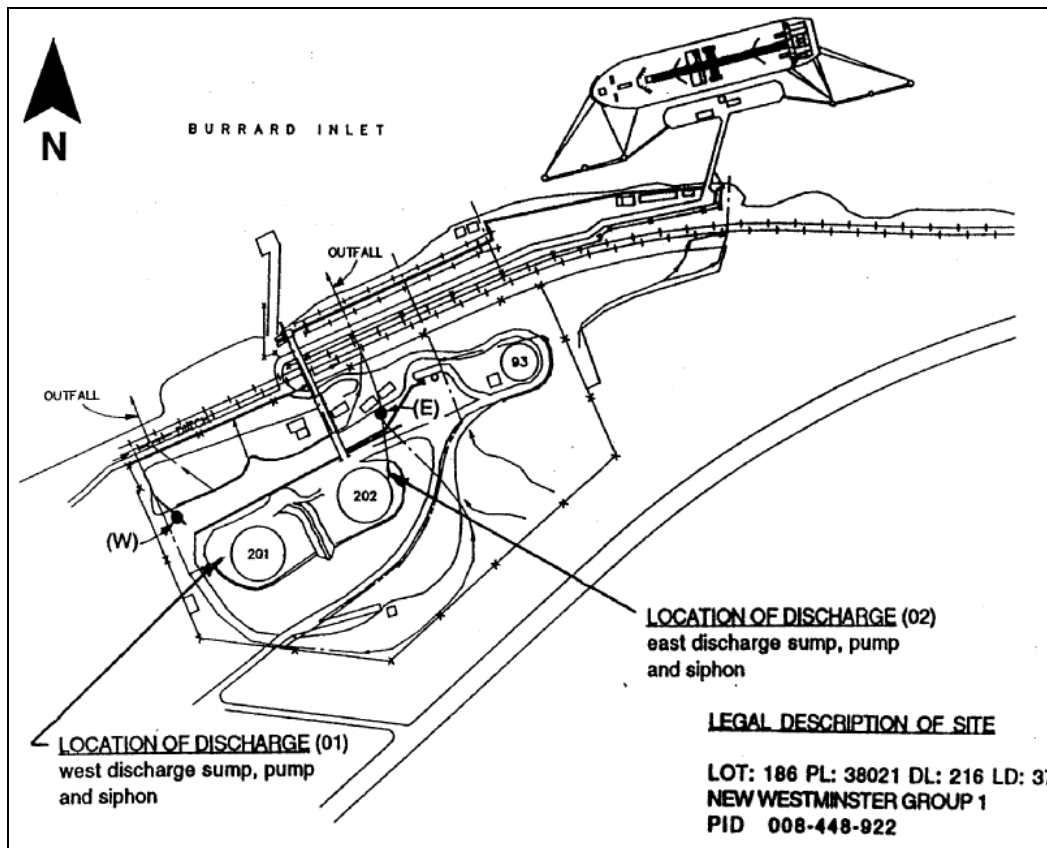
All spills to the environment (as defined in the Spill Reporting Regulation) must be reported immediately in accordance with the Spill Reporting Regulation. Notification shall be via the Provincial Emergency Program at 1-800-663-3456.

Date issued: October 18, 1974
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(most recent)

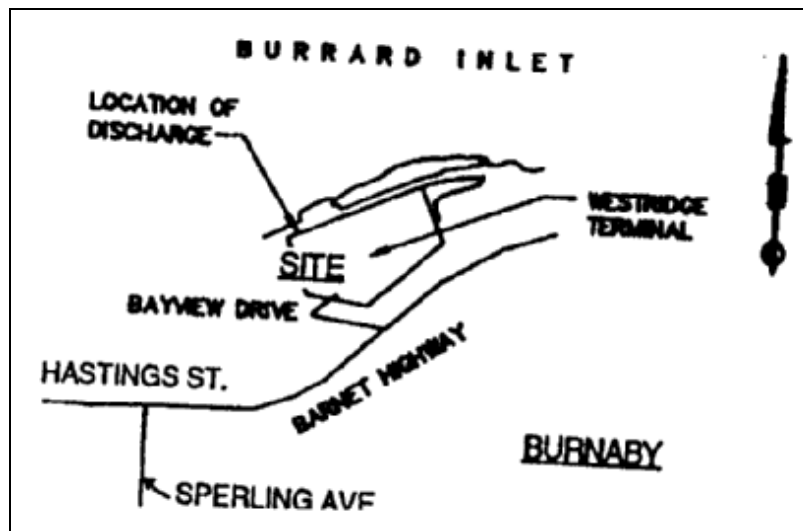


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for Director, *Environmental Management Act*
South Coast Region

Site Plan



Location Map



Date issued:
Date amended:
(most recent)


October 18, 1974
March 25, 2014

Shelley Metcalfe

Shelley Metcalfe, P.Ag.
for Director, *Environmental Management Act*
South Coast Region

APPENDIX C

TMEP Westridge Terminal Best Achievable Technology

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Trans Mountain Expansion Project

TMEP Westridge Terminal Best Achievable Technology

TMC Document # 01-13283-TW-WT00-EV-MEM-0005 R0

Rev No.	Prepared by/ Date	Reviewed by/ Date	Approved by/ Date	Reviewed by TMEP	Pages Revised	Issued Type
0	Matthew Wilson 2018-10-30	Mary Gregory 2018-11-05	Dave Shoemaker 2018-11-05			Issued for Use
	<i>MW</i>	<i>Mary Gregory</i>	<i>DRS</i>			

To:	KLTP TMEP – Trans Mountain Expansion Project	From:	Matthew Wilson and Mary Gregory Stantec Consulting Ltd
File:	117202581-PM-MEM-0002 Rev 0 – TMEP Westridge Terminal BAT Memo	Date:	October 30, 2018

Reference: TMEP Westridge Terminal Best Achievable Technology

INTRODUCTION

In support of Amended Permit 3678 an evaluation of the best achievable technology (BAT) in line with the requirements of the British Columbia Ministry of Environment (BCMOE) was undertaken for TMEP Westridge Terminal (site reference number E213525).

At the Westridge facility two primary technologies will be used to treat or control potentially contaminated storm water runoff. The technologies utilized are oil-water separation, followed by a flow arresting device that stops the discharge of captured storm water when petroleum hydrocarbons are present.

An oil-water separator is required for control and treatment of storm water flow potentially contaminated with hydrocarbons. The system needs to manage a maximum flow rate of 144m³/hr and discharge treated storm water with a maximum hydrocarbon contamination concentration of 15mg/L (approximately 15 parts per million).

The flow arresting system allows uncontaminated storm water to flow through the device at design flow rates ranging from 32m³/hr to 158m³/hr, with discharge hydrocarbon concentrations of 5mg/L or less. If petroleum hydrocarbons are present in the collected storm water the flow arresting system will close to stop all liquid discharge. This technology will be used in series at the outlet of the oil-water separation system for catchments that contain potential hydrocarbon release sources. The flow arresting technology will be used on its own for catchments that do not have direct sources of hydrocarbon release.

BAT EVALUATION

The technologies selected for control of hydrocarbon contamination in the discharge flow from the authorized works consists of both a gravity and coalescing plate type oil-water separators plus *petro-barrier* filters. Evaluation of the oil separators and *petro-barrier* system in the contexts of BAT included a review of the follow factors:

1. Identify applicable technologies and options;
2. Feasibility assessment;
3. Reliability assessment;
4. Ranking of control effectiveness;
5. Ranking of relative cost of operation

Reference: TMEP Westridge Terminal Best Achievable Technology

OIL-WATER SEPARATOR BAT

Regarding Point 1 from the BAT Evaluation section above, five options were evaluated when determining the BAT for oil-water separation at Westridge Terminal. These technologies include; gravity separation, coalescing plates, electrochemical, centrifugal and gas flotation. For reference a brief description of each technology is included below.

Gravity Separation

Due to the difference in specific gravity between water and petroleum hydrocarbons, oil will tend to rise to the surface of a volume of wastewater where it can be removed from the flow for disposal.

Coalescing Plates

Coalescing plates accelerate the natural mechanism of less dense oil rising to the surface of higher density water. Typically, inclined and closely spaced plates are arranged in such a way as to take advantage of Stoke's law by optimizing retention time, flow rates, surface area and plate angle. The surface layer of oil can then be removed from the flow of water.

Electrochemical

Electrochemical treatment introduces electrolytic bubbles into the wastewater stream. These bubbles attract pollutants – in this case, oil – and help transport the pollutant to the surface of the water where the oil can be removed via skimming, overflow or pumping.

Centrifugal

In centrifugal oil-water separation the waste stream is injected into a stationary cylindrical vessel which has a separate internal rotating section, also typically cylindrical. The internal section imparts the waste water with an angular velocity large enough to create a centrifugal force resulting in the denser water accumulating at the periphery of the device, where it can be discharged. The less dense oil accumulates closer to the axis of rotation and can be removed from the flow at that point.

Gas Flotation

Gas bubbles are forced into the flow of wastewater under pressure or by rotating impellers. The resulting bubbles adhere to oil in the waste stream and causes the contaminant to float to the surface where it can be skimmed from the treated flow.

Points 2 through 5 were evaluated and utilized to determine the best achievable technology for control of waste discharge from the approved work. The following table summarizes the rankings of the various oil-water separation technologies considered for the design at Westridge Terminal.

Reference: TMEP Westridge Terminal Best Achievable Technology

Evaluation Category	Technologies for Hydrocarbon Separation				
	Gravity	Coalescing Plates	Electrochemical	Centrifugal	Gas Flotation
Feasibility	<p>Commonly available technology.</p> <p>Simple and reliable.</p> <p>Small footprint appropriate for compact site.</p> <p>Suitable for inlet hydrocarbon concentrations of up to 4000ppm with discharge concentrations of 40ppm.</p>	<p>Commonly available technology.</p> <p>Conventional installation methods.</p> <p>Most suitable for oil droplet size of approx. 60 microns or more.</p> <p>Discharge concentrations of 10 to 15ppm achievable.</p>	<p>System intended for operation in a continuously contaminated flow which is not the anticipated design condition.</p> <p>Eliminated from consideration due to complexity, feasibility and cost.</p>	<p>Most suitable for oil droplet size in water of approximately 15 microns.</p> <p>More powerful than gravity or coalescing plate systems.</p> <p>Copes with variable input flow.</p>	<p>Most suitable for oil droplet size of over 5 microns if chemicals used or over 25 microns without chemicals.</p> <p>Most applicable where oil/water separation is required in large volumes or where other organic matter must be removed from water.</p> <p>Aerated oil at surface can pose an explosion hazard.</p>
Reliability	<p>Passive system. Does not require a power source.</p> <p>Minimum operating costs.</p> <p>Simple maintenance.</p> <p>No moving parts.</p>	<p>Passive system. Does not require a power source.</p> <p>Minimum operating costs.</p> <p>Simple maintenance.</p> <p>No moving parts.</p>	N/A	<p>Requires a power source.</p> <p>High maintenance costs.</p>	<p>Requires a power source.</p> <p>Prevalence of short circuits and sub-optimal flow patterns.</p> <p>Reduced retention time can result in a decrease in oil removal efficiency.</p> <p>Increased turbulence inside vessels can cause oil droplets to become stripped from the gas bubbles that they are attached to.</p>
Effectiveness Rank	3	2	N/A	1	4
Cost Rank	1	2	N/A	3	4
Recommendation	Recommended	Recommended	Not recommended	Not recommended	Not recommended

Gravity separation in combination with coalescing plate technology was selected as the BAT for oil-water separation at Westridge terminal. Several factors combine to make this technology the best option for this project.

Reference: TMEP Westridge Terminal Best Achievable Technology

- Oil contamination concentrations can potentially be reduced to less than 10mg/L without the need for an external power source.
- Maintenance requirements are very low and do not require specialized equipment.
- The selected gravity and coalescing plate oil-water separators can be installed below grade which can free up above ground space which is critical on this compact site.

While it is expected that use of centrifugal technology would be somewhat more effective at oil-water separation this effectiveness would come with a significant increase in cost and operational requirements. These higher costs, compounded with the expectation that the flow of storm water through the system is expected to be free of oil contaminants for the majority of the time, lead to the conclusion that the increased costs associated with a centrifugal system are not warranted.

FLOW ARRESTING BAT

Regarding Point 1 from the BAT Evaluation section above, four options were evaluated when determining a flow arresting BAT to be used for the project. These technologies include; petro-barrier filter, ultrasonic, turbidity and fluorometer hydrocarbon detector with automated valves. For reference a brief description of each technology is included below.

Petro-Barrier Filter

A petro-barrier is a polymer-based filter similar to a conventional filter except when the filter media is exposed to hydrocarbons the polymer material increases in size, thereby closing off the filter void space and quickly stopping all liquid flow through the filter.

Ultrasonic Detector and Valve

With this technology an automated valve, controlled by a sensor, is installed in the waste water flow. Under normal operating conditions the valve is maintained in the open position to allow unimpeded flow out of the system. An ultrasonic hydrocarbon detection device is installed upstream of the valve. This type of device emits an ultrasonic signal then interprets the return signal to establish the presence of hydrocarbons in the waste water flow. The device will send a signal to close the automated valve if hydrocarbons are detected in the waste water, stopping all liquid flow.

Turbidity Detector and Valve

With this technology an automated valve, controlled by a sensor, is installed in the waste water flow. Under normal operating conditions the valve is maintained in the open position to allow unimpeded flow out of the system. An optical turbidity monitoring device is installed upstream of the valve. This type of device emits a light signal then interprets the reflected signal to establish the presence of hydrocarbons in the waste water flow. The device will send a signal to close the automated valve if hydrocarbons are detected in the waste water, stopping all liquid flow.

Fluorometer Detector and Valve

With this technology an automated valve, controlled by a sensor, is installed in the waste water flow. Under normal operating conditions the valve is maintained in the open position to allow unimpeded flow out of the system. A fluorometer monitoring device is installed upstream of the valve. This type

Reference: TMEP Westridge Terminal Best Achievable Technology

of device emits a light signal at a specific wavelength then analyzes the returned fluorescence for Polycyclic Aromatic Hydrocarbons (PAH) detected in the waste water flow. The device will send a signal to close the automated valve if PAH are detected in the waste water, stopping all liquid flow.

Points 2 through 5 listed in the BAT Evaluation Section of this memo were evaluated and utilized to determine the best achievable technology for control of waste discharge from the approved work. The following table summarizes the rankings of the various flow arresting technologies considered for the design at Westridge Terminal.

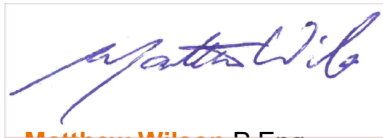
Evaluation Category	Technologies for Flow Arresting			
	Petro-Barrier	Ultrasonic Detector and Valve	Turbidity Detector and Valve	Fluorometer Detector and Valve
Feasibility	<p>Larger footprint than other technologies.</p> <p>Passive operation without the need for a power source.</p> <p>Able to provide filtration to less than 5ppm as well as stop flow.</p>	<p>Smaller footprint than petro-barrier filter.</p> <p>Similar technology utilized on site.</p> <p>Cannot provide any hydrocarbon filtration.</p>	<p>Smaller footprint than petro-barrier filter.</p> <p>Detector prone to errors due to scratches or buildup of solids and interference from air bubbles.</p> <p>Cannot provide any hydrocarbon filtration.</p>	<p>Smaller footprint than petro-barrier filter.</p> <p>Cannot provide any hydrocarbon filtration.</p> <p>Functions in waste streams with high TSS levels.</p>
Reliability	<p>Requires filter monitoring, cleaning and replacement.</p> <p>Does not required a power source.</p> <p>Does not need to be integrated with other systems to function.</p>	<p>Limited maintenance requirements, no wearing parts at the detector.</p> <p>Requires a power source.</p> <p>Detector and valve need to be integrated via PLC to function.</p>	<p>Requires a power source.</p> <p>Potential for errors in readings if sensor not continually maintained.</p> <p>Detector and valve need to be integrated via PLC to function.</p>	<p>High hydrocarbon concentrations can foul sensor.</p> <p>Detector and valve need to be integrated via PLC to function.</p>
Effectiveness Rank	1	4	3	2
Cost Rank	4	1	2	3
Recommendation	Recommended	Not Recommended	Not recommended	Not recommended

A petro-barrier filter system was selected as the flow arresting BAT at Westridge terminal. The leading selection criteria include:

Reference: TMEP Westridge Terminal Best Achievable Technology


- Fully passive system that does not require a power source to function. This is an important factor for potential post disaster operation.
- Of the evaluated technologies the petro-barrier is the only one able to provide hydrocarbon filtration in addition to flow arresting capacity.

The sensor and valve technologies have the potential to be effective at the flow arresting task, however the inability of any of those systems to provide hydrocarbon filtration capacity excludes them from being selected as the BAT in this application.

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APPENDIX D

Westridge Marine Terminal—Erosion and Sediment Control Plan—Phase 3

Trans Mountain Pipeline ULC
Westridge Marine Terminal
Erosion and Sediment Control Plan
Phase 3

Prepared For

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19V0182
Version 9/30/2019

**Down
to Earth
Biology**





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EXECUTIVE SUMMARY

The Trans Mountain Pipeline ULC (Trans Mountain) was established in 1951 to construct and operate the Trans Mountain Pipeline between Strathcona County, AB and Burnaby, BC. The pipeline and terminals began operation in 1953, creating a reliable energy supply for Canada and the United States. During that period, average daily throughput has been progressively increased from 150,000 BPD to today's 300,000 BPD.

Trans Mountain is regulated by the National Energy Board (NEB), a fully independent agency of the Government of Canada. Trans Mountain also complies with all ancillary legislation, unless it conflicts with federal legislation, in which case Trans Mountain will comply with federal legislation as ultimately determined by the NEB.

The Westridge Marine Terminal is the western coastal loading and shipping facility for the Trans Mountain Pipeline. It is an existing facility that has been in operation for over 50 years, providing distribution of refined and crude oil products. As part of the Trans Mountain Expansion Project (TMEP), the Westridge Marine Terminal will be expanded to include a new dock complex, access road, substation and transmission line, product lines, as well as a utility dock and the construction of a tunnel to convey two new 30-inch delivery lines from the Burnaby Terminal under Burnaby Mountain. The existing berth will be decommissioned. Trans Mountain will also be undertaking modifications at the Westridge Terminal to upgrade the security infrastructure.

The onshore and foreshore expansion of the Westridge Marine terminal has been divided into four main permit phases that align with the permitting approach taken by Trans Mountain with the BC Ministry of Environment and Climate Change Strategy (BC MoE). The main permit phases are described in the table below.

Phase	Description
Phase 1	Early site works (outside of the permitted discharge area for the existing waste discharge permit #3678 at Westridge Marine Terminal) that does not require treatment of stormwater
Phase 2	Early construction activities (outside of the permitted discharge area for the existing waste discharge permit #3678 at Westridge Marine Terminal) that requires treatment of stormwater
Phase 3	General construction works for the Westridge Marine Terminal expansion that requires: relocation of the eastern outfall, as well as treatment of stormwater, concrete waste water, hydrostatic test water and tunnel seepage water under the existing waste discharge permit #3678 at Westridge Marine Terminal and installation of new collection and treatment works.
Phase 4	Design and operation of new collection and treatment works under the existing waste discharge permit #3678 at Westridge Marine Terminal



This Erosion and Sediment Control Plan (ESCP) provides site-specific erosion and sediment control (ESC) prescriptions for Phase 3 general construction works within the existing terminal and expanded foreshore area and will guide the activities and the roles and responsibilities specific to ESC planning and execution. The ESCP also outlines the requirements for monitoring and reporting including protective measures and guidance to be implemented during the construction work. In addition, the intent of this ESCP is to address a combination of municipal, provincial and federal regulatory requirements. This ESCP is largely derived from the content of the Westridge Marine Terminal Phase 1 and 2 ESCP previously produced by Qualified Environmental Professionals (R.P.Bio, CPESC)(EDI 2018).

The Phase 4 scope of work encompasses the design and operation of the new collection and treatment works but does not include any construction activities. As such, an ESCP for the Phase 4 works is not required.



AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. As per the Province of British Columbia a Qualified Environmental Professional (QEP) is an “*applied scientist or technologist who is registered and in good standing with an appropriate BC professional organization constituted under an Act. The QEP must be acting under that association’s code of ethics, and subject to the organization’s disciplinary action.*” A QEP can be a professional Biologist, Agrologist, Forester, Geoscientist, Engineer, or Technologist. This includes those belonging to the College of Professional Biologists as Registered Professional Biologists (R.P.Bio). This report has been reviewed by an R.P.Bio. and A.Sc.T. The senior reviewer is also a Certified Professional in Erosion and Sediment Control (CPESC) by the Erosion and Sediment Control Association of Canada. This international designation is considered the top tier of knowledge in Canada related to erosion and sediment control management. More information can be found on their website at <http://www.escac.ca/>.

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Robert J. Redden, R.P.Bio., A.Sc.T., CPESCSenior Review

All of the site-specific information presented in the plan was obtained from the Kiewit Ledcor TM Partnership (KLTP) and the Trans Mountain Expansion Project website¹.

This plan was prepared by EDI for Kiewit Ledcor Trans Mountain Partnership (KLTP). Report content reflects EDI’s best judgement based on the information available at the time of preparation. Any use a third party makes of this plan, or any reliance on or decisions made based on it, are the responsibility of such third parties. EDI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this plan. Any reproductions of this report are uncontrolled and may not be the most recent revision.

¹ <https://www.transmountain.com/>



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GLOSSARY / LIST OF ACRONYMS

BC	British Columbia
BC MoE	BC Ministry of Environment and Climate Change Strategy
BMP	Best Management Practice
BPD	Barrels Per Day
CECs	Contractor Environmental Coordinators
CEM	Contractor Environmental Manager
Chief EI	TM Chief Environmental Inspector
cm	centimeter
CP	Canadian Pacific Rail
CWQMP	Construction Water Quality Monitoring Plan
DFO	Fisheries and Oceans Canada
GHAB	Guided Horizontal Auger Boring
EI	Environmental Inspector
EI Team	TM Environmental Inspection Team
EM	TM Environmental Manager
EPP	Environmental Protection Plan
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
HDD	Horizontal Directional Drilling
ISWRP	Intermediate Stormwater Retention Pond
kg/ha	kilograms per hectare
KLTP	Kiewit Ledcor Trans Mountain Partnership
km	kilometers



L/min	liters per minute
m	metre
mg/L	milligrams per liter
mm	millimetres
NEB	National Energy Board
OCP	Official Community Plan
QEP	Qualified Environmental Professional
RS	Resource Specialist
SFU	Simon Fraser University
TBM	Tunnel Boring Machine
TCA	Tertiary Containment Area
TMEP	Trans Mountain Expansion Project
TSS	Total Suspended Solids
WTP	Water Treatment Plant
VFPA	Vancouver Fraser Port Authority



1 INTRODUCTION

The Westridge Marine Terminal is the western coastal loading and shipping facility for the Trans Mountain Pipeline. It is an existing facility that has been in operation since 1953, providing distribution of refined and crude oil products (Figure 1-1). As part of the Trans Mountain Expansion Project (TMEP), the Westridge Marine Terminal will be expanded to include: three new marine berths, an expanded foreshore area, a manifold station, a metering station, emission control equipment, an expanded access road, a substation, a transmission line, new product lines, a new utility dock, a double perimeter fence will be installed requiring clearing and grubbing around the periphery of the site, and a tunnel to convey three new 30-inch delivery lines from the Burnaby Terminal to the Westridge Marine Terminal under Burnaby Mountain. (Figure 1-2 and Figure 1-3)



Figure 1-1. Location overview



Figure 1-2. Westridge Marine Terminal - Marine Expansion



Figure 1-3. Westridge Marine Terminal - Foreshore and Onshore Expansion.



1.1 PURPOSE AND SCOPE

The intent of this Erosion and Sediment Control Plan (ESCP) is to provide site-specific erosion and sediment control (ESC) prescriptions for Phase 3 construction works including protective measures and guidance to be implemented and to address requirements of municipal, provincial and federal regulatory bodies including:

- City of Burnaby;
- Province of British Columbia;
- Vancouver Fraser Port Authority (VFPA);
- National Energy Board (NEB); and
- Fisheries and Oceans Canada (DFO).

The ESC prescriptions will follow applicable Best Management Practices (BMPs) along with site-specific measures for water management during construction. The measures and strategies outlined in the ESCP will assist KLTP with meeting or exceeding the Project's regulatory conditions. More specifically, the ESCP is intended to prevent or minimize the entrainment, transport, and deposition of sediments and soil particulates from the project site into environmentally sensitive areas such as Burrard Inlet.

Throughout this ESCP, references to soil indicate general site material including spoils, excavated material, mineral soil and topsoil, unless specifically referenced. Sediment is considered soil in water.

1.2 ASSOCIATION TO OTHER PLANS

This ESCP is consistent and supplemental to other plans prepared for TMEP as part of the National Energy Board (NEB) approval process for the pipeline and associated facilities, and references to those plans are made herein as applicable. These may include, but are not limited to:

- Westridge Marine Terminal Environmental Protection Plan (EPP);
- Burnaby Mountain Tunnel EPP;
- Compliance Management Plan; and
- Facilities EPP.

The Westridge Marine Terminal EPP (Trans Mountain Pipeline ULC 2018) includes the following relevant ESC information:

- Terrestrial Construction - Section 7;
- Erosion and Sedimentation - Sections 10 and 11;
- Monitoring - Sections 15 and 16;
- Dust Control - Sections 17 to 23.



The Facilities EPP (Trans Mountain Pipeline ULC 2018a) details relevant information with respect to the Westridge Marine Terminal site. As it pertains to ESC it discusses:

- Environmental Compliance - Section 4;
- Notification of Interested Parties - Section 5;
- General Measures - Section 6;
- Pre-Construction Activities - Section 7;
- Topsoil/Root Zone Material Handling and Grading - Section 8;
- Facility Construction - Section 9; and
- Clean-Up and Reclamation - Section 10.

Appendices to the Facilities EPP that include relevant ESC information include the following:

- Appendix A of the Facilities EPP (Contacts) provides contact information of the appropriate government authorities that are to be consulted and or contacted in the case of an emergency.
- Appendix B of the Facilities EPP (Contingency Plans) provides contingency measures that could be implemented to mitigate potential environmental effects that may occur during construction activities.
- Appendix C of the Facilities EPP (Details) illustrates and describes general mitigation measures.
- Appendix D of the Facilities EPP (Resource-Specific Mitigation Tables) detail known environmental features and recommended mitigation measures at each construction site.
- Appendix E of the Facilities EPP (Westridge Marine Terminal Environmental Facility Drawing) illustrates environmental considerations at the Westridge Marine Terminal construction site.

The relevant sections of the Compliance Management Plan (Trans Mountain Pipeline ULC 2019) that are applicable to ESC management include:

- Roles and responsibilities – Sections 1.5 and 1.6;
- Compliance verification – Section 3.0;
- Non-compliance identification, reporting and correction – Section 3.2;
- Environmental compliance – Section 4.0; and
- Incident reporting – Section 5.0.

The Marine Water Quality Management Plan during Rip Rap Removal (Trans Mountain Pipeline ULC 2017b) has sections relevant to ESC management, specifically:

- Use of turbidity curtain – Section 5.0; and
- Monitoring of water quality during in-water riprap removal – Section 6.0.



Additionally, Hydrostatic Test Plans will be prepared for the Westridge Marine Terminal and Delivery Line at a future date.



2 REGULATORY REQUIREMENTS AND GUIDELINES

In addition to the existing terrain and site conditions, the ESCP for the project must take into consideration many other aspects of the approval and permitting process.

There are federal and provincial legislation, regulations and permits, and municipal bylaws pertaining to the protection of water quality during construction activities that are applicable to this project. A summary of the legislative requirements that influence ESC planning are summarized in the following sections.

2.1 FEDERAL

Fisheries and Oceans Canada: *Fisheries Act* (1985, updated in 2012):

There are several sections of the *Fisheries Act* that are relevant to the topic of erosion and sediment control:

- 35 (1) No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery.
- 36 (3) Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substances that result from the deposit if the deleterious substance may enter any such water. Note that sediment has been defined under case law as a deleterious substance.

Projects that are determined to cause serious harm to fish that are part of or that support a commercial, recreational or Aboriginal fishery, require an Authorization (Paragraph 35(2)(b) of *Fisheries Act*) to ensure compliance with the *Act*. An Authorization (DFO File No. 17-HPAC-00071) was issued to Trans Mountain Pipeline ULC on September 8, 2017 regarding the Westridge Marine Terminal works.

National Energy Board: *National Energy Board Act* (1985)

Of the 157 required conditions identified by the NEB in June 2019, six conditions have an ESC component. All require ESC planning prior to commencing construction, or prior to commencing construction of specified Project components. One ESC related commitment is required after construction (Condition 151, Post-Construction Environmental Monitoring Reports) (Table 2-1).



Table 2-1. National Energy Board Conditions

Condition #	Requirement
35	Marine Sediment Management Plan (Not required as dredging is not required at the Westridge Marine Terminal)
45	Weed and Vegetation Management Plan
47	Access Management Plan(s)
78	Facilities Environmental Protection Plan
81	Westridge Marine Terminal Environmental Protection Plan
151	Post-Construction Environmental Monitoring Reports

Vancouver Fraser Port Authority

The Vancouver Fraser Port Authority (VFPA) manages lands under the purview of the *Canada Marine Act*, which imparts responsibilities for environmental protection. The VFPA accordingly conducts project and environmental reviews of works and activities undertaken on these lands to ensure that the works and activities will not be likely to cause significant adverse environmental effects. The Project and Environmental Review Process applies to all proposed physical works and activities on federal lands and waters partially or wholly within the VFPA's jurisdiction. Trans Mountain has acquired a VFPA Project Permit for the works at Westridge.

2.2 PROVINCIAL

Ministry of Environment and Climate Change Strategy: *Environment Management Act* (2003)

The *Environmental Management Act* regulates industrial and municipal waste discharge and provides the authority for introducing wastes into the environment, while protecting public health and the environment. The Westridge Marine Terminal currently has a Waste Discharge Permit for effluent discharge from the diked tank farm. This is for surface water collected and treated with oil-water separators discharged at two locations into Burrard Inlet.

Trans Mountain is obtaining a waste discharge approval permit from BC Ministry of Environment and Climate Change Strategy (BC MoE) for Phase 3 works described in this ESCP. A Construction Water Quality Monitoring Plan (CWQMP) (Trans Mountain Pipeline ULC 2019a) will be implemented to ensure compliance with the BC MoE waste discharge permit requirements. A final permit amendment will be required for the design and operation of the new collection and treatment works required for the TMEP.



3 EXISTING SITE CONDITIONS

3.1 TOPOGRAPHY

The Westridge Marine Terminal is located at 7065 Bayview Drive in the City of Burnaby, BC, north of Burnaby Mountain. The property is situated on the lower slopes of a north-facing hillside and extends to the Burrard Inlet shoreline. The elevations of the project area range from approximately 58 m at the top of the property down to -6 m in the waters of Burrard Inlet. Aside from the relatively flat foreshore, most of the property is steeply sloped (approximately 26% gradient). Figure 3-1 illustrates existing topography.

3.2 GEOLOGICAL SETTING AND SOILS

The site is located in the Georgia Depression Physiographic Region, a flat valley floor 1-5 km wide, steep valley walls, gently rolling uplands and ridges, gently rolling to flat lowlands of terraces and plains, and deltas. The geologic types found at the Westridge Marine Terminal include coarse-grained clastics and volcanic rock types overlaid with surficial glaciofluvial soils. From an ESC perspective this means, the site has an initial surface layer that may be easily erodible with a relatively stable underlying layer.

3.3 CLIMATE

The project is located in the Fraser Lowland Ecosection within the Lower Mainland Ecoregion (Province of British Columbia 2016a), an area of high rainfall, with precipitation increasing towards the Coast Mountains and Cascade ranges. Pacific air can stall in this region bringing intense rain or snow to the adjacent mountains. Infrequently, Arctic air moving through the area can bring winter storms with cold temperatures and deep snow. The extreme minimum temperature recorded at the weather station at Simon Fraser University (SFU) is -19.4 °C (December 2, 1968) (Environment Canada 2016). Hot, dry air from the south can bring warm, very dry conditions in the summer (BC MoE 2016a), with an extreme maximum temperature recorded at SFU of 34.5 °C (September 3, 1988). Daily average maximum temperatures are highest in July and August at 21.2 °C, with daily average minimums lowest in December and January at approximately 1°C. Average precipitation recorded at the monitoring station at SFU between 1981 and 2010 is 2009.9 mm per year, with 89.3 cm of this falling as snow. Figure 3-2 summarizes the climate normals (average monthly precipitation, monthly average, minimum and maximum temperatures) for the SFU monitoring station.



Figure 3-1. Existing site topography (Note: Numbers represent elevation in meters).

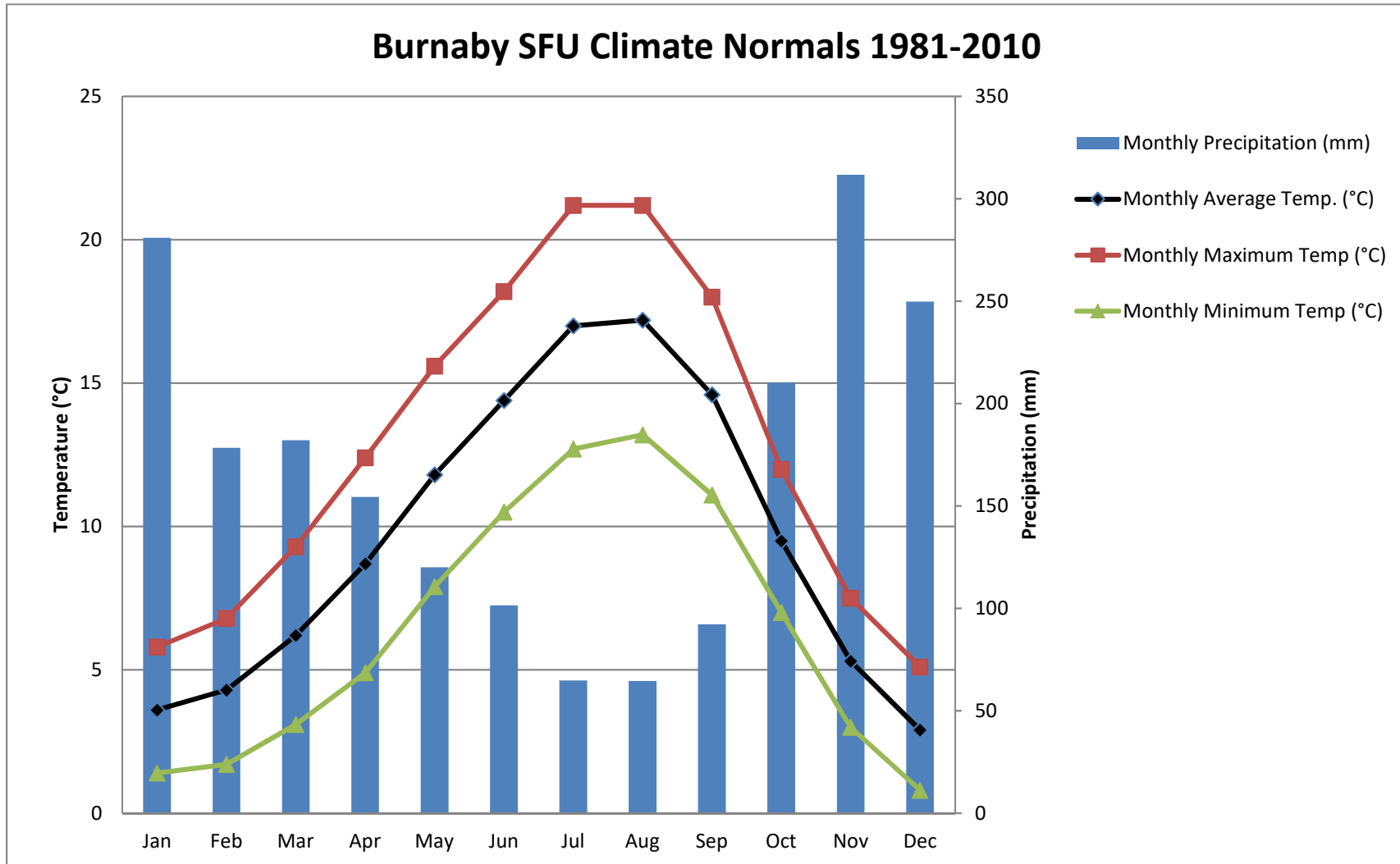


Figure 3-2. Climate normals for the site taken at Simon Fraser University (SFU), displaying total rainfall for each month of the year in addition to average, maximum and minimum monthly temperatures.



3.4 HYDROLOGY

Current onsite drainage for the Westridge Marine Terminal captures surface runoff and directs it to several drains/ditches, with direct discharge points into Burrard Inlet. Hydrology figures for Phases 3.1, 3.2/3.3 and 3.4.1/3.4.2 are provided in Figure 3-3, Figure 3-4, and Figure 3-5, respectively. ESC measures will be employed upslope of drains/ditches to reduce the amount of sediment entering them.

3.5 WATERCOURSES

Based on a site visit (December 20, 2016) and available geographic databases (Province of British Columbia 2016b, City of Burnaby 2016b), no fish bearing watercourses are noted within the Project area. A vegetated drainage ditch runs parallel to the Canadian Pacific (CP) railway on the south side of the tracks, but this appears to be only seasonally wetted. A manmade ditch on the west side of the property boundary also runs north to the same east-west drainage ditch. Another small watercourse (non-fish bearing stream) crosses onto the property on the south side from Inlet Drive directly south of the Tunnel portal area and flows north across the site before entering a roadside catch basin which is then culverted under property to Burrard Inlet.

3.6 GROUND COVER

Ground cover in the Westridge Marine Terminal property is largely dominated by paved surfaces with some maintained grass lawn surrounding the existing infrastructure and forested lands in the undisturbed areas of the property. Most of the forested area along the south and east sides of the property have been cleared for the perimeter fence. Undeveloped areas of the property are dominated by mature mixed wood forest with deciduous species being dominant. Tree species include black cottonwood (*Populus trichocarpa*), red alder (*Alnus rubra*), and western hemlock (*Tsuga heterophylla*). Although most of the foreshore is currently paved, there is a vegetated area west of the dock.





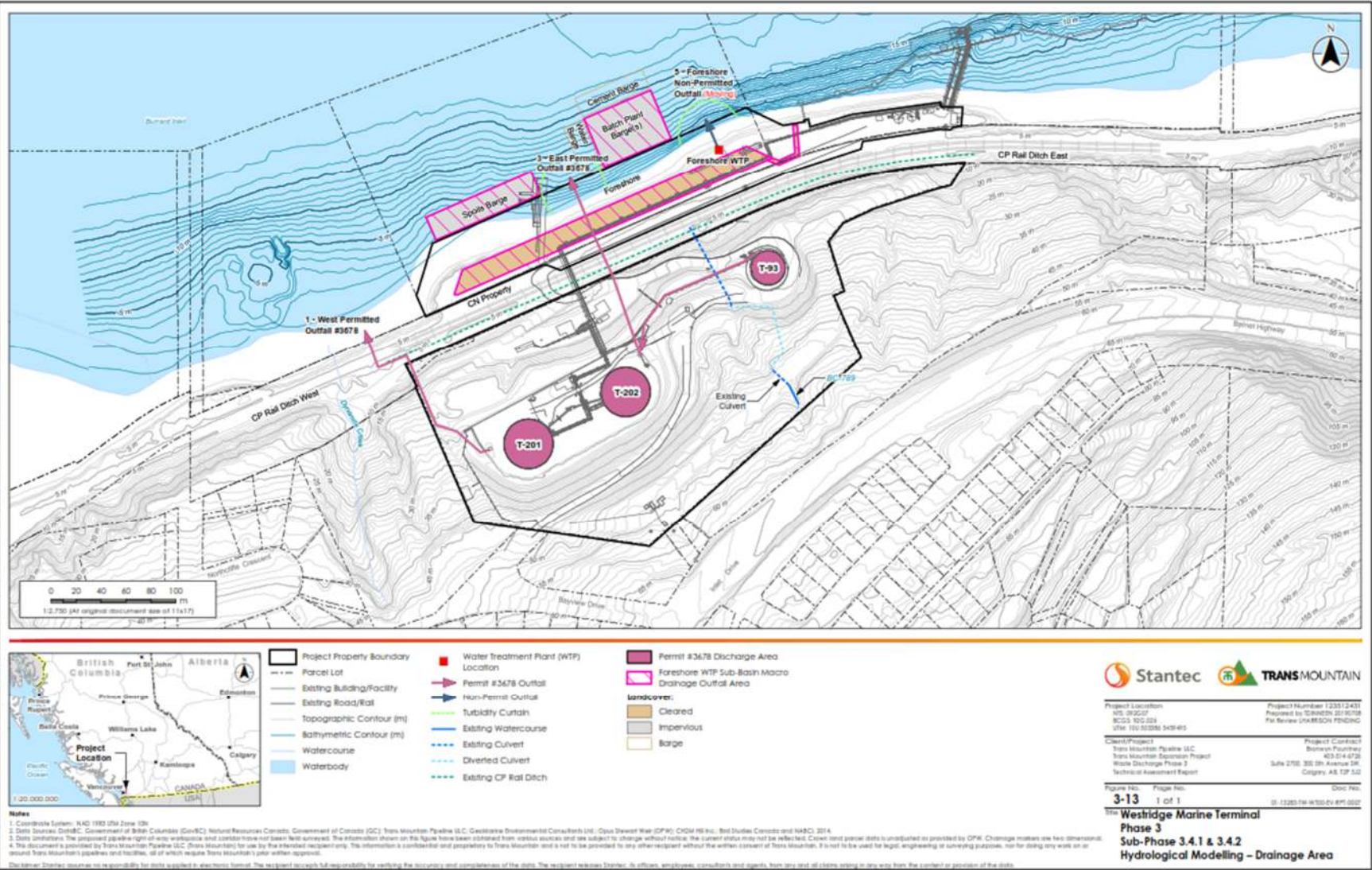


Figure 3-5. Sub-phase 3.4.1 & 3.4.2 drainage area.



3.7 AQUATIC RESOURCES

Data collected as part of the NEB Application (Trans Mountain Pipeline ULC 2013) documented at least 75 species of fish known to use Burrard Inlet. These include all five species of Pacific salmon (Chinook [*Oncorhynchus tshawytscha*], Chum [*Oncorhynchus keta*], Coho [*Oncorhynchus kisutch*], Pink [*Oncorhynchus gorbusha*], and Sockeye [*Oncorhynchus nerka*]), Pacific Herring (*Clupea pallasii*), Anchovy (*Engraulis mordax*), Lingcod (*Ophiodon elongates*), Copper Rockfish (*Sebastes caurinus*), and Quillback Rockfish (*Sebastes maliger*). Marine fish use of the area includes marine riparian, intertidal, and subtidal for spawning, rearing, migration, and foraging. The proposed marine construction area (Shore Area) overlaps with a Rockfish Conservation Area called the Eastern Burrard Inlet Rockfish Conservation Area. Consideration of an offset is proposed using removed riprap material to create subtidal rock reefs. Shellfish present in the area include Dungeness Crab (*Metacarcinus magister*) and Red Rock Crab (*Cancer productus*). A DFO Important Area for Dungeness Crab has been identified within the proposed construction footprint. Pacific harbour seal (*Phoca vitulina richardsi*) are likely the most prevalent marine mammal with the potential to be near the Shore Area construction, although other marine mammal species have been identified in Burrard Inlet.

3.8 LAND USE

The current footprint of the Westridge Marine Terminal is zoned as M3 (Heavy Industrial District) according to the City of Burnaby Official Community Plan (OCP) (Figure 3-6). The property is immediately bordered to the west, south and east by the Barnet Marine Park, zoned P3, then by areas zoned as residential districts (R2 and R11).

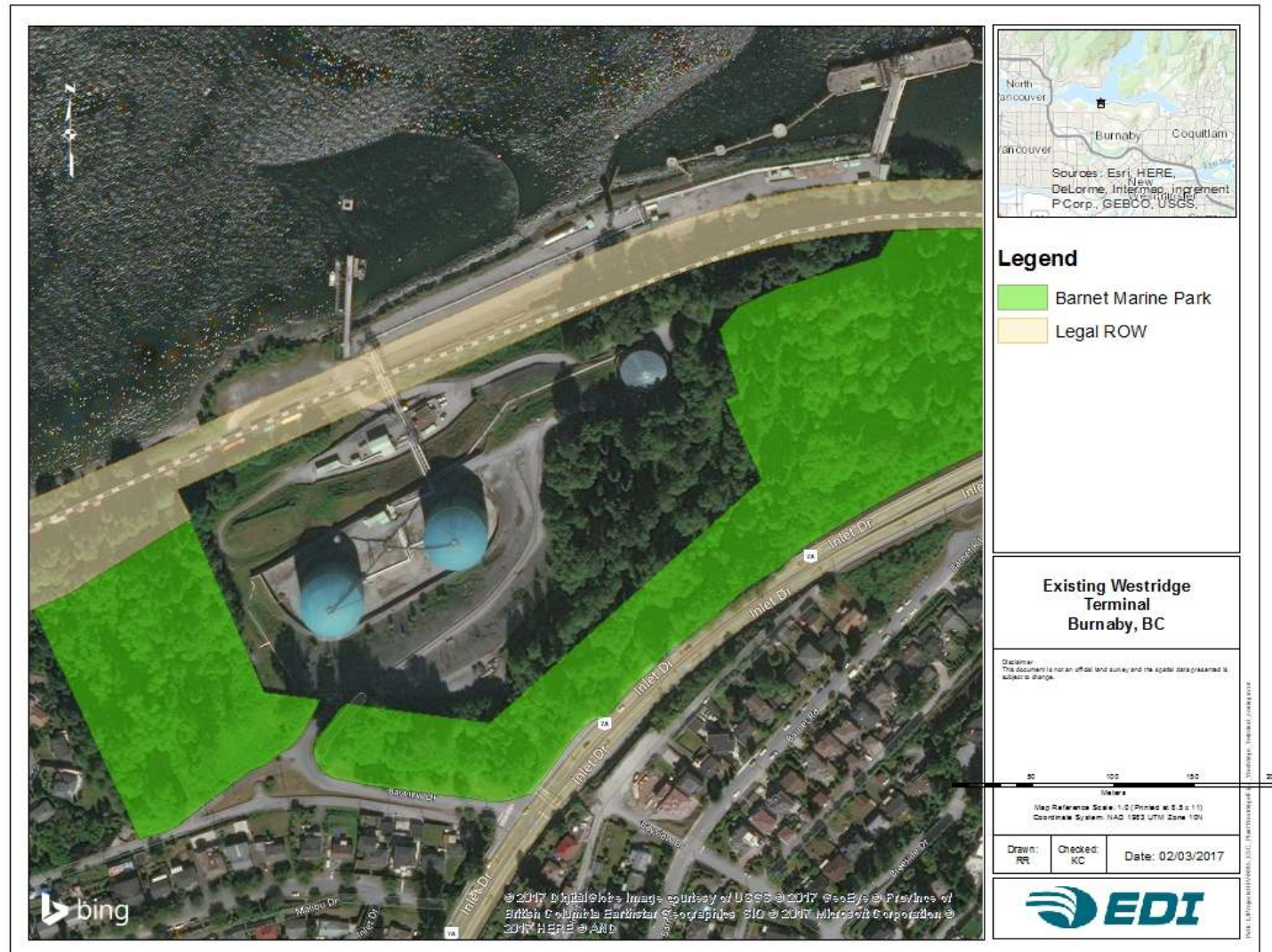


Figure 3-6. Westridge Marine Terminal zoning

4 EROSION POTENTIAL AND RISK ASSESSMENT

The selection of ESC practices and appropriate level of effort for ESC management is based on the risk of erosion within the site during construction. The determination of the site-specific risk of erosion and sedimentation has been completed based on the Transportation Association of Canada's approach to assessing risk using erosion potential combined with the consequence of sedimentation on downstream or off-site resources (i.e., environmental, regulatory and project related consequences) (Transportation Association of Canada 2005). Risk assessment is integrated into ESC planning.

Geological mapping of the Vancouver Metropolitan Area indicates that soils at the Westridge Marine Terminal site are characterized primarily as tills (Turner et al. 1998). Till is a heterogenous glacial deposit consisting of clay, silt, sand and stones ranging from pebble to boulder size. Silt and clay-bearing tills disturbed during construction activities can be a major source of sediment suspended and deposited by water.

The property is effectively divided into the steep slopes south of the railway tracks and a relatively flat foreshore to the north of the railway tracks. The average gradient on the hillside is approximately 26%, although this is characterized by steeper pitches broken by occasional flatter benches, both natural and anthropogenic (e.g. road, tank containment area) (City of Burnaby 2016b). It is anticipated that many slope lengths will be no more than 10 m, thus reducing erosion potential (TAC 2005). Areas with higher and longer gradients are considered higher risk and will require the implementation of additional ESC measures.

In addition, as construction works will take place year-round, they will overlap with the time of the year when the highest cumulative rainfall occurs (refer to Figure 3-2). Therefore, a combination of highly erodible soils, steeper slopes, and high rainfalls will have to be considered in the planning and implementation of the ESCP.

The potential consequences of erosion and sedimentation are considered high in areas where there is direct stormwater discharge to Burrard Inlet. Areas with moderate to high erosion potential and high consequences require an increased level of erosion and sediment control, including project planning and design BMPs, procedural BMPs, water management BMPs, erosion control BMPs and sediment control BMPs (TAC 2005). For effective erosion control, the project must incorporate sound planning and the implementation of multiple, complementary ESC measures and practices. The project site, construction activities and ESC measures must be monitored closely and adjusted as necessary to meet regulatory requirements.

5 BEST MANAGEMENT PRACTICES

Procedures and processes will be incorporated into construction schedules and site planning, where possible, to minimize erosion and prevent sediment transport off the site prior to construction or as contingency measures during construction. Various guiding principles apply to construction works:

- Reduce movement of exposed soil on sloped areas or salvaged/stockpiled material by installing temporary control structures;
- Minimize the input of sediment into non-contact water by minimizing, to the extent possible, the surface area of disturbed ground at any given time;
- Manage drainage and stormwater into, through and around work sites and direct contact water to centralized water treatment plant locations;
- Prevent the discharge of untreated sediment laden water to the environment, utilizing water treatment plant systems, incorporating water retention areas with sufficient storage capacity to manage for major storm events (e.g., from dewatering work sites, surface runoff due to rain events, etc.);
- Prevent erosion at discharge points e.g., by maintaining or reducing existing flow velocities and/or by providing dissipation measures;
- Maintain water quality at discharge points; and
- Control entry of sediment laden water into Burrard Inlet (e.g., using turbidity curtains).

The general BMPs (Table 5-1) outlined in this ESCP largely draw upon recommendations from the Trans Mountain Pipeline ULC Facilities Environmental Protection Plan (Trans Mountain Pipeline ULC 2018a) and the appended associated contingency plans (e.g., Soil Handling Contingency Plan, Wet/Thawed Soils Contingency Plan and Soil Erosion and Sediment Control Contingency Plan), Standards and Best Practices for Instream Works (BC MWLAP 2004), Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993), and the National Guide to Erosion and Sediment Control on Roadway Projects (TAC 2005). The BMPs are intended to be used throughout the project site in conjunction with site-specific prescriptions identified in Section 5.

Table 5-1. Best Management Practices.

BMP	Comments
Procedural	
Minimize exposed soils	Cover exposed soils, where practical, as quickly as possible (e.g., capping with gravel, seeding, mulching). Hydroseed/dry-seed and mulch permanently completed areas with exposed soils and cover temporarily completed areas with exposed soils with plastic/poly sheeting on an as required basis based on the instructions and judgement of an ESC QEP.
Minimize clearing	Only clear areas as required to complete work within the approved clearing boundaries. No clearing and/or grubbing will take place within established 15m riparian buffer adjacent to streams
Minimize site access	Limit access points within the project area and use gravel for high use access roads when feasible.
Maximize favourable weather	Where possible, schedule construction activities in high risk areas during periods of lower precipitation.
Prepare for shutdowns	Be prepared for scheduled or unplanned work stoppages and ensure contingency supplies are available and high-risk areas are addressed promptly.
Install BMPs early	Install runoff, erosion and sediment control measures before works in a given area occur or as soon as practicable.
Restore early	Restore or reclaim completed areas as soon as possible (e.g., hydroseed/dry-seed and mulch).
Water Management	
Keep clean water clean	Collect clean water (non-contact) and convey it through work site using pipes, culverts, or diversion channels. Maintain natural drainage patterns (natural draws) throughout the construction footprint where possible.
Use energy dissipater	Install riprap in areas such as culvert outlets to reduce flow velocities and provide erosion protection.
Diversion ditches/berms	Collect runoff with perimeter ditches at the tops of slopes and convey non-contact water around exposed areas.
Stormwater treatment	Convey contact water to water treatment plant prior to releasing water offsite.
Erosion Control	
Slope texturing/grading	Track completed slopes perpendicular to the grade as soon as final grades are achieved, or if slope is being left for extended periods of time.
Seeding	Establish vegetative cover as soon as possible.
Tackifier/Mulching	Cover exposed soils with certified weed free straw mulch, use a tackifier, or both, to minimize surface erosion.
Hydroseeding	Conduct hydroseeding in stages to stabilize any exposed soils and take advantage of the growing season. Alternatively, exposed soils may be dry-seeded using an approved seed mixture and application rate.
Fibre rolls and wattle slope interrupters	Reduces slope length, slows runoff and traps sediment on steeper slopes (up to 1:1). Also provides sediment control.
Polyethylene sheeting/tarp	Where practical, temporary fills, exposed slopes or stockpiles should be covered with polyethylene sheeting or tarps.
Rolled erosion control products	Cover completed slopes following seeding.
Riprap	Provide energy dissipation of flowing water, particularly at culvert outlets.

BMP	Comments
Check dams	Construct clear crush gravel berms back armoured with large clean rock to reduce flow velocities and provide grade control within drainage ditches to reduce erosion and allow some suspended sediment to settle out. Requires regular inspection and maintenance.
Sediment Control	
Sediment fencing	Slow runoff to allow suspended sediment to settle out. Applicable to sheet flow only. Must be regularly inspected and maintained as necessary.
Sediment basin or trap	Slow runoff to allow sediment to settle but requires sufficient space to hold anticipated flow levels and require regular maintenance to remove accumulated sediment.
Sediment bags/socks	Act as a filter by retaining sediment in a closed bag while allowing cleaner water to discharge.
Turbidity curtains	Control entry of sediment laden water into receiving waters.

Adapted from TAC (2005).

The ESCP is based on two key principals: keep clean water clean and minimize sediment transport by implementing erosion control. This will minimize the volume of water to be treated and the amount of sediment that will have to be captured in sediment controls. To achieve this, the following will be carried out at each of the work areas:

- Construct or extend perimeter ditches before construction is started. These ditches will allow non-contact water from upslope areas to be intercepted and prevented from entering the work areas. Non-contact water will continue to be discharged directly into Burrard Inlet.
- Minimize cleared areas and minimize time that soil is exposed to rainfall or snowmelt runoff. This will involve the implementation of various erosion and sediment control best management practices (BMPs) to reduce erosion and sediment transport.
- Contain contact water. A series of internal interception pathways will be created to contain contact water and direct it to the stormwater treatment/retention areas, where water will be detained and treated as required before releasing it off-site.

The water management infrastructure is critical to the success of the ESCP. Therefore, it is critical that perimeter and containment ditches, and the water treatment plants (WTPs) are constructed before largescale construction activities begin.

5.1 SLOPE AND SURFACE PROTECTION

Surface soil erosion and movement of sediments from slopes are affected by the soil type, gradient and moisture content (TAC 2005). Project soils comprised of silt, sands, mixed sand and gravel, and topsoil, are overlaid on long steep slopes and have the potential for high precipitation loading, and therefore the surface erosion and subsequent potential sediment related issues will have to be closely managed. General approaches used for temporary ESC on slopes are as follows:

- Design and installation of interceptor ditches;

- Application of surface protection; and
- Application of sediment fences or wattles/fibre rolls.

During active construction, the following general guidelines will be followed where practicable to protect exposed soils:

- All cut/fill and cleared slopes and surfaces should have erosion controls implemented immediately following reaching the final slope, as per the design.
- Erosion control should be implemented immediately on completion of the grading operations of the worked area.
- Temporary graded areas should be protected from erosion through the use of straw mulch, sediment fencing, straw bales, coir matting, polyethylene tarps/sheeting or other appropriate measures in non-traffic areas; a gravel cap should be utilized in zones of construction traffic. Final graded areas should have the appropriate permanent surface erosion protection or landscaping implemented as soon as possible.
 - Soil surfaces to be treated should be roughened. Recommendations from TMEP SME include a cover crop species based on the season. Use fall rye if seeding occurs between July and February or use an approved annual and perennial local ryegrass mix if seeding occurs between March and June.
 - Cover the seeded area with approximately 5 cm of certified weed free straw, preferably applied by hand but if necessary, with a blower. The straw should be held in place with staked straw bales/wattles, silt fencing, hydroseed application of wood fiber mulch at 500 kg/ha and a tackifier at 40 kg/ha, or with netting, depending upon the slope gradient.
- Soil that is stockpiled for more than seven days and less than two months should be covered with polyethylene sheeting or a tarp, where practical.
- Topsoil stockpiles that will remain in place more than two months shall be contoured, and an appropriate seed mix should be applied as soon as possible, utilizing mulch and/or tackifier to reduce erosion prior to germination. A containment structure of some kind is required for all topsoil piles to prevent contamination of water resources and to control sedimentation (i.e. sediment fence, berm or ditch). Sufficient capacity must be provided by the berm to prevent overtopping during precipitation events.
- Always be prepared for possible wet conditions.

5.2 WATER CONVEYANCE SYSTEMS

5.2.1 CULVERTS

Culverts are closed systems used under roads or other structures usually set 900 mm below grade. They can have armoured aprons constructed with riprap at their outlets depending upon the intended discharge volume and flow velocity. Specifications for typical culverts to be used on this project are detailed in Figure 5-1.

5.2.2 DITCH TYPES

There are three types of ditches used on site (Figure 5-1).

- Type A is a lined 1:1.5 open ditch 600 mm wide and 600 mm deep.
- Type B is a shotcrete open swale 300 mm deep and wide. This has drain rock and a perforated pipe at the centre.
- Type C is a lined 1:1.5 open ditch 600 mm wide and 700 mm deep.

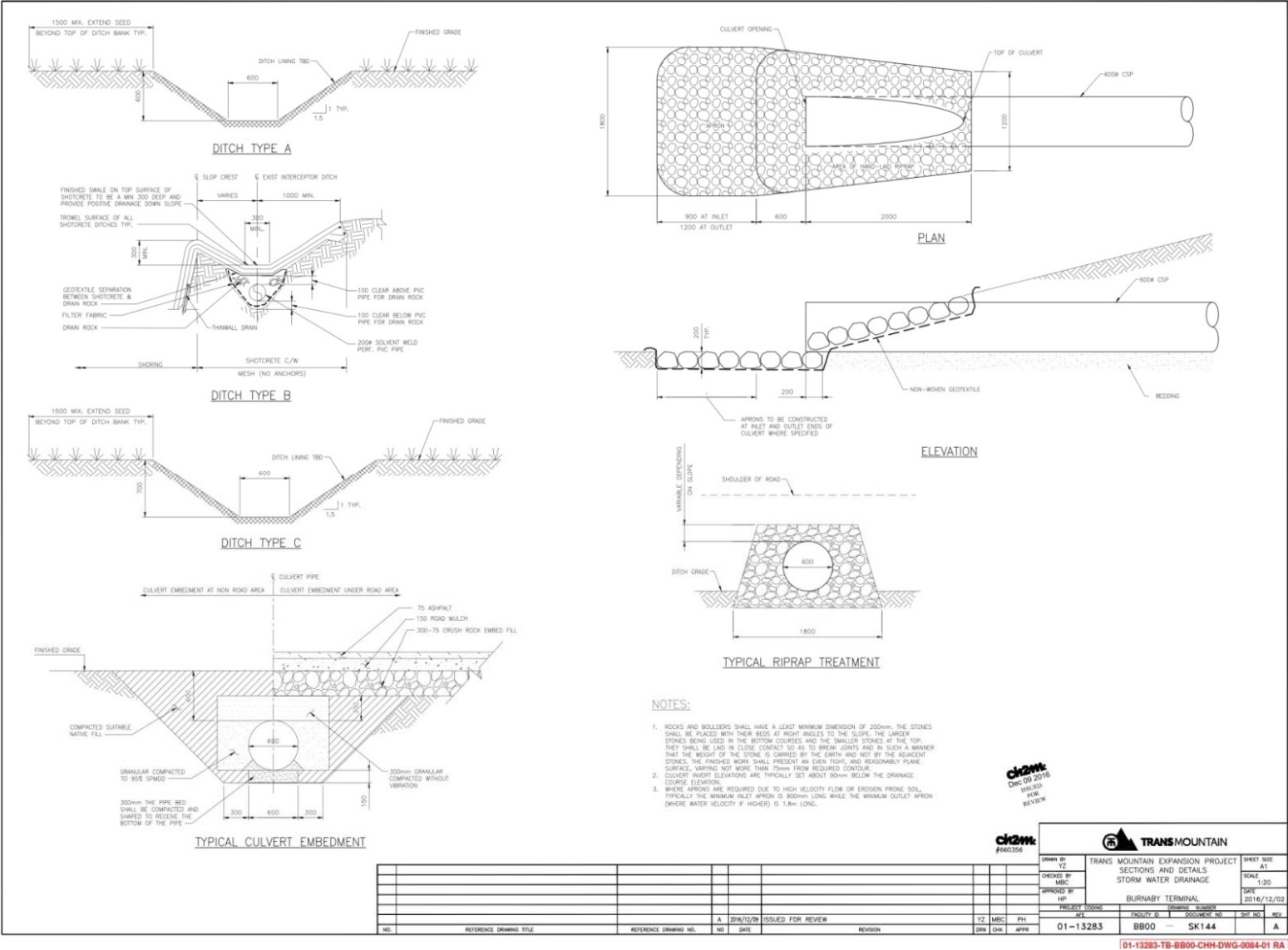


Figure 5-1. Ditch and culvert types
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5.2.3 CONTACT VS NON-CONTACT WATER MANAGEMENT

The general approach to onsite stormwater management during construction will be in the context of water exposed to construction areas (contact water) and water not exposed to construction areas (non-contact water). Water in contact with construction areas will be kept separate from non-contact water. During construction, water is summarized in the following way:

Water from Non-Construction Areas (Non-contact)

Stormwater drainage that has not been exposed to or come into contact with construction areas will be collected in exterior ditches and directed to the existing stormwater system. This primarily addresses the upper slopes of the property and the area around the tanks. Four culverts currently convey non-contact stormwater to Burrard Inlet through the foreshore. The existing stream that enters the site at the southern extent of the property (BC-789) from Inlet Drive will be conveyed in a new culvert under the fence and at the secant pile wall and diverted around the tunnel construction area to reconnect with the existing drainage off site.

Water from Construction Areas (Contact Water)

Water that has come into contact with active construction areas will be directed via culverts/ditches to respective WTPs. Water storage tanks and treatment systems are modular and will be installed based on workflow.

5.3 WATER TREATMENT SYSTEMS

5.3.1 PHASE 3 WATER TREATMENT PLANTS

The Water Treatment Plants (WTPs) set up during Phase 2 will be utilized for Phase 3. Specifically, the west WTP will be used in Phase 3.1, the east WTP will be used in Phases 3.2 and 3.3, and a foreshore WTP will be used in Phases 3.4.1 and 3.4.2. An example WTP system is depicted in Figure 5-2. A storage tank with a carbon dioxide bubbler will be set up to treat concrete curing water in Phases 3.5 and 3.6.

For the west construction works, the water treatment system will be located at the northwestern extent of the onshore area. This system will capture water from the manifold and pipe rack construction works. The WTP will be capable of treating 400 gallons per minute (GPM) using flocculent to aid in the settling of the sediment from contact water. This WTP system is modular and can be scaled to meet the required demand by adding or removing tanks. This treatment plant will discharge clean water to the western CP ditch and out to Burrard Inlet via a culvert outfall.



Contact water from the east construction works will be captured in culverts/ditches and diverted to the eastern WTP, located at the northeastern extent of the onshore area. This WTP will be capable of treating 800 GPM, using flocculent to aid in the settling of the sediment from contact water. This WTP system is modular and can be scaled to meet the required demand by adding or removing tanks. This treatment plant will discharge clean water to the eastern culvert.

In Phase 3.4, contact water will be diverted to a WTP using a sump pump. The WTP will be capable of treating 200 GPM. In Phase 3.5, a storage tank with a carbon dioxide bubbler will be set up in the foreshore area. This tank will be used to treat concrete curing water during foreshore foundation works. During offshore superstructure concrete works in Phase 3.6, concrete curing water will be transported to the foreshore storage tank for pH treatment using a separate tank set up on a barge.

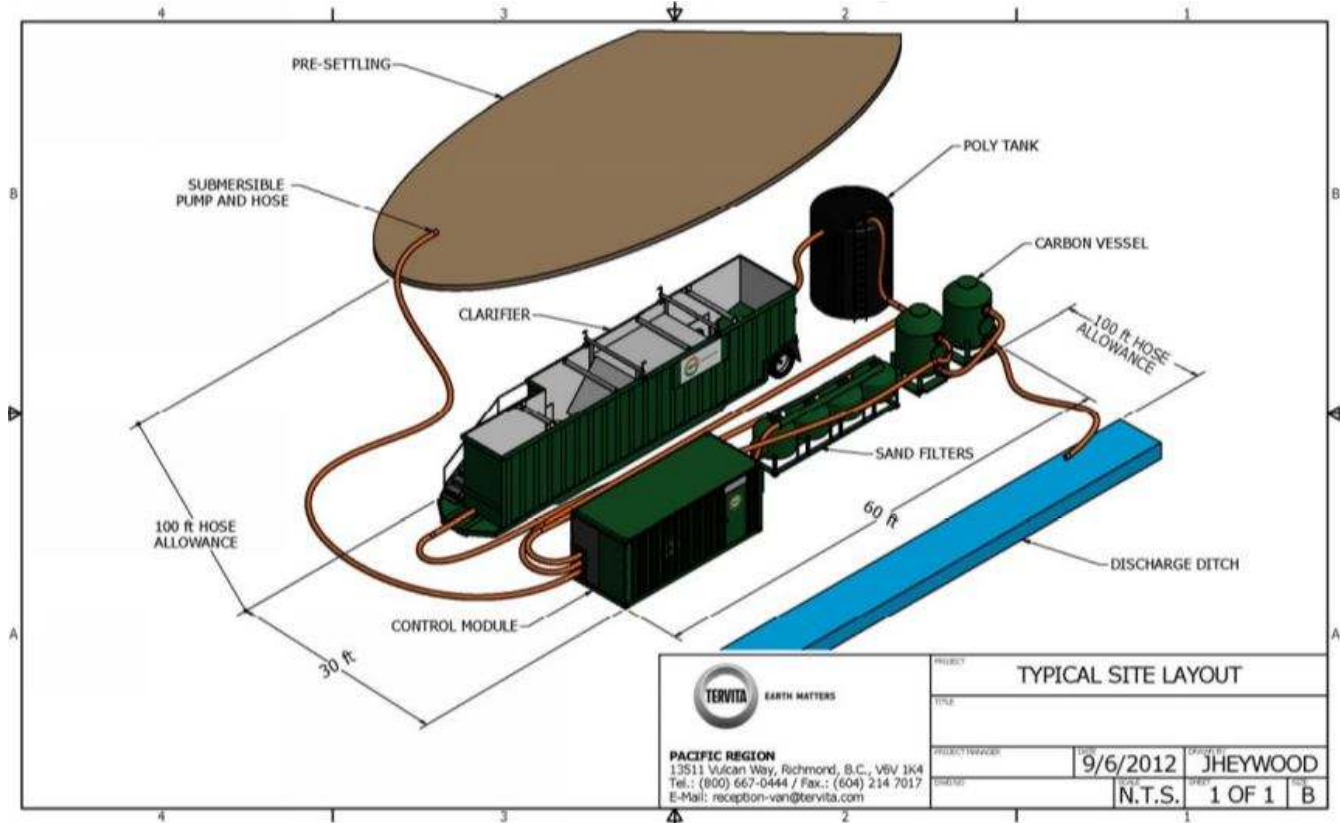


Figure 5-2. Typical site layout of water treatment plant system.

5.4 WATER QUALITY MONITORING

The Construction Water Quality Monitoring Plan (CWQMP) (Trans Mountain Pipeline ULC 2019a) outlines how water quality monitoring will be undertaken to meet water quality criteria including the new Westridge Marine Terminal approval application limits.

Water quality of contact water will be monitored for permit compliance at the discharge point from the treatment plants and prior to discharge to Burrard Inlet. KLTP will submit water quality monitoring reports to Trans Mountain. For any results that indicate an exceedance of the approval permit limits, Trans Mountain will follow the regulatory agency notification and reporting requirements identified in the approval permit.

5.5 SEDIMENT CONTROL ACCESS/EGRESS

Mechanical or passive wheel wash systems may be employed within the Westridge Marine Terminal site if warranted to clean trucks and equipment tires of accumulated sediment prior to exiting the project boundaries. Wheel wash facilities require consideration of maintenance and dewatering requirements to remove



accumulated sediments and to ensure that the ESC mitigation objectives are being met. Typically wheel wash facilities should ensure that wheels in contact with the wash facility should achieve at least four full rotations. Wash water will be treated at the onshore east WTP prior to discharge. Truck wheel wash stations will be located at access/egress points. These formal access/egress points shall be established for all trucking/hauling routes to mitigate sediment tracking on to municipal roadways.

A passive rock mulch egress point within the construction area may also be established to assist in the cleaning of truck and equipment tires.

To assess the efficacy of the wheel wash systems, municipal roads will be assessed regularly for the presence of tracked material. A street sweeper will be used to remove any material that is tracked out on to the roads. Storm drain filters may also be used if necessary. Note that the Burnaby stormwater bylaws prohibit washing the streets as this would introduce sediment to the storm sewer system.

5.6 SOIL MANAGEMENT

The following mitigation measures will be followed for soil management:

- Topsoil will be salvaged during grubbing and stripping activities and stored for later use, wherever practicable.
- Soil and debris will be stockpiled in designated areas and not mixed with or buried by other materials.
- Temporary soil stockpiles (seven days to two months) will be covered with polyethylene sheeting or tarps and permanent soil stockpiles (over two months) will be seeded with an approved, certified weed-free seed mixture to establish grass cover and reduce the opportunities for erosion.

5.7 DUST MANAGEMENT

If required, dust control measures will be implemented to maintain air quality in the project area at or near ambient levels and to avoid significant deposition of airborne particulates offsite. The following mitigation measures will be applied to reduce fugitive dust during construction activities.

5.7.1 MATERIAL HANDLING

- Adjust drop heights to less than two metres where feasible to reduce dust when loading materials into vehicles and depositing within stockpile areas.
- Material loads that may emit dust when being hauled should be covered.
- Load trucks so that loads do not spill during movement and use load covers.



5.7.2 MATERIAL EXTRACTION

- Use water sprays as required to suppress dust, except where this would result in not meeting technical specifications of the material being extracted or processed.
- Minimize vertical drop distance of materials to transfer points to the extent feasible.
- Establishment of construction material stockpiles in areas least prone to impact from prevailing winds.
- Retain vegetative barriers, or install temporary barriers, where practical.

5.7.3 ROADS

- Follow posted speed limits. Reduced speed limits may be implemented if necessary to reduce the generation of fugitive dust emissions.
- Timely stabilization of exposed areas prone to wind erosion.
- Oil may not be used as a dust suppressant.
- For controlling dust in spring and summer, apply sprayed water to the existing roadway.
- Fine-grained material vehicle loads will be covered to reduce wind-blown dispersal.
- Clean-up of mud and dust from paved roads and access points.
- Apply water or other approved chemical treatment for dust suppression on non-paved surfaces.

5.8 EROSION AND SEDIMENT CONTROL CONTINGENCY MATERIALS

KLTP will have miscellaneous ESC materials readily available throughout the duration of the project as a contingency measure should conditions necessitate their use. The list of ESC materials was derived from the review of National Guide to Erosion and Sediment Control on Roadway Projects (TAC 2005) and Trans Mountain Pipeline ULC Facilities Environmental Protection Plan (Trans Mountain Pipeline ULC 2018a) and appended associated contingency plans (e.g., Soil Handling Contingency Plan, Wet/Thawed Soils Contingency Plan and Soil Erosion and Sediment Control Contingency Plan). Contingency materials will include the following, at a minimum:

- sediment fence and extra wooden stakes (36”);
- certified weed free straw bales;
- rope;
- non-woven geotextile;
- polyethylene sheeting/tarps;
- rolled erosion control matting;
- spring berms;



- storm drain filters
- burlap sandbags (unfilled is acceptable as long as material is available to fill sandbags as required);
- fibre rolls or wattles;
- Sediment bags with or without flocculant;
- regionally appropriate reclamation seed mix; and
- a variety of pumps and hoses.



6 WORK PHASES AND SITE-SPECIFIC EROSION AND SEDIMENT CONTROL

6.1 PHASE 3.1 - MANIFOLD AND PIPE RACK AREA CONSTRUCTION

Phase 3.1 includes grubbing and excavating of manifold, pipe rack, and pipe bore pit areas, construction of shotcrete retaining walls and concrete foundations, and preparation of pipe bore pit area for guided horizontal auger boring (GHAB). The approximate duration to complete Phase 3.1 work activities is nine months. Figure 6-1 illustrates the proposed works and ESC measures during Phase 3.1 of the construction.

6.1.1 WORK SCOPE

- Grub and excavate pipe rack area to its final elevation and grade this work area.
- Complete shotcrete retaining walls with soil anchors to secure cut slopes for pipe rack area.
- Grub, strip and excavate pipe bore pit area and prepare area for GHAB.
- Grub and excavate manifold area.
- Removal of abandoned underground piping and installation of new utilities in manifold area.
- Bring manifold to rough grade in preparation for concrete foundations.
- Construction of shotcrete retaining walls and installation of soil anchors for manifold area.
- Complete concrete foundations for manifold and pipe rack area.
- Hydrostatic testing of facility pipes.

6.1.2 ESC MEASURES

- Install drainage ditch and check dams as required to the north of the excavation directing water towards the West WTP.
- Apply cover to exposed areas where practicable.
- Collect runoff and transmit to the West WTP.
- Install sump pumps to pump storm water requiring treatment to the West WTP.
- The West WTP will be designed to allow for treatment of concrete waste water.
- Water will be discharged to a distribution and dissipation pipe along the crest of the CP Rail ditch.
- Water that reaches Burrard Inlet will be released behind a turbidity curtain placed immediately around the outfall.

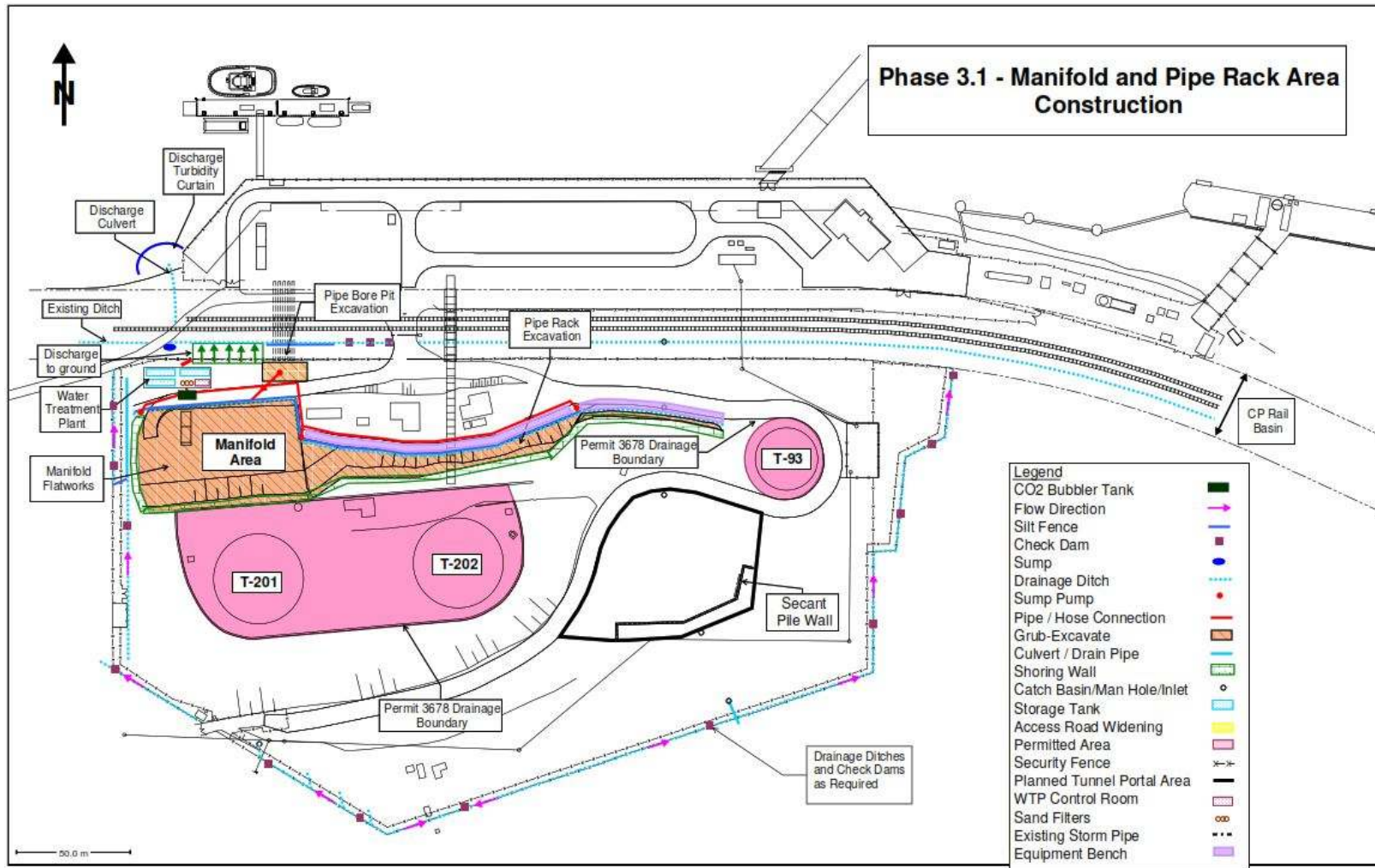


Figure 6-1 Phase 3.1 (Manifold and Pipe Rack Area Construction) work plan and ESC measures

6.2 PHASE 3.2 – TUNNEL AND SUBSTATION AREA CONSTRUCTION

Phase 3.2 includes road widening and substation area construction, tunnel and tunnel portal construction, and hydrostatic testing of the tunnel delivery lines. The approximate duration to complete Phase 3.2 work activities is two years. Figure 6-2 illustrates the proposed works and ESC measures during Phase 3.2 of the construction.

6.2.1 WORK SCOPE

Road Widening and Substation Area Construction:

- Grub work area adjacent to existing access road and excavate upslope to allow for widening the road surface.
- Complete shotcrete retaining walls with soil anchors for upper road widening and substation area.

Tunnel Portal Construction:

- Divert the S6 watercourse around the east side of the tunnel portal via a new culvert.
- Install concrete secant piles.
- Grub, strip, excavate, and support tunnel portal area to final elevation.
- Install concrete slabs and place gravel surface to finish tunnel portal area.

Tunnel Construction:

- Set up and assemble Tunnel Boring Machine (TBM) as approved under NEB Condition 26
- Bore and stabilize tunnel with pre-cast segmental concrete liner.
- Grout annulus between the pre-cast segmental concrete liner and tunnel wall excavation to control ground water seepage.
- Install delivery pipelines within the tunnel.
- Hydrostatic testing of delivery pipes.
- Backfill tunnel with lightweight concrete.

6.2.2 ESC MEASURES

- Set up settling pond and sump to collect stormwater surface drainage and tunnel seepage water.
- Treat overflow water from the settling pond at the EAST WTP.
- Treat used hydrostatic test water at the East WTP.
- Install check dams in the drainage ditches to slow the velocity of water to and from the East WTP in order to settle large particles of sediment out of suspension.
- Discharge water from the East WTP directly to the storm drain.

- Treated water that reaches Burrard Inlet will be released behind a turbidity curtain placed immediately around the outfall.

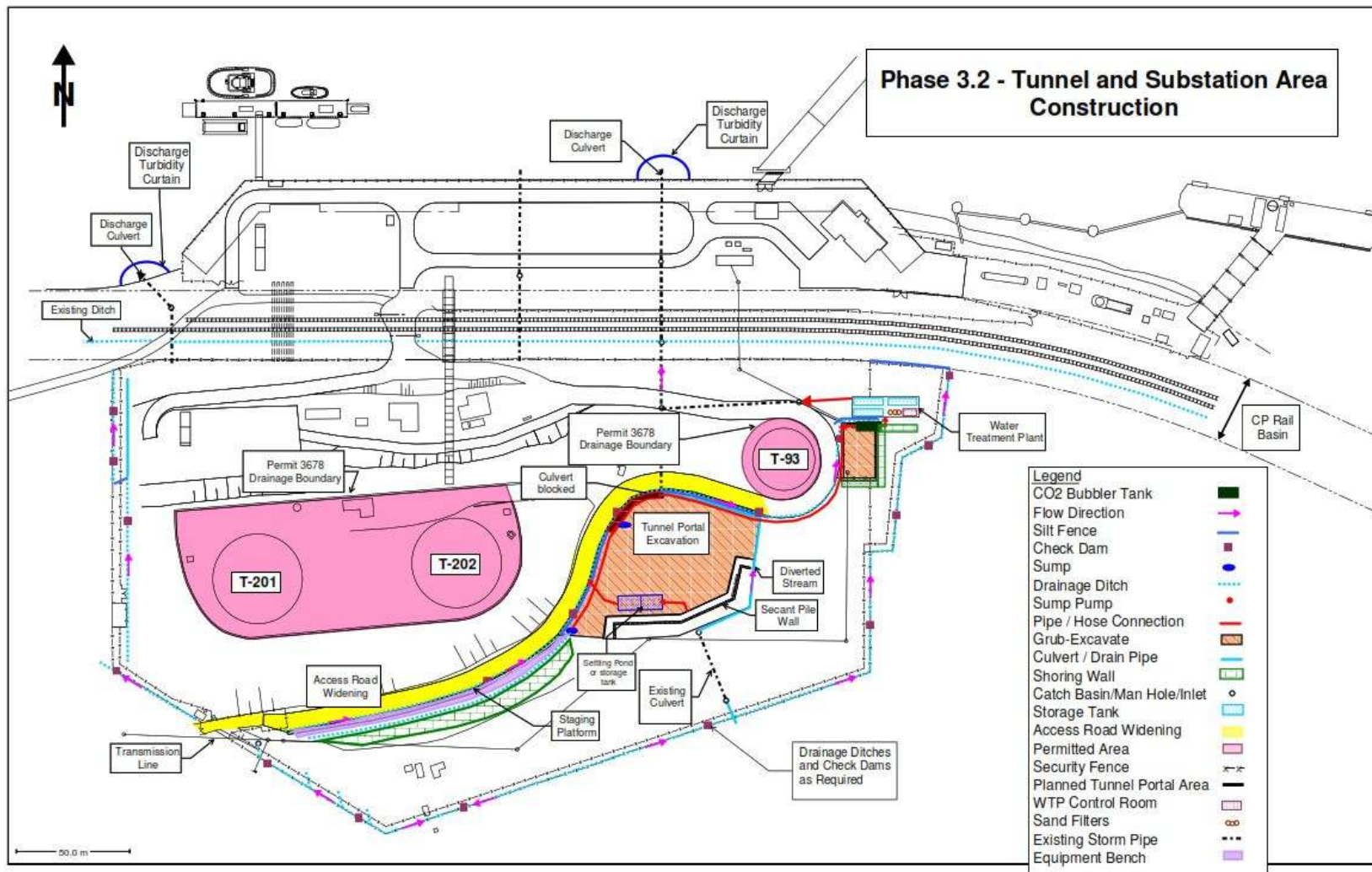


Figure 6-2 Phase 3.2 (Tunnel, Substation and Road Construction) work plan and ESC measures

6.3 PHASE 3.3 – TUNNEL RECLAMATION

Phase 3.3 includes the backfilling of the tunnel, restoration of the S6 drainage, and hydroseeding of the area. The approximate duration to complete Phase 3.3 work activities is three months. Figure 6-3 illustrates the proposed works and ESC measures during Phase 3.3 of the construction.

6.3.1 WORK SCOPE

- Backfill and restore tunnel portal area.
- Restore S6 drainage channel.
- Spread topsoil and hydroseed to stabilize the area.

6.3.2 ESC MEASURES

- Install check dams in the drainage ditches to slow the velocity of water in order to settle large particles of sediment out of suspension.
- Treat stormwater in East WTP.
- Install hydraulically-applied erosion control products (hydroseeding) and/or rolled erosion control products to protect slopes while reclamation plantings become established.

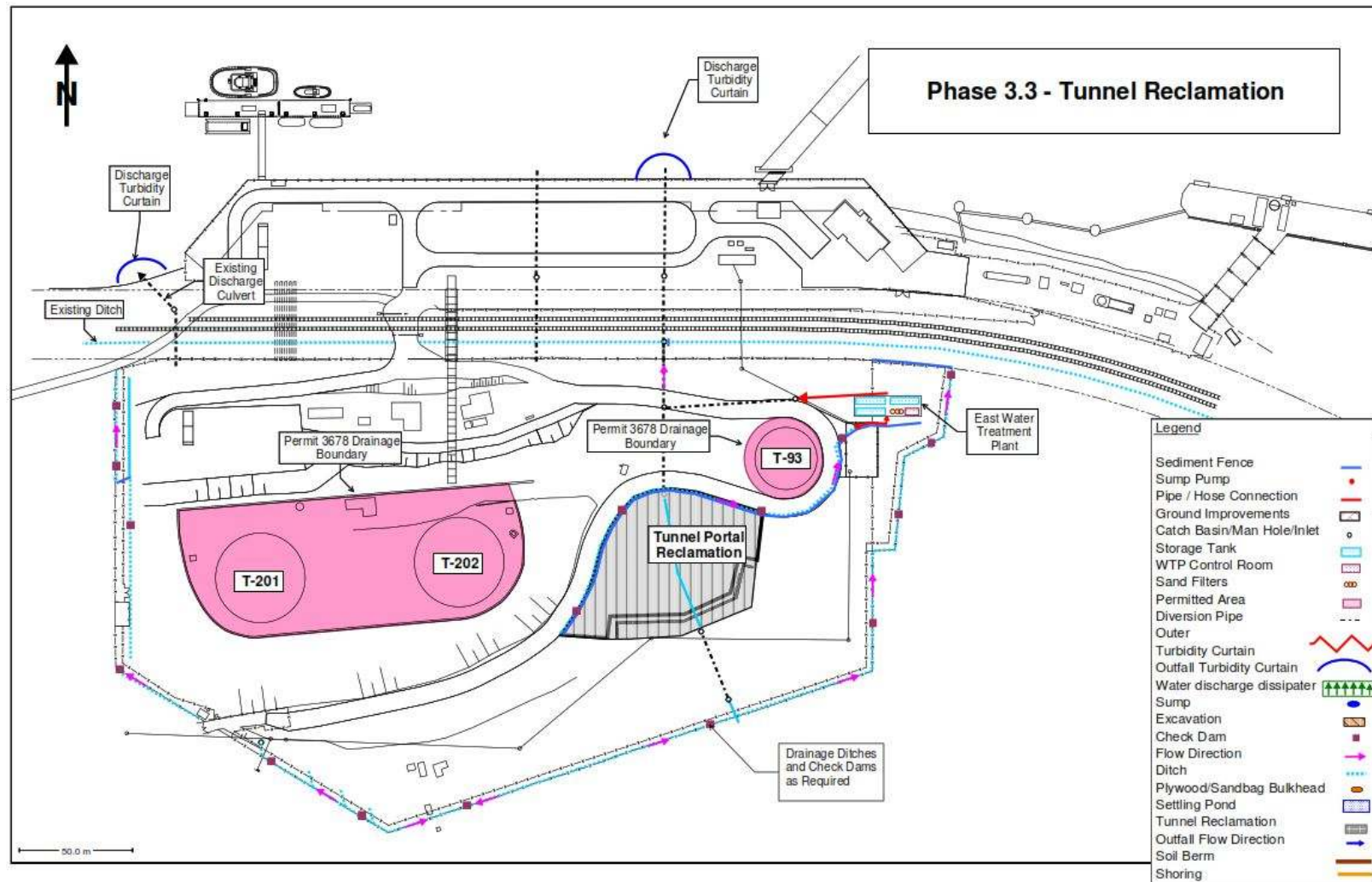


Figure 6-3 Phase 3.3 (Tunnel Reclamation) work plan and ESC measures

6.4 PHASE 3.4.1 – FORESHORE EXCAVATION AND OUTFALL DIVERSIONS

Phase 3.4.1 includes the excavation of the foreshore and pipe bore pit areas, guided horizontal auger boring (GHAB), and pipe installation. Also as part of 3.4.1, discharge locations 3 and 4 will be combined and diverted to discharge location 6 to allow for the development of the foreshore. A new stormwater piping system and a new outfall pipe to Burrard Inlet will be installed at discharge location 6 and the existing outfall pipe associated with discharge location 4 will be removed by excavation and diverted to discharge location 6. The existing outfall pipe associated with discharge location 3 will be removed by excavation and the new stormwater piping will be connected to the new, permanent outfall pipe at discharge location 6.

The approximate duration to complete Phase 3.4.1 work activities is three months. Figure 6-4, 6-5 and 6-6 illustrates the proposed works and ESC measures during Phase 3.4.1 of the construction.

6.4.1 WORK SCOPE

Foreshore Excavation

- Excavation of foreshore area prior to ground improvement.
- Complete GHAB and pipe installation.

Diversion of Discharge Location 4

- Install new, permanent stormwater piping system and connect to existing outfall at discharge location 6.
- Install new outfall to Burrard Inlet.
- Install temporary outfall diversion.
- Excavate and remove existing outfall pipe associated with discharge location 4 and diverted to discharge location 6.
- Tie new outfall pipe into new stormwater piping system.

Diversion of Discharge Location 3

- Remove existing outfall pipe by excavation.
- Divert existing permitted stormwater outfall to a new permanent outfall east of the cellular sheet pile wall (coffer cells).
- Install new/permanent stormwater utilities and tie into previously installed utilities.

6.4.2 ESC MEASURES

- Haul excavated material off-site.
- Install Foreshore WTP and install water conveyance measures as required to control the flow of water to/from the Foreshore WTP.
- Install a turbidity curtain around the location of discharge location 6 prior to construction and installation.
- Control runoff entering excavation with field fit diversion, swales or water bars, as required.
- Use a sump pump to divert the water from the excavated area to the Foreshore WTP.
- Treated water from the Foreshore WTP will be released behind a turbidity curtain.

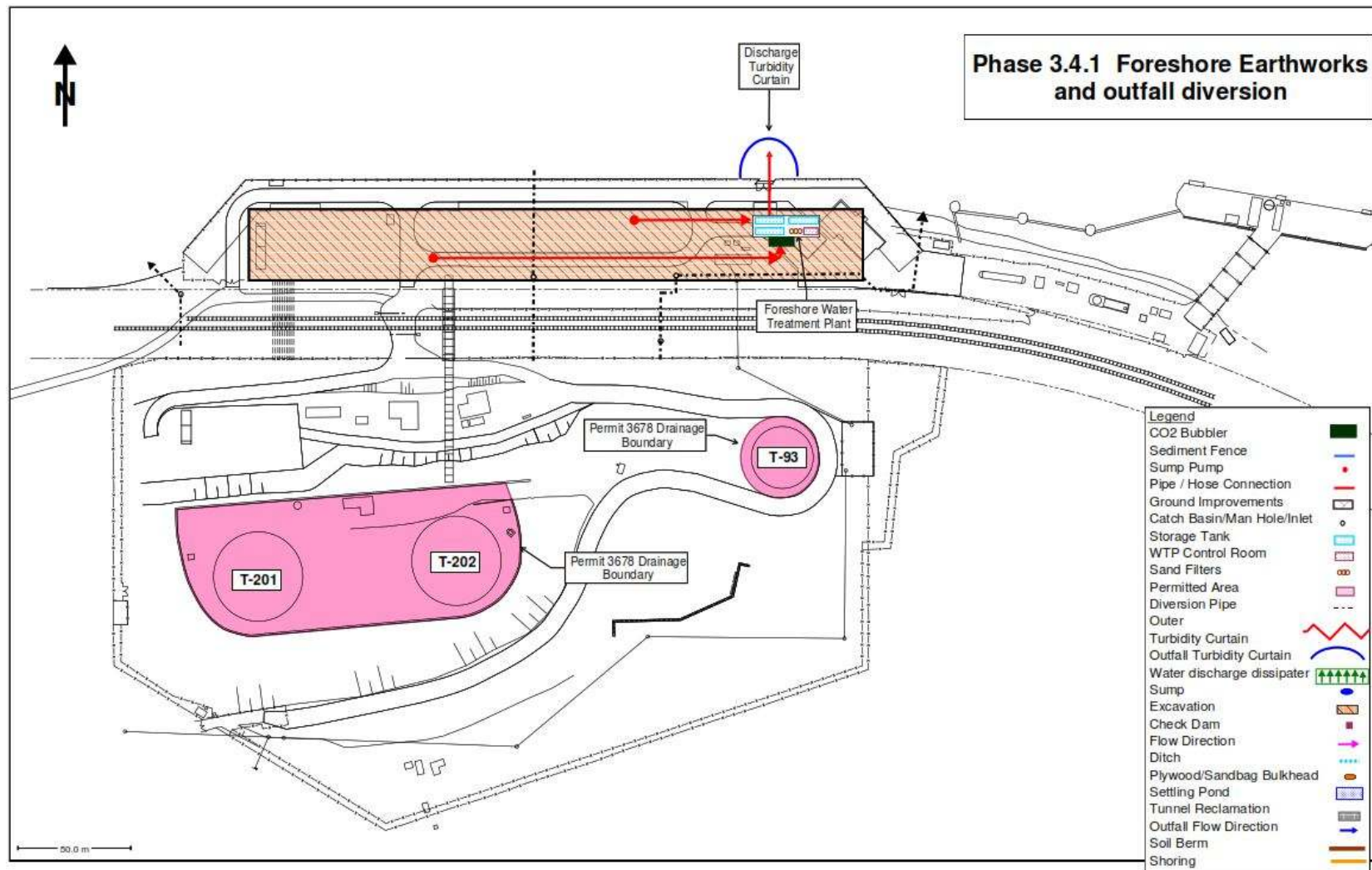


Figure 6-4 Phase 3.4.1 (Foreshore Excavation) work plan and ESC measures

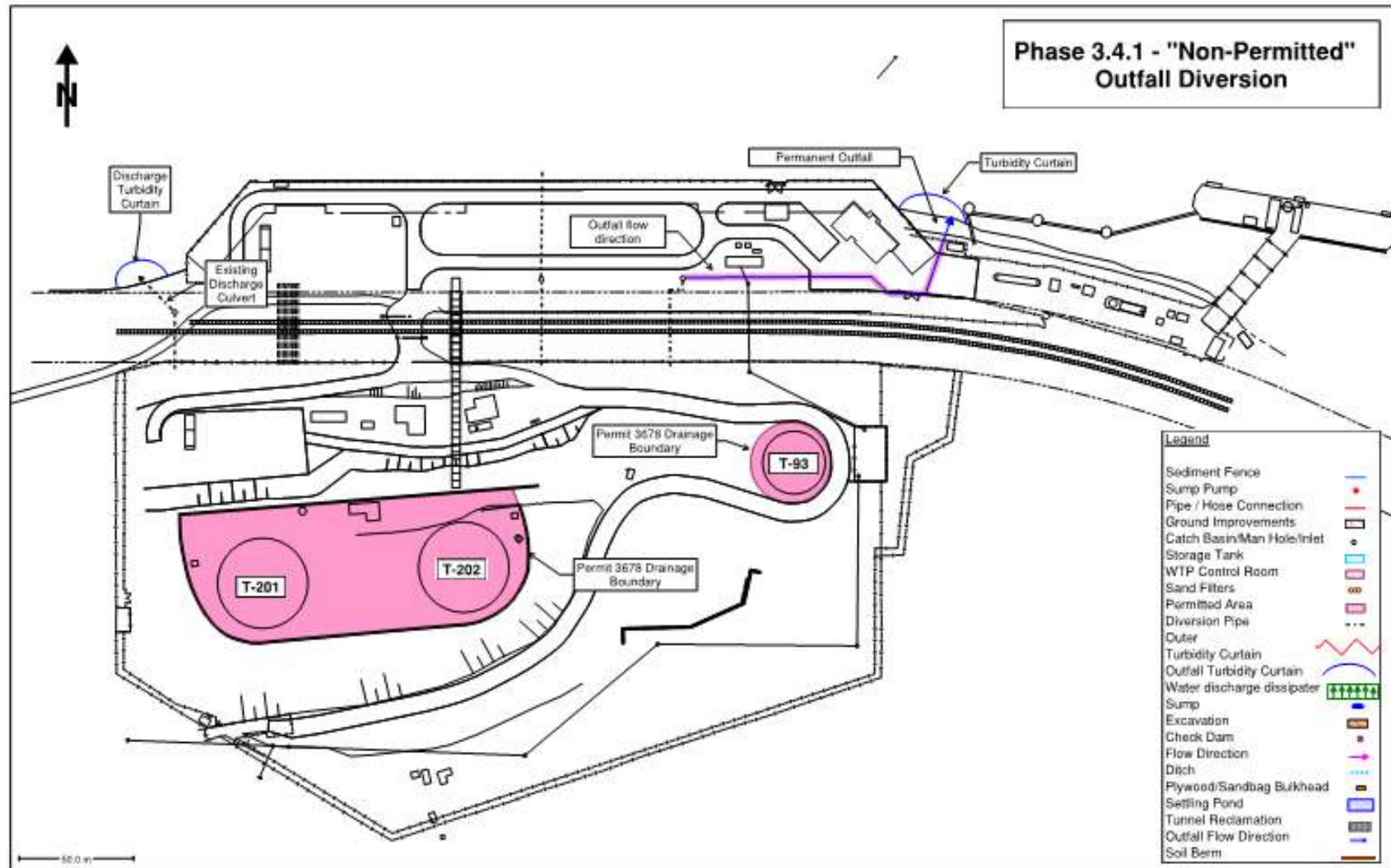


Figure 6-5 Phase 3.4.1 (Non-Permitted Outfall Diversion) work plan and ESC measures

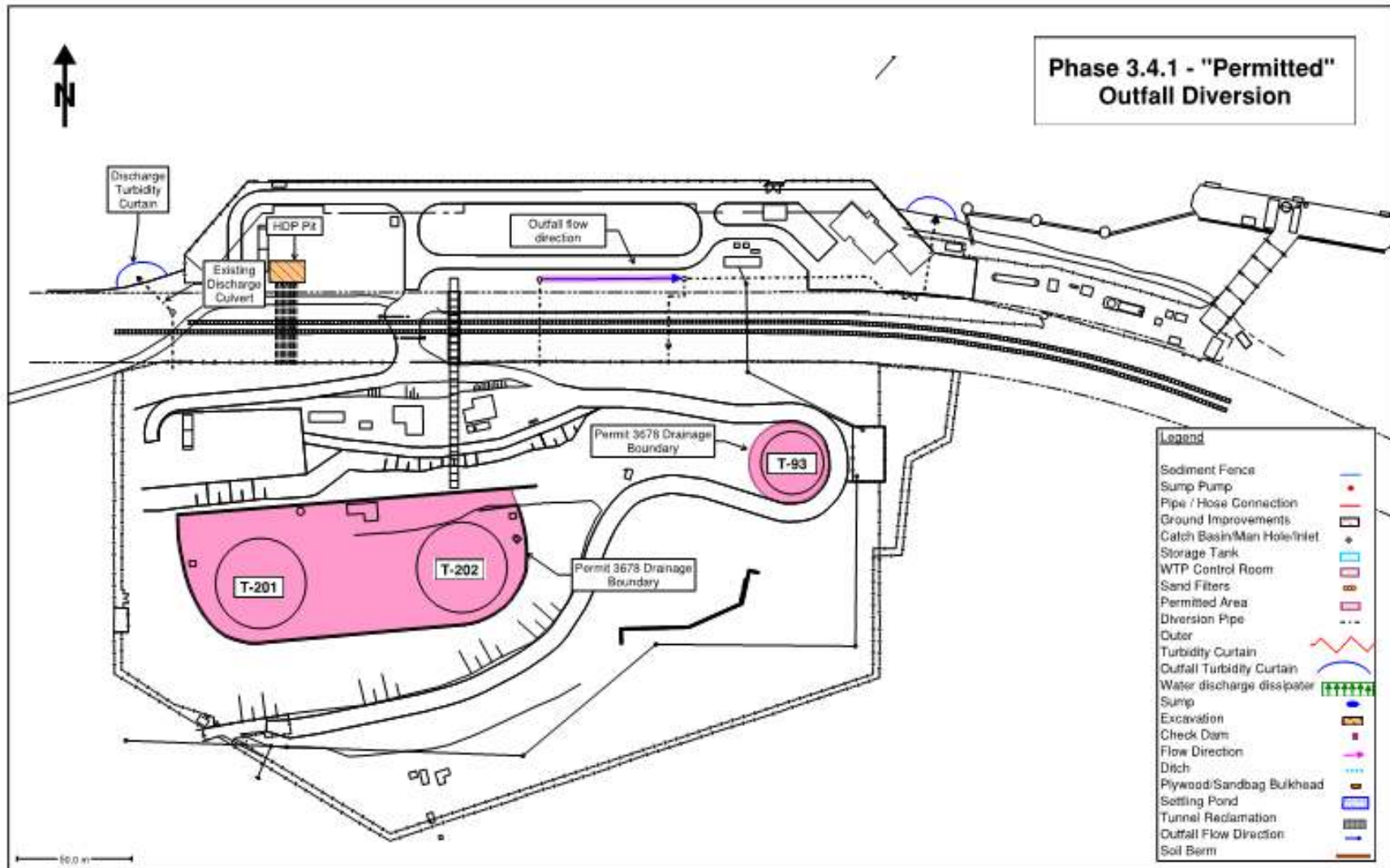


Figure 6-6 Phase 3.4.1 (Permitted Outfall Diversion) work plan and ESC measures

6.5 PHASE 3.4.2 – GROUND IMPROVEMENT

Coffer cells (to be completed under a *Fisheries Act* Authorization) are installed during Phase 3.4.2 to enclose the foreshore area. Ground improvement will be carried out in stages along the foreshore and will follow the progression of cellular sheet pile wall installation (coffer cells) and placement of backfill behind and within the coffer cells. The proposed ESC measures and treatment of stormwater and construction waste water will be consistent for all ground improvement work. The approximate duration to complete Phase 3.4.2 work activities is eight to ten months. Figure 6-7 illustrates the proposed works and ESC measures during Phase 3.4.2 of the construction.

6.5.1 WORK SCOPE

- Lay out overlapping soil mixing column locations.
- Auger soil column using drill rigs and inject grout slurry to stabilize soil.
- Once soil mixing inside coffer cell has been completed, jet grouting will be completed inside the coffer cells, followed by soil mixing behind the cells.
- As grout is injected into the ground, spoils are generated as existing material is mixed and displaced. This material will be removed from the site and disposed of at an approved facility.

6.5.2 ESC MEASURES

- Install water conveyance measures as required to control the flow of water to/from the Foreshore WTP.
- Install a soil perimeter berm on the south, east and west sides of the ground improvement work area that connects with the northern sheet pile wall to contain excess soil cement slurry within the work area.
- Use a sump pump to divert the water from the soil mixing work area to the Foreshore WTP where turbid water will be able to settle and/or be treated.
- Spoil materials will be sent to the spoils barge for disposal. The spoils barge will be removed as required for appropriate off-site disposal. Excess water collected on the spoils barge will be treated in the Foreshore WTP as required.
- Spoils barges will have a sealed perimeter and be fenced such that spoils material and/or water runoff cannot leak from the barges.
- Treated water from the Foreshore WTP will be released behind a turbidity curtain.

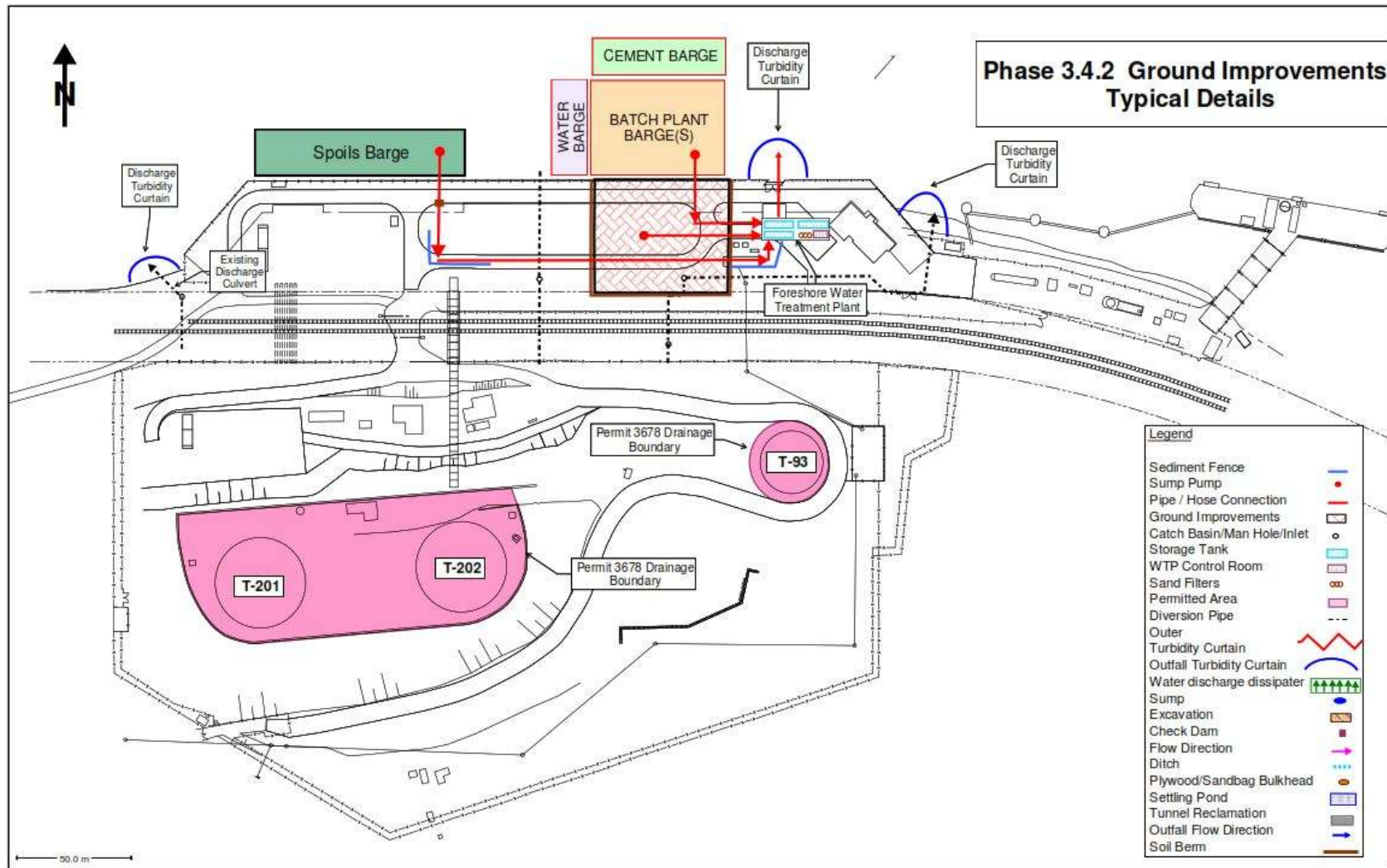


Figure 6-7 Phase 3.4.2 (Ground Improvement) work plan and ESC measures

6.6 PHASE 3.5 – FORESHORE CONCRETE FOUNDATIONS

This phase includes formwork and concrete pouring of the foreshore foundations and management of curing water. The approximate duration to complete Phase 3.5 work activities is six months. Figure 6-8 illustrates the proposed works and ESC measures during Phase 3.5 of the construction.

6.6.1 WORK SCOPE

- Install formwork for foreshore foundations.
- Install rebar, mechanical inserts, anchor bolts, conduit and grounding, as required.
- Pour concrete foundation pads.
- Place curing blankets and plastic sheets over the concrete foundations to reduce the amount of curing water that is required.
- Leave formwork in place until curing of slabs is complete.

6.6.2 ESC MEASURES

- Set up a storage tank with a carbon dioxide bubbler system for treatment of concrete washwater or wastewater.
- Set up sump pumps and hose connections to move curing water from the individual foundation sites to the storage tank.
- Set up water conveyance structures (e.g. ditches, etc.) around disturbed areas to capture curing water runoff.
- Treat curing water with CO₂ bubbler and discharge treated curing water behind a turbidity curtain.

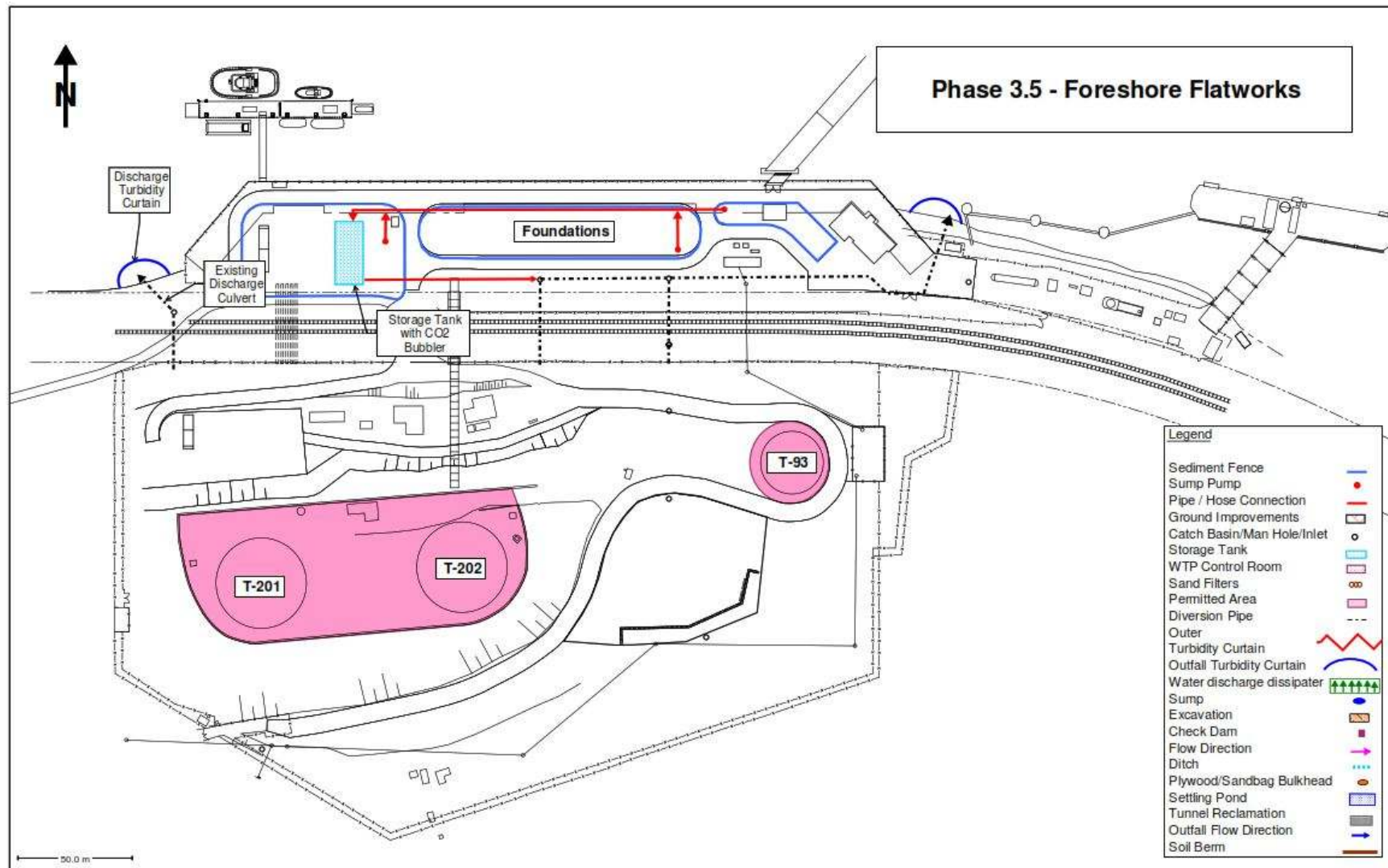


Figure 6-8 Phase 3.5 (Foreshore Concrete Foundations) work plan and ESC measures

6.7 PHASE 3.6 – OFFSHORE SUPERSTRUCTURE

A cast-in-place concrete deck will be placed on top of the various loading platform and trestle structures. The concrete deck placement will take place as the piling foundation work is completed and access to the structures is available via marine-based equipment. The approximate duration to complete Phase 3.6 work activities is 30 months. Figure 6-9 illustrates the proposed works and ESC measures during Phase 3.6 of the construction.

6.7.1 WORK SCOPE

- Install formwork for offshore foundations.
- Install rebar, mechanical inserts, anchor bolts, conduit and grounding, as required.
- Pour concrete deck within formwork.
- Place curing blankets and plastic sheets over the slabs to reduce the amount of curing water that is required.

6.7.2 ESC MEASURES

- Storage tank will be set up on a barge.
- The amount of curing water required to be in contact with recently poured concrete will be reduced by utilizing curing blankets that maintain moisture on concrete surface.
- Leave formwork in place until curing of deck is complete.
- At end of concrete curing period, pump excess curing water with high pH into the storage tank on the barge.
- Move barge to the foreshore and pump water to foreshore storage tank set up with CO₂ bubbler.
- Treat curing water with CO₂ bubbler and discharge treated curing water behind a turbidity curtain.

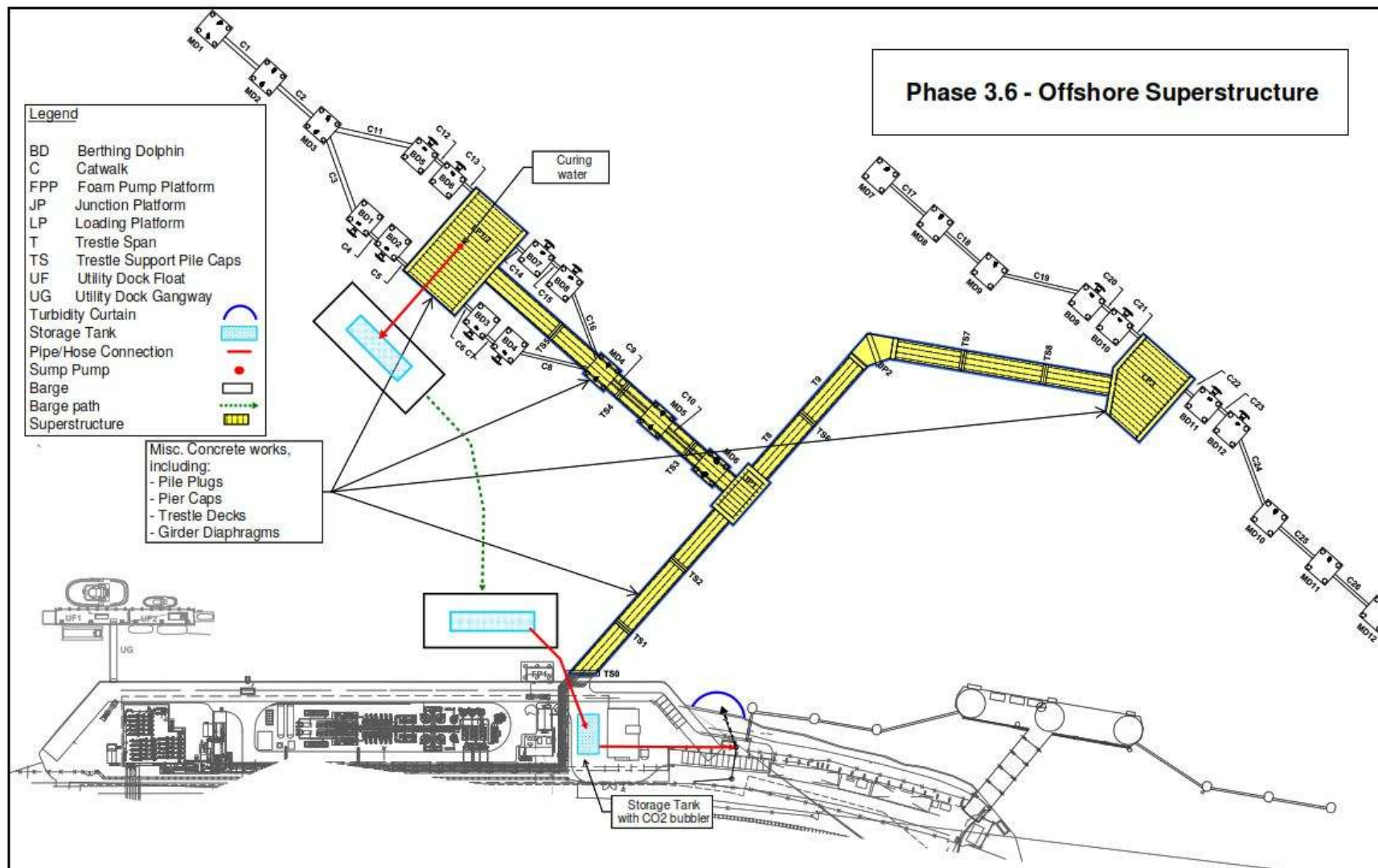


Figure 6-9 Phase 3.6 (Offshore Superstructure) work plan and ESC measures



7 ROLES AND RESPONSIBILITIES

This section outlines specific roles and responsibilities of the proposed key members of the Trans Mountain and KLTP construction teams with regards to implementing the ESCP and complying with all applicable regulatory requirements. This structure is based on the Facilities EPP (Trans Mountain Pipeline ULC 2018a) and the Compliance Management Plan (Trans Mountain Pipeline ULC 2019).

7.1 TRANS MOUNTAIN ENVIRONMENTAL TEAM

7.1.1 TRANS MOUNTAIN ENVIRONMENTAL MANAGER (EM)

The EM is retained by Trans Mountain Pipeline ULC and is responsible for:

- all environmental matters on the project inclusive of the activities outlined in the TMEP Project Description;
- directing the development and implementation of the environmental components of the project, including ensuring that environmental conditions are integrated into project documents and enforced during construction; and
- liaison where required, with regulatory agencies and ensuring environmental reporting requirements are met.

7.1.2 TRANS MOUNTAIN CHIEF ENVIRONMENTAL INSPECTOR (CHIEF EI)

The Chief EI retained by Trans Mountain Pipeline ULC has the following responsibilities and involvement:

- oversees the EI Team across the entire project;
- keeps abreast of all environmental reports, incident reports, contractor environmental action plans, and corrective action plans for the project; and
- communicates with the Lead EI and Contractor Environmental Manager (CEM) regularly, and as necessary over the course of the project.

7.1.3 TRANS MOUNTAIN LEAD ENVIRONMENTAL INSPECTOR (LEAD EI)

The Lead EI is retained by Trans Mountain Pipeline ULC and is responsible for:

- oversight of mitigation measures implemented in the field to verify it is timely, effective, and appropriate and in line with environmental objectives and requirements; and



- keeping abreast of all environmental reports, incident reports, contractor environmental action plans, and corrective action plans for their assigned area of construction (i.e., construction spread).

7.1.4 TRANS MOUNTAIN ENVIRONMENTAL INSPECTION TEAM (EI TEAM)

The EI Team is comprised of EIs retained by Trans Mountain Pipeline ULC who will monitor construction activities to ensure mitigation and contingency plans are being implemented to minimize environmental disturbance and that activities comply with environmental requirements and conditions. They will also:

- review and approve contractor construction plans for compliance with applicable environmental objectives; and
- where necessary, the EIs will consult with the onsite Construction Manager to support halt work orders where non-compliant conditions exist and assist with discussions on how corrective solutions may be applied.

7.2 KLTP CONTRACTOR ENVIRONMENTAL TEAM

7.2.1 KLTP CONSTRUCTION ENVIRONMENTAL MANAGER (CEM)

The Construction Environmental Manager (CEM) is responsible for ensuring compliance to all Project environmental requirements; confirming and tracking that all regulatory and contractual requirements are implemented; reviewing environmental plans prepared by the Contractor Environmental Coordinators (CEC) and ensure they are approved by the Environmental Inspector (EI); initiating and implementing environmental corrective and preventative action plans as required; liaising with EIs for scoping and scheduling the needs of the Resource Specialists (i.e., those that are not defined in the Contractor's Scope of Work).

The qualification requirements of the CEM include the designation as a certified Qualified Environmental Professional by a recognized professional organization. The CEM shall have experience on major projects that are comparable in scope, complexity and nature to the Project; in the development and management plans to address environmental requirements; leading a multidisciplinary environmental team; implementing an environmental management system; knowledgeable in legislation and regulation applicable to the Project; and working with regulatory agencies.

7.2.2 KLTP CONTRACTOR ENVIRONMENTAL COORDINATORS (CEC)

Contractor Environmental Coordinators (CECs) are responsible for: ensuring that environmental requirements are understood by applicable Contractor personnel (e.g., toolbox talks, environmental



orientation, etc.); confirming that environmental requirements are met during all phases of construction; preparing specific environmental action plans for approval by the EI; and working closely with the EI team to manage environmental compliance. The CECs are also responsible for communicating to the KLTP the need for Resource Specialists. CECs will report directly to the CEM.

The qualification requirements of the CECs include an appropriate educational background, hands on experience maintaining and implementing environmental programs on construction projects, and the ability to work with and train staff on environmental compliance.

7.2.3 RESOURCE SPECIALISTS (SUBCONTRACTORS)

The Resource Specialist(s) will be a QEP and can be hired by the Prime Contractor or Trans Mountain Pipeline ULC as needed, to support the ESCP. They may provide planning guidance, review of mitigation measures, advice or signoff as necessary. They are independent to the project and have the appropriate training and/or experience related to erosion and sediment control and water quality.



8 ENVIRONMENTAL MONITORING

Environmental monitoring is a key step in environmental process and risk management for the project. Not only is environmental monitoring used to review, observe and report on environmental impacts resulting from construction activities, it is also a critical tool in assessing potential risk during pre-construction planning and during construction and forms part of the feedback component of adaptive management. To reduce environmental risk, environmental monitoring needs to anticipate potential impacts, be commensurate with the area of sensitivity, and be designed to assess whether the mitigation/avoidance strategies are achieving the goals and objectives set out in the EPPs and regulatory agency approvals are addressed during all project phases.

8.1 ENVIRONMENTAL RISK VS MONITORING EFFORT

Monitoring for this project will be based on the construction activities, time of year, site conditions and potential for impacts:

- Monitoring related to ESC and water quality will increase during wet periods (i.e., September through March);
- The onsite monitoring frequency will be full time (daily) when contact water has the potential to discharge from site;
- Monitoring the turbidity curtain isolating the Marine Area after high tides, winds/waves. Risk factors will need to be established after the curtain has been installed and performance assessed; and
- During other lower risk period of activities, onsite monitoring will only be required weekly.

8.2 TYPES OF MONITORING

8.2.1 PHASE 3 ESC PERFORMANCE

Monitoring of ESC performance will be completed by KLTP and Trans Mountain environmental personnel.

- ESC measures will be inspected regularly and whenever water is discharging from the site;
- Should treated contact water move off site, turbidity levels will be monitored prior to discharge as per the CWQMP (Trans Mountain Pipeline ULC 2019a). If levels exceed allowable limits water will be pumped back to infiltration vegetation or the WTP systems;
- Inspection of silt fencing, silt curtains, gravel berms, check dams and bale structures for status and /or necessary repair;



- Inspection of ESC measures during storm events;
- Site review for visible signs of erosion and sediment movement (e.g., riling, slumping, channelizing, flooding, concavity, etc.) or possible risk of erosion, including along the water edge inspecting for sign of turbidity runoff;
- Inspection of drains, ditches, culverts, swales, and catch basins for status and/or necessary repair;
- Inspection of truck wheel wash functionality and proper drainage (if installed);
- Inspection of public roads for loose soils and implement sweeping as required;
- Assess dust suppression requirements as per Section 5.7.
- Water retention areas and catch basins are cleaned out by vacuum truck when accumulated sediments reach 250 mm (City of Burnaby 2016a); and
- Inspection and status of exposed slopes, stockpiles and spoils.

8.2.2 CONTINUOUS IMPROVEMENT

Each day the CEC reports will be reviewed by the KLTP Construction Team for areas of improvement and potential risk. Furthermore, feedback from other agency reporting will also be routed back to the construction team as it relates to erosion and sediment control (e.g., monthly NEB reporting)

8.2.3 WATER QUALITY MONITORING AND RESPONSE

As noted above, water quality monitoring will be done at regular planned intervals and during storm events in accordance with the CWQMP (Trans Mountain Pipeline ULC 2019a). The results of the water quality monitoring will be reviewed daily by the CEC and Trans Mountain EI Team. If TSS is increasing and at risk of exceeding compliance levels, the following actions will be taken by the CEC before thresholds are exceeded:

- Site inspection to determine source of sediment and effectiveness of existing ESC measures;
- Develop site specific response plan to increase the effectiveness of ESC measures (e.g., reduce sediment source); and
- Liaison with the Construction Team.

8.2.3.1 Water Quality Non-compliance

The release of water that does not meet water quality criteria is considered an environmental incident and will result in the immediate stop of discharge. Incident reporting as outlined in Section 8.3 will be implemented. An investigation of the root cause of the discharge along with the impacts on the receiving environment will be conducted by the CEC reporting to the CEM and Trans Mountain EI Team.



Stop Work

The following actions will be applied to reduce erosion during periods of heavy or prolonged rainfall or rapid snowmelt:

- Work will be shut down if rainfall exceeds the shutdown criteria for Zone 4 described in Statlu (2018) or if snowmelt on wet or thawing soils causes water quality results to show exceedance of acceptable values.
- Work will remain shut down for at least 24 hours, or in the case of 48- and 72-hour rainfall exceedances, a minimum of 48 hours (Statlu 2018).
- Work may be temporarily shut down under lower rainfall intensities at the direction of the CEC or the Trans Mountain EI Team. CECs will have “Stop Work” authority.

The purpose of shutting down during periods of heavy or prolonged rainfall or rapid snowmelt will be to limit sediment generation and to focus efforts on maintaining the integrity of water and sediment management measures.

ESC Failure

An ESC failure may include but is not limited to a slump, discharge from a significant sediment source that is not being treated effectively, or repeat failure of the sediment control system. Incident reporting as outlined in Section 8.3 will be implemented. An investigation of the root cause of the failure along with the impacts on the receiving environment will be conducted by the CEC reporting to the CEM.

8.3 ENVIRONMENTAL NON-COMPLIANCE REPORTING

As outlined in the Westridge Marine Terminal EPP (Trans Mountain Pipeline ULC 2018) and Compliance Management Plan (Trans Mountain Pipeline ULC 2019), a potential non-compliance may be identified by anyone at any time. Non-compliances must be reported to supervisory level personnel. The CEM must be notified and will contact the Construction Manager or designate and, in consultation with the Trans Mountain Environmental Team, determine if the non-compliance is in violation with legal requirements and whether corrective action is required.

An environmental incident is defined in the Compliance Management Plan as “any unplanned release that exceeds a reportable quantity, the quantity is unknown, or the release enters or threatens to enter a body of water will be reported to applicable government authority” (Trans Mountain Pipeline ULC 2019). The same document also provides a detailed form for reporting incidents.

If immediate measures or corrective action is required, the Construction Team will make the decision to either modify the work practice or shut the activity down until conditions improve.



All environmental non-compliances, including those related to erosion and sediment control will be documented, including photographs. The CEC and the construction personnel will be responsible for documenting all environmental non-compliances as they occur and providing the information in their reports to the Trans Mountain Environmental Team. The Trans Mountain Environmental Team will then be responsible for reporting all environmental non-compliances to the appropriate regulatory authority.



9 ENVIRONMENTAL EDUCATION AND TRAINING

Environmental education and awareness of all project personnel form the cornerstone of a strong environmental program. The KLTP environmental and construction teams will provide standardized ESC orientation for its workers, including subcontractors, designed to:

- Increase employee awareness and appreciation of the environment and the natural resources likely to be affected during construction activities including legislated requirements;
- Familiarize workers with the negative impacts their actions can have on the environment and how these can best be avoided or minimized; and
- Convey mitigation and protection expectations such as monitoring, inspection and reporting requirements.

The education program is intended to facilitate worker understanding of the environmental context of the project and is fully detailed in the EPPs and the Compliance Management Plan (Trans Mountain Pipeline ULC 2019). Training is intended to increase environmental accountability of individual workers respecting protection of the environment therefore environmental training is mandatory for all personnel. The level of training will be commensurate of a worker's responsibility and role, but all workers on site including visitors will have some level of training, building upon the minimum site orientation.

The program will include training on the operation and maintenance of WTPs that will be provided to KLTP environmental field personnel by Tervita, who will provide the WTPs.

Records will be kept for all training that summarize the objective or purpose of the training, the type of material covered, attendance, as well as minutes/notes where appropriate.



10 CLOSURE

As large construction projects are dynamic in nature, changes can and do occur that will necessitate revisions or updates to this plan. These may include but are not limited to changes to the project schedule, construction task sequence, site conditions, and permit conditions, which all have the potential to impact ESC management. With this in mind, this plan should be considered a living document.



11 REFERENCES

- British Columbia Ministry of Environment (BC MoE). 2016a. Ecoregion Unit Descriptors. Available: <http://www.env.gov.bc.ca/ecology/ecoregions/humidtemp.html>
- British Columbia Ministry of Environment (BC MoE). 2016b. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report. Ministry of Environment, Water Protection & Sustainability Branch, Victoria, BC.
- British Columbia Ministry of Water, Land and Parks (BC MWLAP). 2004. Standards and Best Practices for Instream Works. Ministry of Water, Land and Air Protection, Ecosystem Standards and Planning, Biodiversity Branch. Victoria, BC
- City of Burnaby. 2016a. Sediment Control Notes. Revision 4. City of Burnaby, BC. Available at www.burnaby.ca/Assets/Sediment+Control+Information.pdf
- City of Burnaby, 2016b. Burnaby Map. Available at <http://webmap.burnaby.ca/publicmap/>
- Environmental Dynamics Inc. 2018. Trans Mountain Pipeline ULC, Westridge Marine Terminal Clearing, Erosion, Sediment Control Plan Phase 1 and 2. April 2018.
- Environment Canada. 2016. Canadian Climate Normals. Available at: http://climate.weather.gc.ca/climate_normals/index_e.html
- Fisheries and Oceans Canada (DFO). 1993. Land Development Guidelines for the Protection of Aquatic Habitat. Habitat Management Division of the Department of Fisheries and Oceans and the Integrated Management Branch of the Ministry of Environment, Lands and Parks.
- Government of Canada. 1985. Fisheries Act. RSC 1985, c. F-14. 2012. Ottawa, ON.
- Province of British Columbia. 2016a. DataBC. iMap. Available: <http://www2.gov.bc.ca/gov/content/governments/about-the-bc-government/databc/geographic-data-and-services/imapbc>
- Province of British Columbia. 2016b. Habitat Wizard. Available: <http://maps.gov.bc.ca/ess/sv/habwiz/>
- Statlu Environmental Consulting. 2018. Wet Weather Shutdown Criteria for Worker Safety – Operational Guidelines. Prepared for BC Timber Sales, Strait of Georgia and Chinook Business Areas. March 2018.
- Trans Mountain Pipeline ULC. 2013. Trans Mountain Expansion Project: An Application Pursuant to Section 52 of the National Energy Board Act for the Trans Mountain Pipeline ULC. December 2013. Available: <https://www.transmountain.com/neb-application>

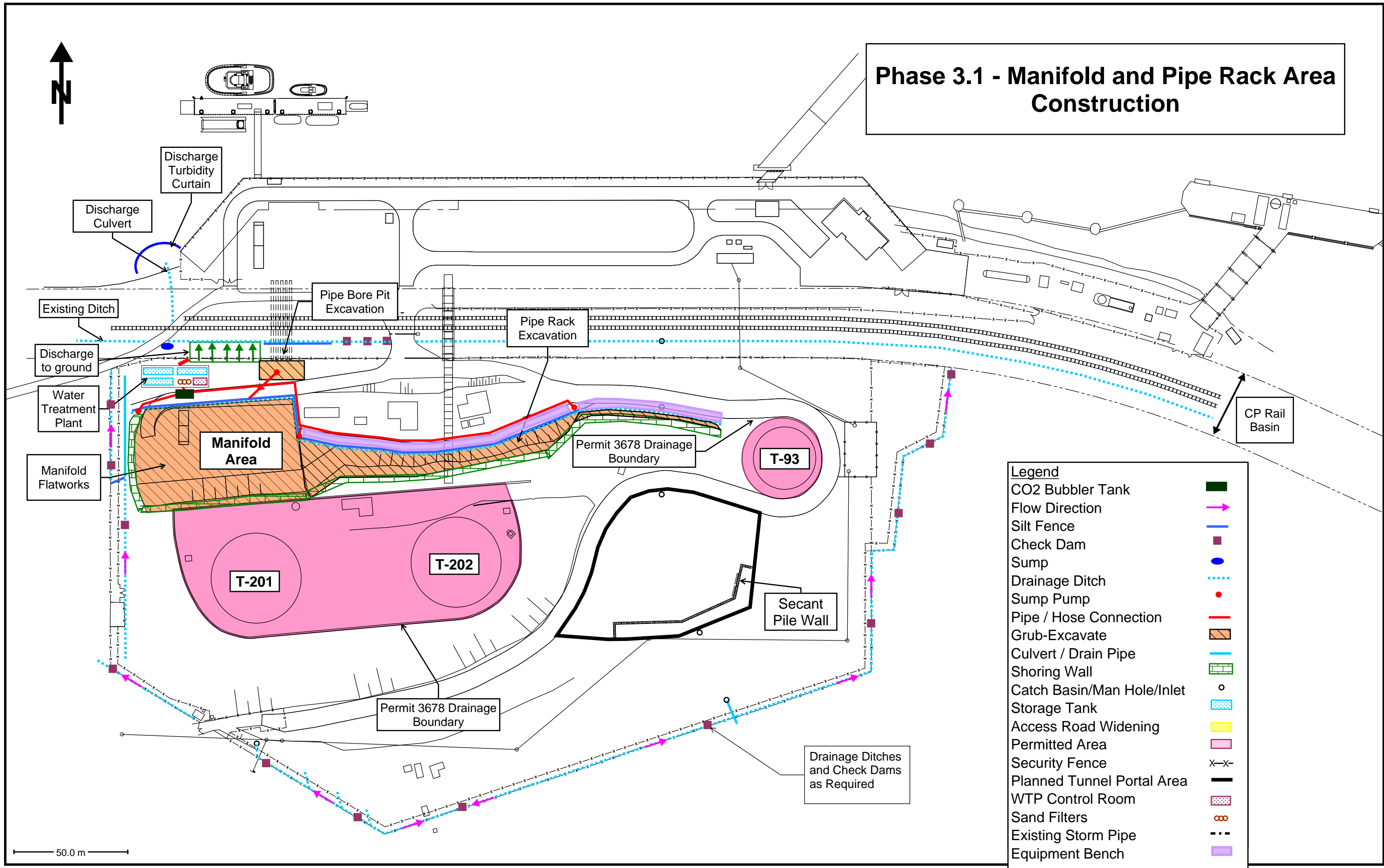


- Trans Mountain Pipeline ULC. 2017. Environmental Plans Volume 6. Section 10.4 Marine Water Quality Management Plan during Rip Rap Removal for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (Revision 2). August 2017. Available: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3308626>
- Trans Mountain Pipeline ULC. 2017a. Environmental Plans Volume 9. Burnaby Mountain Tunnel Environmental Protection Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (Revision 2). September 2017. Available: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3330905>
- Trans Mountain Pipeline ULC. 2018. Environmental Plans Volume 4. Westridge Marine Terminal Environmental Protection Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (Revision 5). March 2018. Available: file:///O:/16V0085_KLTP_TMEP_ESC/NEB%20Files/A89187-2%20Trans%20Mountain%20Attachment%201%20WMT%20EPP%20Condition%2081%20-%20A5Z1S0.pdf
- Trans Mountain Pipeline ULC. 2018a. Environmental Plans Volume 3 Facilities Environmental Protection Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project NEB Condition 78 (Revision 4). August 2018. Available: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3321578>
- Trans Mountain Pipeline ULC. 2018b. Environmental Plans Volume 6. Section 8.2 Water Quality Monitoring Management Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (Revision 4). September 2018. Available: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3331453>
- Trans Mountain Pipeline ULC. 2019. Environmental Plans Volume 10. Compliance Management Plan for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project (Revision 4). January 2019. Available: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3330905>
- [Trans Mountain Pipeline ULC. 2019a. Westridge Marine Terminal Construction Water Quality Monitoring Plan Phase 3 for the Trans Mountain Pipeline ULC Trans Mountain Expansion Project. July 2019.](#)
- Transportation Association of Canada (TAC). 2005. National Guide to Erosion and Sediment Control on Roadway Projects. Transportation Association of Canada, Ottawa, ON.
- Turner, R.J.W., Clague, J.J., Groulx, B.J. and Journeay, J.M. (1998). GeoMap Vancouver: geological map of the Vancouver Metropolitan area. Government of Canada, Natural Resources Canada, Earth Sciences Sector, Canada Centre for Mapping and Earth Observation.

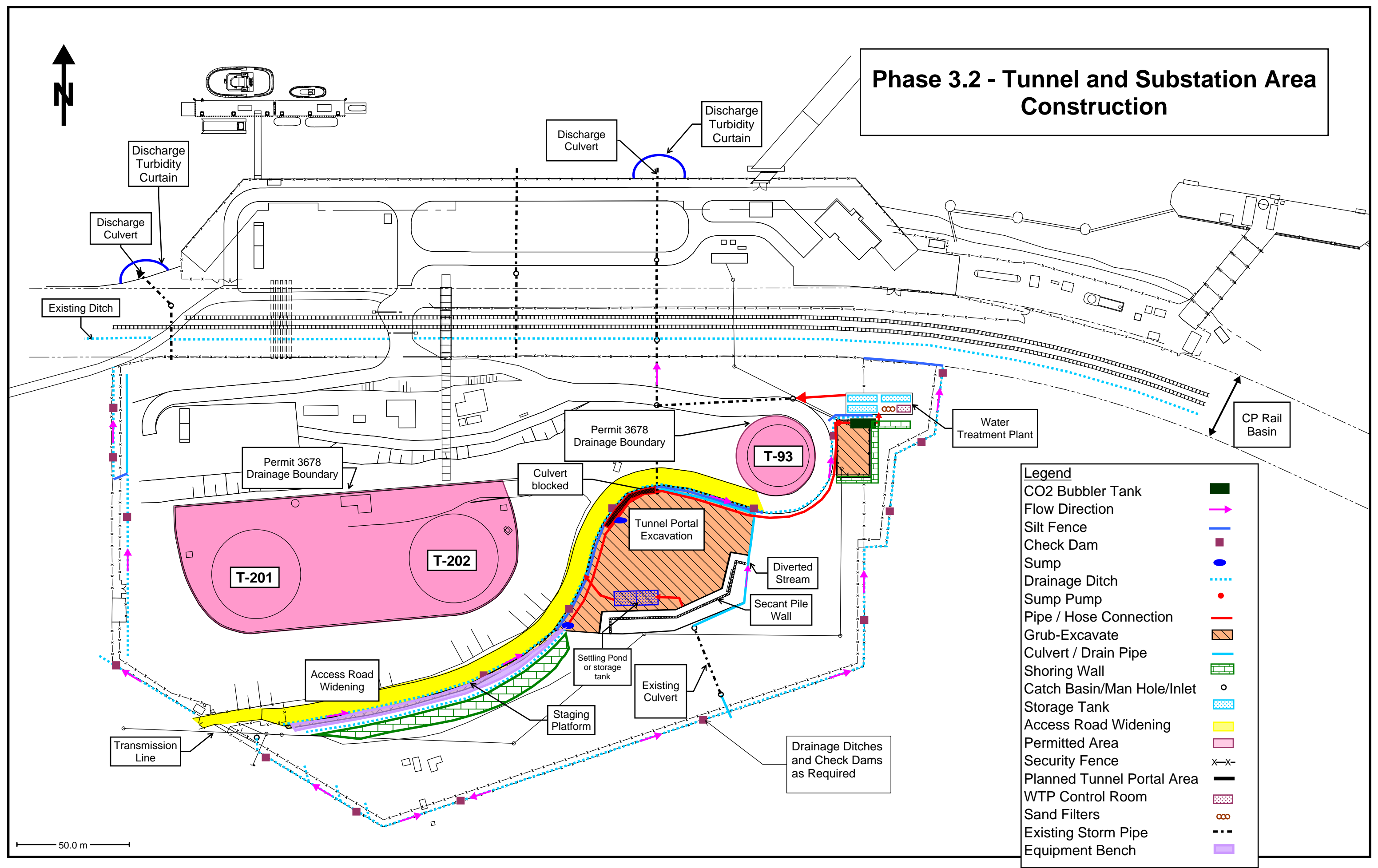
APPENDIX E

Phase 3 Construction Activities and Erosion and Sediment Control Measures

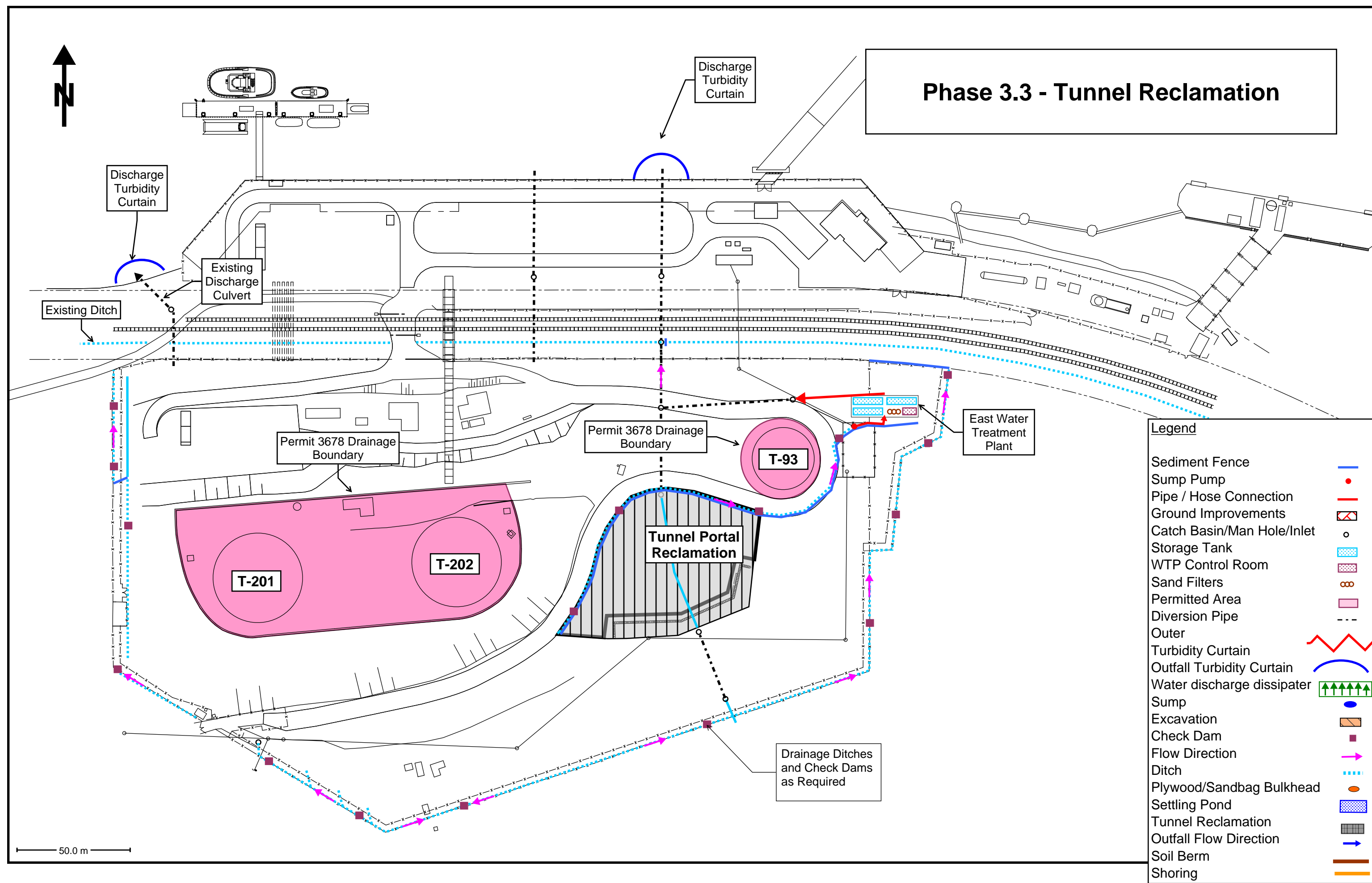
Phase 3.1 - Manifold and Pipe Rack Area Construction



Phase 3.2 - Tunnel and Substation Area Construction

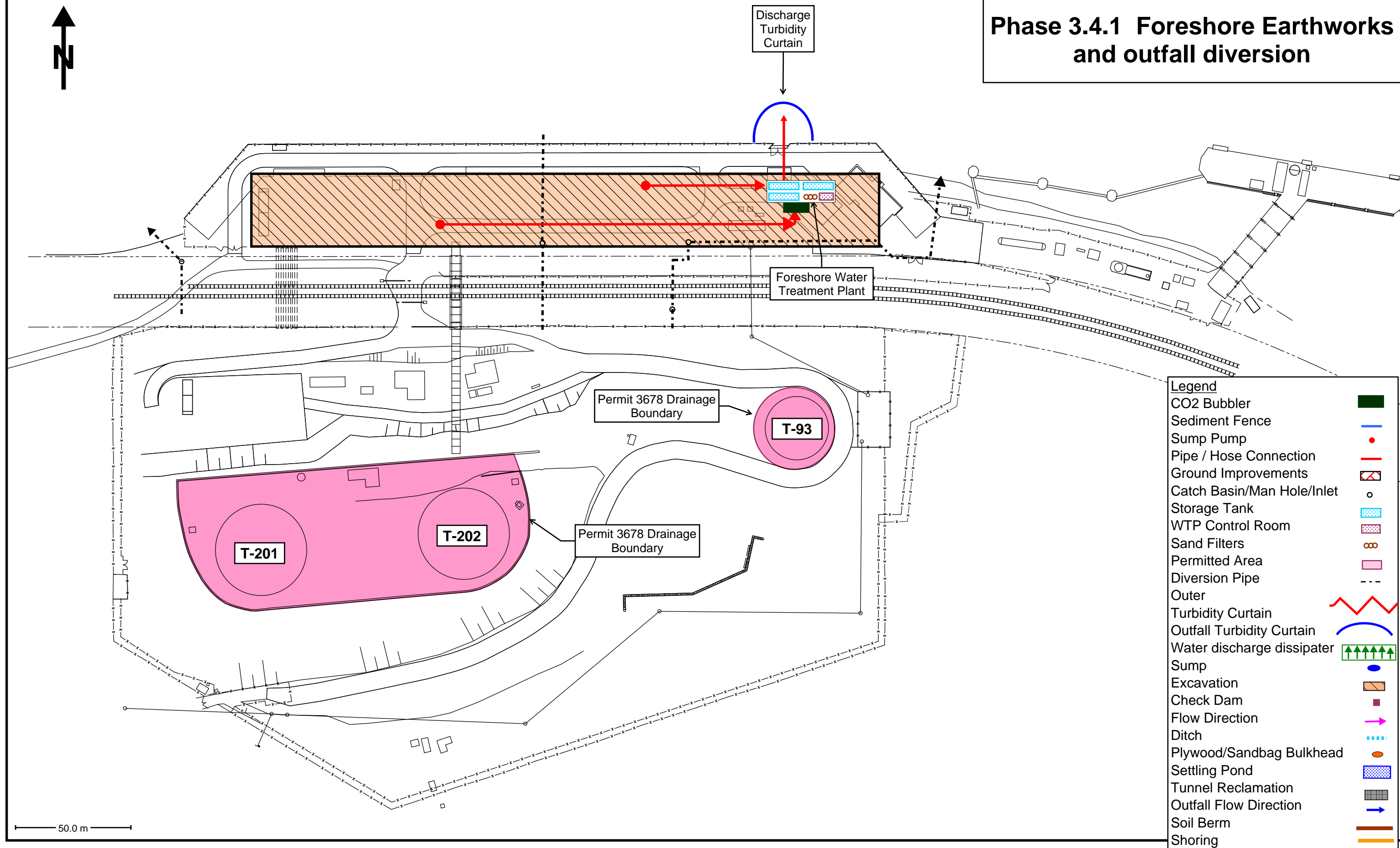


- Legend**
- CO2 Bubbler Tank
 - Flow Direction
 - Silt Fence
 - Check Dam
 - Sump
 - Drainage Ditch
 - Sump Pump
 - Pipe / Hose Connection
 - Grub-Excavate
 - Culvert / Drain Pipe
 - Shoring Wall
 - Catch Basin/Man Hole/Inlet
 - Storage Tank
 - Access Road Widening
 - Permitted Area
 - Security Fence
 - Planned Tunnel Portal Area
 - WTP Control Room
 - Sand Filters
 - Existing Storm Pipe
 - Equipment Bench

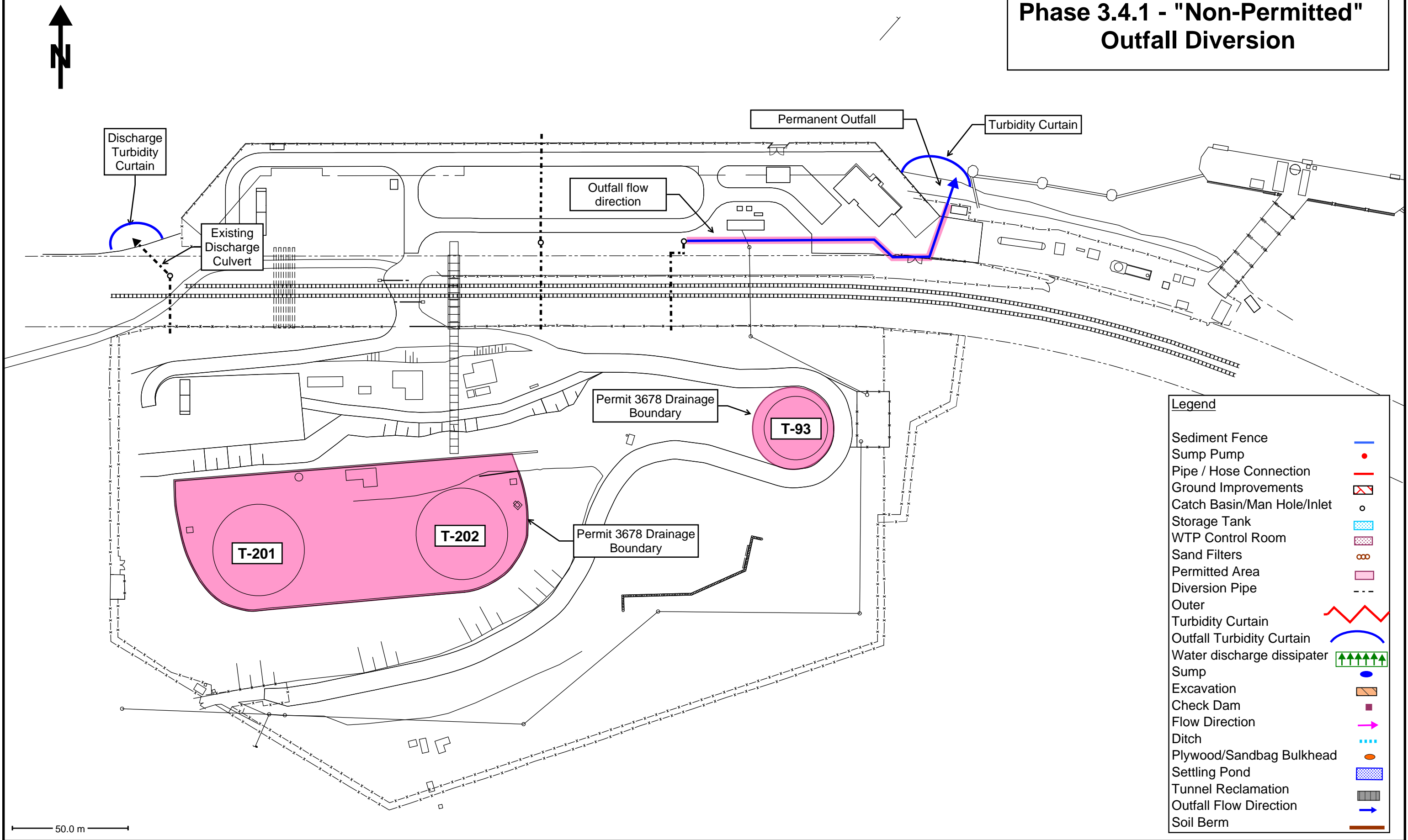




Phase 3.4.1 Foreshore Earthworks and outfall diversion

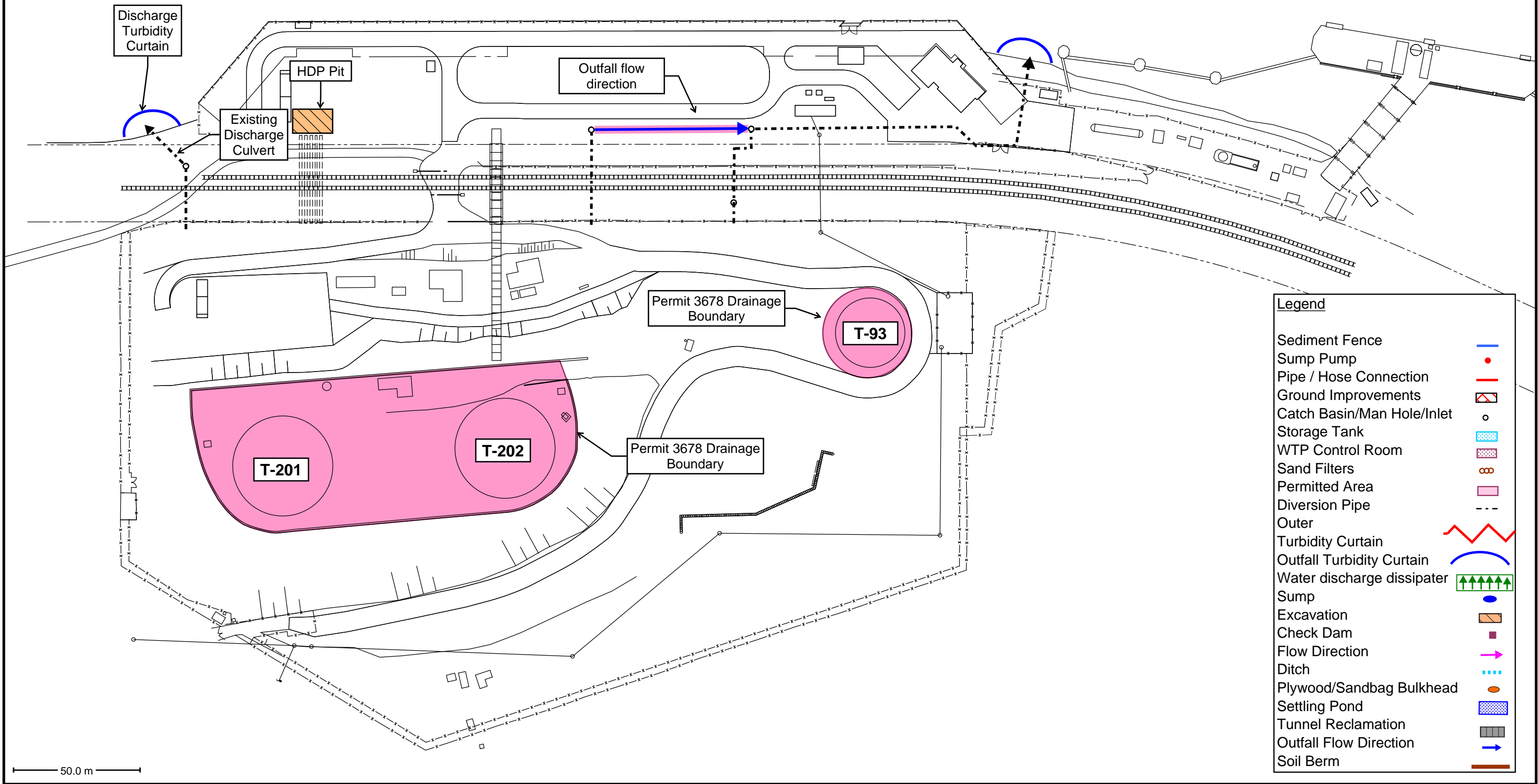


Phase 3.4.1 - "Non-Permitted" Outfall Diversion



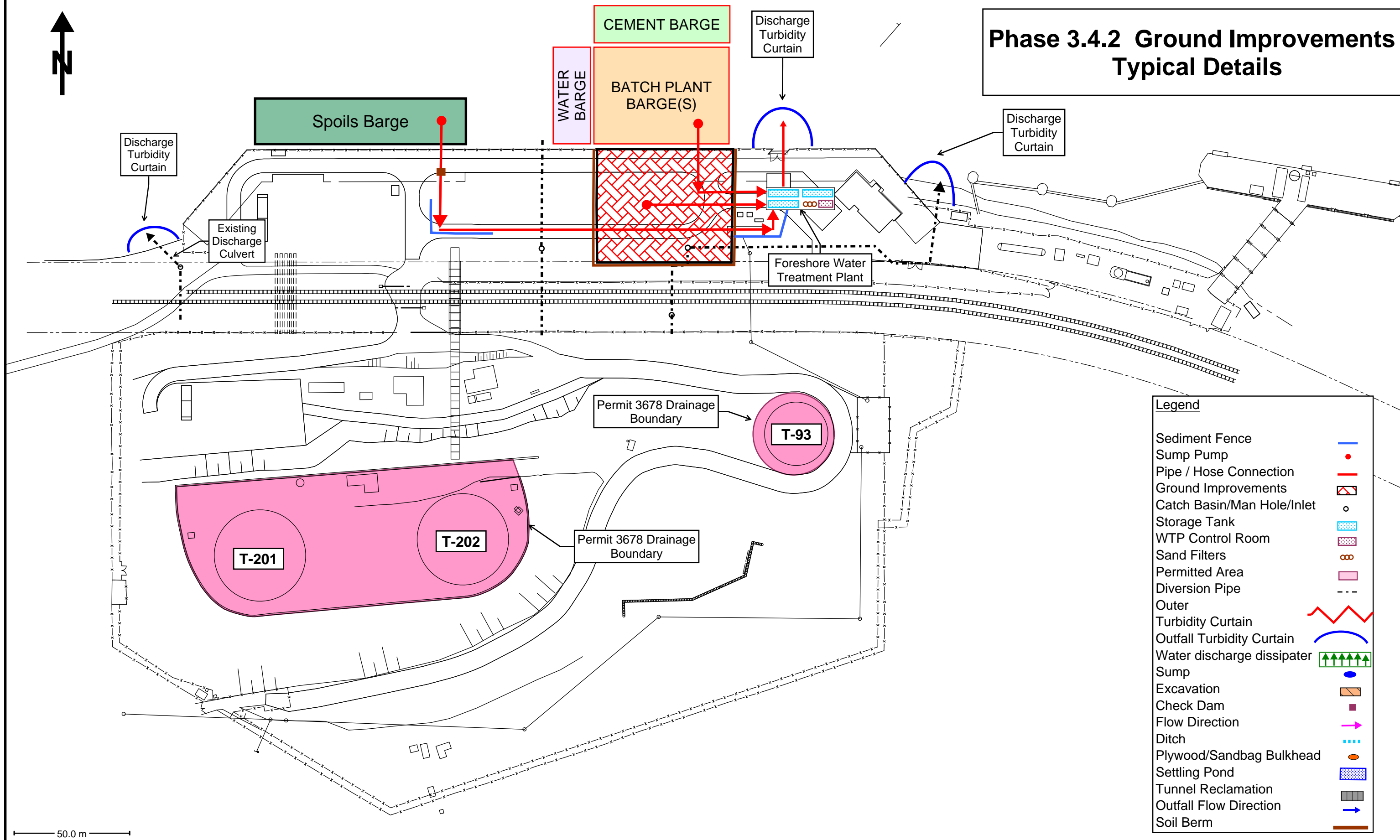


Phase 3.4.1 - "Permitted" Outfall Diversion



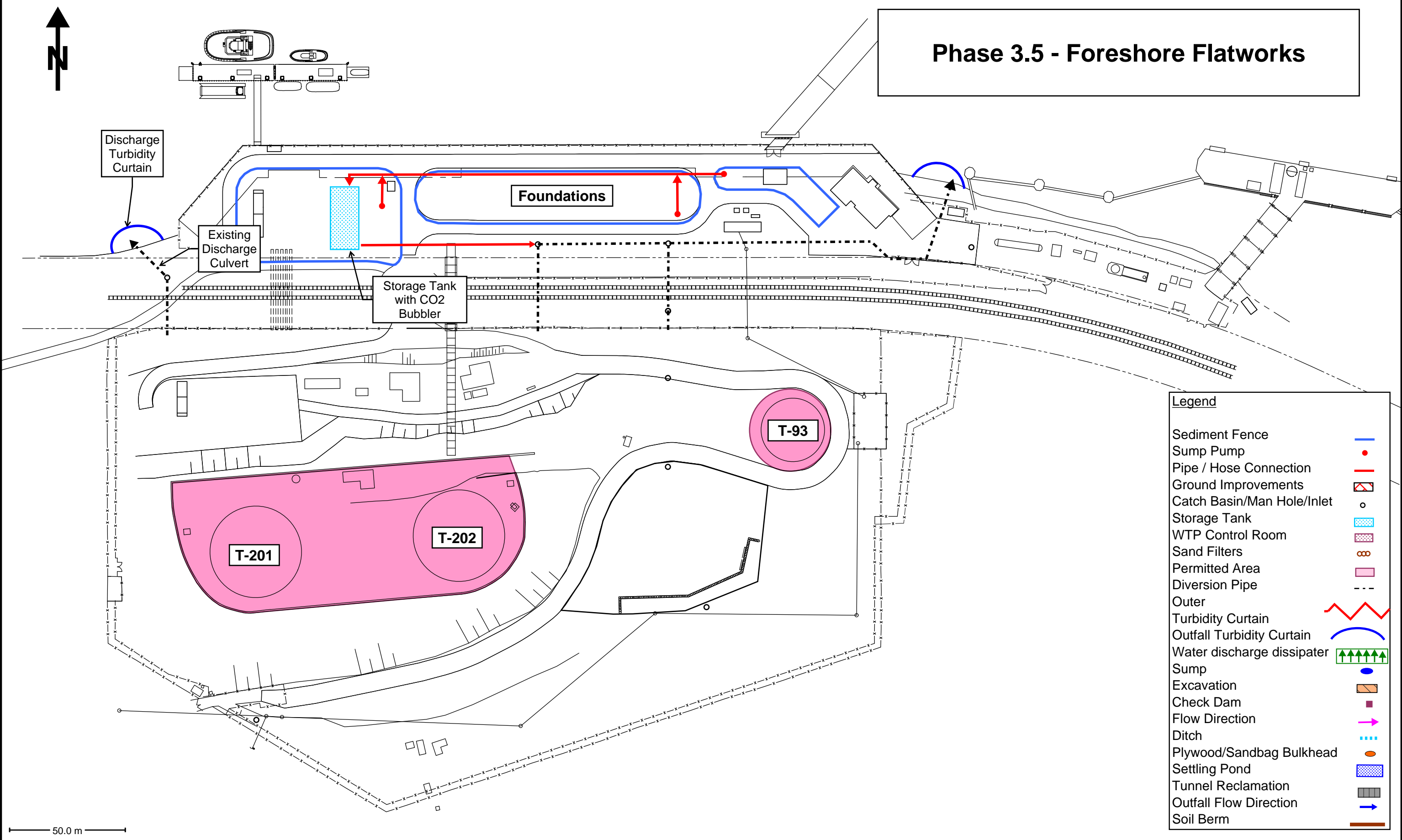


Phase 3.4.2 Ground Improvements Typical Details



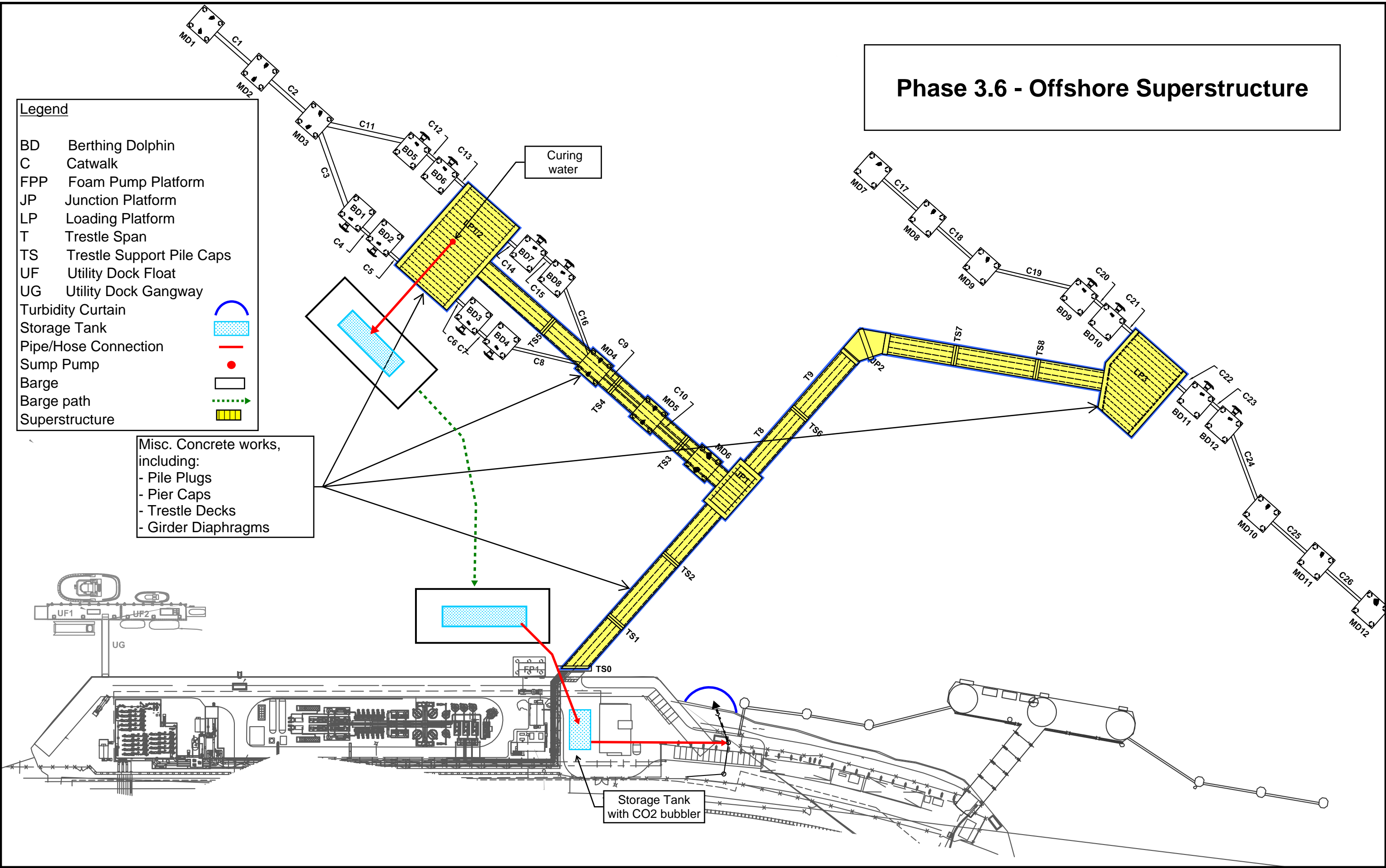
50.0 m

Phase 3.5 - Foreshore Flatworks



Legend	
Sediment Fence	
Sump Pump	
Pipe / Hose Connection	
Ground Improvements	
Catch Basin/Man Hole/Inlet	
Storage Tank	
WTP Control Room	
Sand Filters	
Permitted Area	
Diversion Pipe	
Outer	
Turbidity Curtain	
Outfall Turbidity Curtain	
Water discharge dissipater	
Sump	
Excavation	
Check Dam	
Flow Direction	
Ditch	
Plywood/Sandbag Bulkhead	
Settling Pond	
Tunnel Reclamation	
Outfall Flow Direction	
Soil Berm	

Phase 3.6 - Offshore Superstructure



APPENDIX F

Tunnel Boring Machine Product Information and Data Sheets



AQUAGEL®

Viscosifier

Description AQUAGEL®, finely ground, premium-grade Wyoming sodium bentonite meets the requirements of American Petroleum Institute (API) Specification 13A, section 9. AQUAGEL functions as a viscosifier and filtrate reducer in freshwater drilling fluids.

Applications/Functions *The use of AQUAGEL viscosifier assists or promotes the following:*

- Viscosify water-based drilling fluids
- Reduce filtration by forming a thin filter cake with low permeability
- Improve hole cleaning capabilities
- Promote hole stability in poorly consolidated formations

Advantages

- Helps develop gel structure for cuttings suspension
- NSF/ANSI Standard 60 certified
- Can be added directly to fresh water or freshwater drilling fluids
- Helps provide lubricity in drilling fluids

Typical Properties

- Appearance Variable-colored powder (gray to tan)
- Bulk density, lb/ft³ 68 to 72 (as packaged)

Recommended Treatment Mix slowly through a jet mixer or sift slowly into the vortex of a high-speed stirrer.

Approximate Amounts of AQUAGEL® viscosifier Added to Water-Based Fluids			
Added to Fresh Water	lb/100 gal	lb/bbl*	Kg/m ³
Under normal drilling conditions	30-50	13-22	35-60
To stabilize caving formations	60-80	25-35	70-100
To stop circulation loss	70-95	30-40	85-110
Added to Freshwater Drilling Fluid	lb/100 gal	lb/bbl*	Kg/m ³
Under normal drilling conditions	10-25	4-10	11-28
To stabilize caving formations	20-45	9-18	25-50
To stop circulation loss	25-50	10-20	28-56

* 1 bbl = 42 U.S. gallons

Packaging AQUAGEL® viscosifier is packaged in 50-lb (22.7 kg) multiwall paper bags.

Availability AQUAGEL viscosifier can be purchased through any Baroid Industrial Drilling Products Retailer. To locate the Baroid IDP retailer nearest you, contact the Customer Service Department in Houston or your area IDP Sales Representative.

Baroid Industrial Drilling Products

Product Service Line, Halliburton

3000 N. Sam Houston Pkwy. E.

Houston, TX 77032

Customer Service (800) 735-6075 Toll Free (281) 871-4612

Technical Service (877) 379-7412 Toll Free (281) 871-4613

MATERIAL SAFETY DATA SHEET**Product Trade Name: BENTONITE****Revision Date:** 04-Jan-2010**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

Product Trade Name: BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Weight Additive

Manufacturer/Supplier Halliburton Energy Services
P.O. Box 1431
Duncan, Oklahoma 73536-0431
Emergency Telephone: (281) 575-5000

Prepared By Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Bentonite	1302-78-9	60 - 100%	Not applicable	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	0.025 mg/m ³	1/2 x 10 mg/m ³ %SiO ₂ + 2
Crystalline silica, tridymite	15468-32-3	0 - 1%	0.05 mg/m ³	1/2 x 10 mg/m ³ %SiO ₂ + 2
Crystalline silica, quartz	14808-60-7	< 3	0.025 mg/m ³	10 mg/m ³ %SiO ₂ + 2

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

3. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD

May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

4. FIRST AID MEASURES

Inhalation

If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin

Wash with soap and water. Get medical attention if irritation persists.

Eyes

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion

Under normal conditions, first aid procedures are not required.

Notes to Physician

Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media All standard firefighting media.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection

Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection

Normal work gloves.

Skin Protection

Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection

Wear safety glasses or goggles to protect against exposure.

Other Precautions

None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	9.9
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	60
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	<p>Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).</p> <p>Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).</p>
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to <u>IARC Monograph 68, Silica, Some Silicates and Organic Fibres</u> (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Chronic Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.

EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.
Canadian Regulations	
Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2A Very Toxic Materials Crystalline silica

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS

Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****



AQUAGEL (aka BARA-KADE 90) Slurry Rheological Properties and Profiles
 tested and prepared by Andrew Liao / Baroid R&D Lab (Houston)

AQUAGEL (aka BARA-KADE 90) % by wt Slurry	3%	5%	9%
Slurry after mixed with tap water (not deionized water) was aged statically for 18 hours before slurry rheological properties were measured			
Initial Funnel viscosity, sec/quart	32	38	64
Slurry density in, lb/gal	8.5	8.6	8.8
API fluid loss, c.c./30 minutes	29.5	22.5	15
Slurry specific gravity	1.02	1.03	1.05
<i>FANN 35A readings:</i>			
600 rpm	15	37	75
300 rpm	10	26	53
200 rpm	8	21	43
100 rpm	6	16	32
6 rpm	3	8	19
3 rpm	2	6	18
Plastic Viscosity, cP	5	11	22
Yield Point, lb/100 ft²	5	15	31
Apparent Viscosity, cP	7.5	18.5	37.5
10 second gel strength, lb/100ft²	2	7	23
10 minute gel strength, lb/100ft²	3	9	32

(Note: Water used to mix with AQUAGEL is a tap water not deionized water. If deionized water is used to prepare the slurries, the rheological properties will increase due to less ionic species present in deionized water. However, very seldom deionized is used in the job site for mixing.)

Figure 1: Slurry Marsh funnel viscosity (second/quart) as function of AQUAGEL % by wt profile

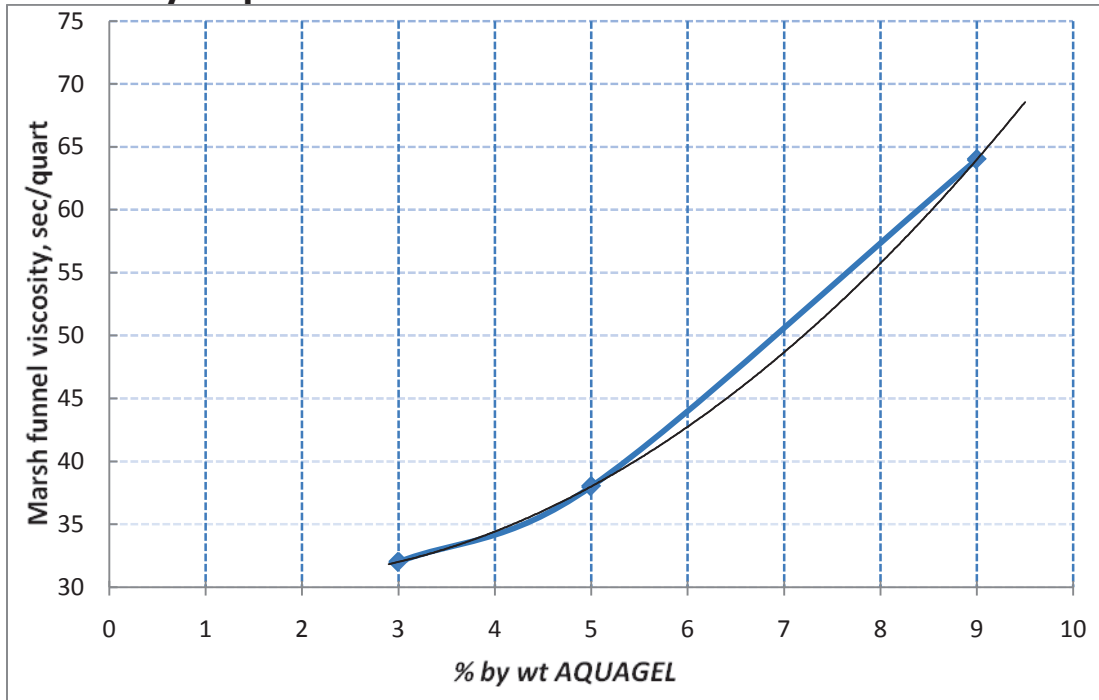


Figure 2: Slurry yield point (lb/100 ft²) as function of AQUAGEL % by wt profile

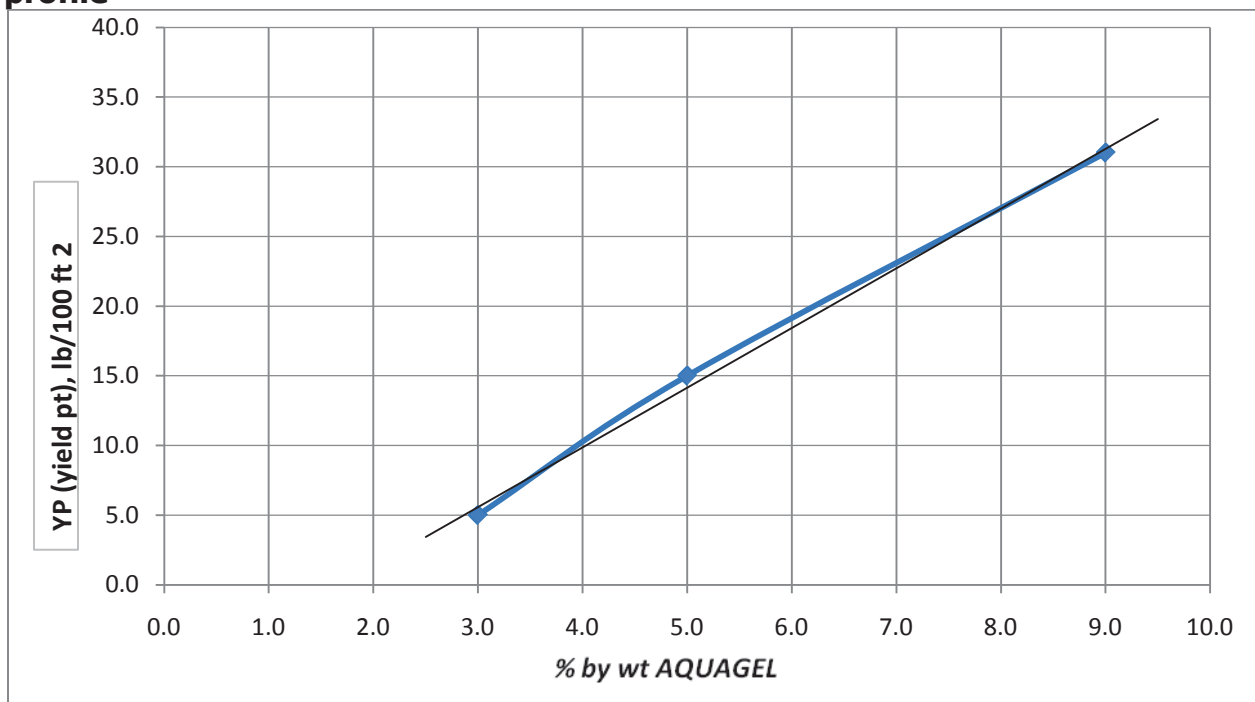
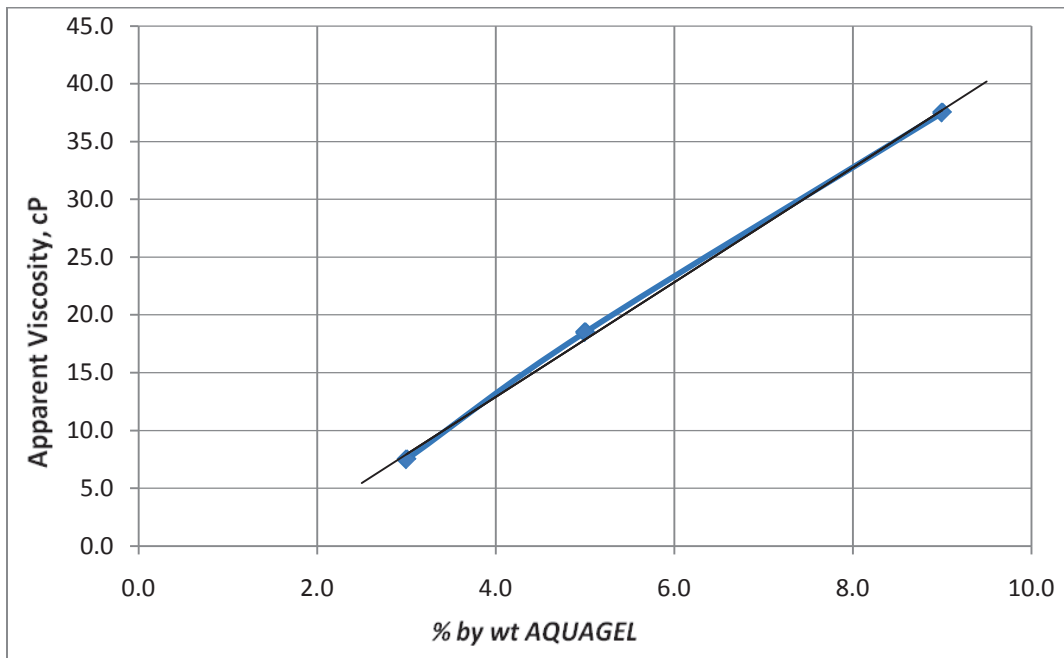


Figure 3: Apparent viscosity (600 rpm/2, cP) as function of AQUAGEL % by wt profile



Andrew Liao
Sr. Project Specialist
Halliburton/Baroid

Resource Materials Testing, Inc.
"Specialists in Fly Ash Testing"

24 Fine Drive Murphy, NC 28906 828.506.7636

REPORT OF FLY ASH ANALYSIS

TO: Fly Ash Direct

Attn: Mr. Jim Irvine

4228 Airport Road

Cincinnati, OH 45226

PROJECT NO. RMT-484

SAMPLE NO. 18171

DATE REC.: 07-08-11

DATE REP.: 08-18-11

PROJECT NAME: Avon Lake Fly Ash Quality Assurance Program

SAMPLE ID: Class F Fly Ash June 2011 Composite 2,000-ton Composite

CHEMICAL ANALYSIS:	RESULTS:	ASTM C 618 Spec F/C
Silicon Dioxide, SiO ₂ , %	49.18	----
Aluminum Oxide, Al ₂ O ₃ , %	24.43	----
Iron Oxide, Fe ₂ O ₃ , %	17.18	----
Sum of SiO ₂ , Al ₂ O ₃ & Fe ₂ O ₃ , %	90.79	70/50 Min
Calcium Oxide, CaO, %	3.38	----
Magnesium Oxide, MgO, %	1.00	----
Sodium Oxide, Na ₂ O, %	0.66	----
Potassium Oxide, K ₂ O, %	1.90	----
Sulfur Trioxide, SO ₃ , %	0.61	5.0 Max
Moisture Content, %	0.35	3.0 Max
Loss on Ignition, %	3.75	6.0 Max
Total Alkalis as Na ₂ O Equivalent, %	1.91	
PHYSICAL ANALYSIS:	RESULTS:	ASTM C 618 Spec F/C
Amount Retained on No. 325 Sieve, %	15.7	34 Max
Sieve Uniformity, % Points from Ave	-5.09	5 Max
Strength Activity Index		
Portland Cement @ 7 days, % of Control	78	75 Min
Portland Cement @ 28 days, % of Control	87	75 Min
Water Requirement, % of Control	98	105 Max
Autoclave Expansion, %	-0.01	0.8 Max
Density	2.50	----
Density Uniformity, % from Ave	+0.73	5 Max
Increase of Drying Shrinkage, %*	-0.00	0.03 Max
Reactivity with Cement Alkalis, %*		
Reduction of Mortar Expansion, %	----	----
Mortar Expansion, % of LA Cement Control	14	100 Max
Air Entrainment of Mortar, %	0.034	----
Air Entrainment Uniformity, % from Ave	+1	20 Max

*Optional Requirements applicable only when requested by purchaser. This material meets the requirements of ASTM C 618 and AASHTO M 295 for the parameters tested.

By Robert L. Smith
 Robert L. Smith, Ph.D.



Material Safety Data Sheet (MSDS)

Section 1 – Chemical Product and Company Identification

Product/Chemical Name: Fly Ash

Chemical Names/Synonyms: Coal Fly Ash

CAS Number: 68131-74-8

Manufacturer: RRI Energy

Avon Lake Power Plant

33570 Lake Road

Avon Lake, Ohio 44012

General Information: 440-930-6459

Original Issue Date: 9/08/10

Off-Hour Emergency Phone Number: 440-930-6459

Revised: Not Applicable

Section 2 - Composition/Information on Ingredients

Ingredient Name	CAS Number	Percentage by vol. *	OSHA PEL ¹	ACGIH TLV ²
Fly Ash	68131-74-8	100	15 mg/m ³ (as total dust, PNOR) ³ 5.0 mg/m ³ (as respirable fraction, PNOR)	10 mg/m ³ (as inhalable fraction, PNOS) ^{4,5} 3.0 mg/m ³ (as respirable fraction, PNOS) ⁶
Silica (crystalline quartz)**	14808-60-7	Varies	$\frac{10 \text{ mg/m}^3}{\% \text{SiO}_2 + 2}$ (as respirable fraction) $\frac{30 \text{ mg/m}^3}{\% \text{SiO}_2 + 2}$ (as total)	0.025 mg/m ³
Iron Oxide (dust)	1309-37-1	Varies	15 mg/m ³ (as total dust, PNOR) 5.0 mg/m ³ (as respirable fraction, PNOR)	10 mg/m ³ (as inhalable fraction, PNOS) 3.0 mg/m ³ (as respirable fraction, PNOS)
Barium	7440-39-3	0-1	0.5 mg/m ³	0.5 mg/m ³

Notes:

* Percentage by vol. is a representative percent by volume for each ingredient in the total product.

** Total silicon dioxide reported as SiO₂. Silicon dioxide may be present in silicate, amorphous and crystalline (as quartz) forms. The regulatory listings above, PEL and TLV are for crystalline silica (as quartz). For silica, amorphous, including natural diatomaceous earth (112926-00-8) the OSHA PEL-TWA is 80 mg/m³ / %SiO₂.

1. OSHA Permissible Exposure Limits (PELs) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday. A Peak is defined as the acceptable maximum peak for a maximum duration above the ceiling concentration for an eight-hour shift. A "skin" notation refers to the potential significant contribution to the overall exposure by the cutaneous route, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A "skin" notation refers to the potential significant contribution to the overall exposure by the cutaneous route, either by contact with vapors or, of probable greater significance, by direct skin contact with the substance. ACGIH-TLVs are only recommended guidelines based upon consensus agreement of the membership of the ACGIH. As such, the ACGIH TLVs are for guideline use purposes and are not legal regulatory standards for compliance purposes. The TLVs are designed for use by individuals trained in the discipline of industrial hygiene relative to the evaluation of exposure to various chemical or biological substances and physical agents that may be found in the workplace.
3. PNOR (Particulates Not Otherwise Regulated). All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the PNOR limit which is the same as the inert or nuisance dust limit of 15 mg/m³ for total dust and 5 mg/m³ for the respirable fraction.
4. Inhalable fraction - The concentration of inhalable particulate for the application of this TLV is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2009 TLVs® and BEIs® (Biological Exposure Indices) Appendix D, paragraph A.
5. PNOS (Particulates Not Otherwise Specified). Particulates identified under the PNOS heading are "nuisance dusts" containing no asbestos and <1% crystalline silica. A TWA-TLV of 10 mg/m³ for inhalable particulate and 3.0 mg/m³ for respirable particulate has been recommended.
6. Respirable fraction - The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2009 TLVs® and BEIs® Appendix D, paragraph C.

Section 3 – Hazards Identification

☆☆☆☆☆Emergency Overview ☆☆☆☆☆

CAUTION!

Fly Ash is a byproduct of the combustion of coal and is used for soil stabilization, an ingredient for cement, concrete and products made from concrete, filler in asphalt, and products used in construction.

May cause skin, eye and respiratory tract irritation. Avoid prolonged or repeated contact. Cancer Hazard. Observe good hygiene and safety practices when handling. If appropriate, respiratory protection and other personal protective equipment should be used. Potentially hazardous airborne particulate may be generated when disturbed and should be performed in well-ventilated areas.

Potential Health Effects

Primary Entry Routes: Excessive total particulate exposure may cause irritation to the eyes, skin and respiratory tract. Operations which generate high dust concentrations may result in the following effects if exposures exceed recommended limits as listed in Section 2

Target Organs: Respiratory system, skin, eyes

Acute Effects:

- **Inhalation:** Excessive exposures may cause irritation to nose, throat, lungs, and respiratory tract.
- **Eye:** Contact with eyes may cause moderate to severe irritation.

Section 3 – Hazards Identification (continued)

Acute Effects (continued):

- **Skin:** May cause mild to moderate irritation with prolonged or repeated contact. Irritation comes from both the abrasiveness and alkalinity of the fly ash. Chemical irritation may come from water becoming more alkaline from chemicals in the fly ash. In very rare instances the chemical irritation may lead to blistering
- **Ingestion:** No known health effects

Chronic Effects: Chronic effects to individual components of **Fly Ash** may include:

- **Inhalation:** Excessive and repeated exposures may cause benign lung changes associated with exposure to nuisances dust. Prolonged inhalation of silica dust may result in disabling pulmonary disorders, cough, dyspnea, and scarring of lung tissue (silicosis).
- **Eye:** Contact with eyes may cause moderate to severe irritation.
- **Skin:** May cause mild to moderate irritation with prolonged or repeated contact.
- **Ingestion:** No known health effects.

Chronic effects by component:

- **SILICA (Crystalline quartz):** Inhalation of quartz is classified by IARC as a Group 1 Carcinogen, Carcinogenic to Humans. Chronic exposure can cause silicosis, a form of lung scarring that can cause shortness of breath, reduced lung function, and in severe cases, death.
- **IRON OXIDE:** Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in the development of a benign pneumoconiosis, called siderosis, which is observable as an X-ray change. No physical impairment of lung function has been associated with siderosis. Inhalation of excessive concentrations of ferric oxide may enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens. Iron oxide is listed as a Group 3 (not classifiable) carcinogen by IARC.
- **BARIUM:** The three stages of poisoning from soluble barium compounds are acute gastroenteritis, loss of reflexes with the onset of muscular paralysis, and progressive muscular paralysis. When ingested, barium compounds exert profound effects on all muscles, especially the heart. In addition, exposure to metallic barium may result in severe burns, through explosion and fire.

Carcinogenicity: IARC, NTP, and OSHA do not list **Fly Ash** as a carcinogen. However, IARC identifies crystalline silica as a Group 1, Carcinogenic to Humans. NTP identifies crystalline silica of respirable size as Known to be a Human Carcinogen.

Medical Conditions Aggravated by Long-Term Exposure: May adversely affect individuals with existing medical conditions such as chronic blood disorders (i.e. anemia), eye, skin, and respiratory disorders (i.e., asthma, chronic bronchitis, emphysema, etc.).

SARA Potential Hazard Categories: Immediate Acute Health Hazard; Delayed Chronic Health Hazard

Section 4 - First Aid Measures

Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Seek immediate medical attention.

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes. Hold eyelids open during this flushing with water. Seek immediate medical attention. Contact physician regardless of route of exposure.

Skin Contact: Remove contaminated clothing. Flush and wash affected areas with soap or mild detergent and water. Do not reuse clothing until laundered. If irritation persists, seek medical attention.

Ingestion: Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention or contact poison control center immediately

Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders (i.e., asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by any airborne particulate matter exposure.

Notes to Physician: Respiratory disease may be aggravated by exposure to dust. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

Section 5 – Fire and Explosion Hazard Information

Flash Point: Not Determined

LEL: Not Determined

Flash Point Method: Not Applicable

UEL: Not Determined

Burning Rate: Not Determined

Auto-ignition Temperature: Not Determined

Flammability Classification: Non-Combustible

Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Unusual Fire or Explosion Hazards: None Known.

Hazardous Combustion Products: Above 1450° C decomposes to calcium oxide and sulfur dioxide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Wear a self-contained breathing apparatus (SCBA) with a full face-piece operated in pressure-demand or positive-pressure mode and full protective clothing.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Wear appropriate personal protective equipment as specified in Section 8. Contain and recover material when possible. Do not release into sewers or waterways. Contain material and follow normal clean-up procedures. Collect material in appropriate, labeled containers for recovery or disposal. Keep unnecessary people away. Isolate hazard area and deny entry. Stay upwind.

Regulatory Requirements Follow applicable Federal, state, and local regulations.

Disposal: Follow applicable Federal, state, and local regulations.

Water Release: Keep out of water supplies and sewers.

Section 7 - Handling and Storage

Handling Precautions: Avoid inhalation or contact. Ventilate area of spill. Use vacuum or wet mop to clean up dust. Minimize dust generation or accumulation where ignition sources may occur.

Storage Requirements: Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances, heat or ignition sources.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use controls as appropriate to minimize exposure to dust and incompatible materials and heat during handling operations.

Ventilation: Provide general or local exhaust ventilation systems to minimize airborne concentrations. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen.

Protective Clothing/Equipment: Persons handling this product should wear appropriate wear resistant gloves/clothing and safety glasses with side shields, goggles or face shield to prevent skin and eye contact are required. Contact lenses should not be worn where industrial exposures to this material are likely. Wash skin that has been exposed with soap and water or waterless hand cleaner.

Section 9 - Physical and Chemical Properties

Physical State: Solid Powdery Material

Appearance and Odor: Light Brown/No Odor

Odor Threshold: No Data Supplied (ND)

Vapor Pressure: Not Applicable (NA)

Vapor Density (air = 1): NA

Molecular Formula: Varies

Molecular Weight: Varies

Density: No Information Found (NIF)

Specific Gravity (H₂O = 1): 1.06 – 1.14

pH (as shipped): NA

Water Solubility: NA

Other Solubilities: NA

Boiling Point: NA

Viscosity: NA

Refractive Index: NIF

Surface Tension: NIF

% Volatile: 1 - 3

Evaporation Rate (Butyl Acetate = 1): NA

Freezing Point: NIF

Melting Point: NIF

Section 10 - Stability and Reactivity

Stability: Fly Ash is stable under normal storage and handling conditions. Fly Ash may react with water, resulting in a slight release of heat, depending on the amount of lime (calcium oxide) present.

Polymerization: Hazard polymerization will not occur.

Chemical Incompatibilities: Fly ash is incompatible with acids, diazomethane, phosphorus, aluminum metal and strong oxidizing agents

Conditions to Avoid: Storage with incompatible materials.

Hazardous Decomposition Products: Decomposes to calcium oxide and sulfur dioxide above 1450° C. Slight exothermic reaction when water is mixed with fly ash.

Section 11 - Toxicological Information

The following information is available:

Eye Effects:

Eye contact may cause moderate to severe irritation.

Acute Inhalation Effects: Acute toxicity of Fly Ash components may result primarily from irritation to nose, throat, lungs, and respiratory tract.

Acute Oral Effects: No Information Found

Other: No LC50 or LD50 has been established for Fly Ash, however, the following toxicity data has been determined for the components: Silica, Amorphous CAS 7631-86-9: LD50: 3,160 mg/kg (oral rat); Silica, crystalline quartz: NIF; Iron Oxide: NIF; Barium LD50: NIF

Section 11 - Toxicological Information

Skin Effects:

Skin contact may cause mild to moderate irritation with prolonged or repeated contact.

Chronic Effects: Refer to Section 3

Carcinogenicity: IARC lists Crystalline Silica as a Group 1 carcinogen. NTP list Crystalline Silica of respirable size as known to be a human carcinogen.

Mutagenicity: No Information Found

Teratogenicity: No Information Found

Notes:

NIOSH, Registry of Toxic Effects of Chemical Substances (RTECS); (GF8285000) for additional toxicity data on fly ash; (VV7330000) for crystalline silica, quartz; (NO7400000) for iron oxide; and (CQ8370000) for barium

Section 12 - Ecological Information

Ecotoxicity: No Information Found (NIF). However, individual components of the product have been found to be toxic to the environment and may migrate into soil and groundwater and be ingested by wildlife.

Environmental Fate: NIF - This material is not expected to significantly bioaccumulate.

Environmental Degradation: NIF - This material is not expected to biodegrade significantly.

Soil Absorption/Mobility: NIF - However, individual components of the product have been found to be absorbed by plants from soil.

Aquatic Toxicity: NIF

Section 13 - Disposal Considerations

Disposal: Follow applicable Federal, state, and local regulations for disposal of solid waste accumulated during handling operations of the product.

Disposal Regulatory Requirements: Follow applicable Federal, state and local regulations.

Container Cleaning and Disposal: Follow applicable Federal, state and local regulations.

Section 14 - Transport Information

US Department of Transportation (DOT) Data (49 CFR 172.101):

Fly Ash is currently **Not Listed** as a hazardous substance under 49 CFR 172.101 DOT regulations

All Federal, state, and local laws and regulations that apply to the transport of this type of material must be adhered to.

Shipping Name: Not Applicable (NA)

Packaging Authorizations (173.*)**

Quantity Limitations (173.27 & 175.75)

Shipping Symbols: NA

a) Exceptions: NA

a) Passenger Aircraft or Rail: NA

Hazard Class: NA

b) Non-bulk: NA

b) Cargo Aircraft Only: NA

ID No.: NA

c) Bulk: NA

Packing Group: NA

Vessel Stowage Location:

DOT/IMO Label: NA

a) Vessel Stowage: NA

Special Provisions (172.102): NA

b) Other: NA

The International Maritime Dangerous Goods (IMDG) and the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) classification, packaging and shipping requirements follow the US DOT Hazardous Materials Regulation.

Section 15 - Regulatory Information

Regulatory Information: *The following listing of regulations relating to an RRI Energy, Inc product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities.*

This product and/or its constituents are subject to the following regulations:

OSHA Regulations: OSHA has not established a substance-specific standard for occupational exposure to **Fly Ash**. However, exposures are regulated under OSHA, Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-2 & Z-3): The product as a whole is not listed. However, individual components of the product are listed: Crystalline silica, iron oxide, and barium (Refer to Section 2 for exposure limits)

EPA Regulations: **Fly Ash** is not listed as a whole. However, individual components of the product are listed for SARA 313, Refer to **Section 313 Supplier Notification** information below:

CAA: The product, **Fly Ash** as a whole, and individual components of the product are not listed.

CERCLA: The product, **Fly Ash** as a whole, and individual components of the product are not listed.

CWA: The product, **Fly Ash** as a whole, and individual components of the product are not listed.

RCRA: The product, **Fly Ash** as a whole, and individual components of the product are not listed.

SARA 311/312: Immediate Acute Health Hazard; Delayed Chronic Health Hazard

SARA 313: The product, **Fly Ash** as a whole is not listed. Barium is subject to SARA 313 reporting requirements. Please also note that if you prepackage or otherwise redistribute this product to industrial customers, SARA 313 requires that a notice be sent to those customers

TSCA: Product and components are listed.

SDWA: The product, **Fly Ash** as a whole is not listed. Barium is regulated under this act.

Section 15 - Regulatory Information (continued)

Regulation Key:

CAA	Clean Air Act (42 USC Sec. 7412; 40 CFR Part 61 [As of: 8/18/06])
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (42 USC secs. 9601(14), 9603(a); 40 CFR Sec. 302.4, Table 302.4, Table 302.4 and App. A)
CWA	Clean Water Act (33 USC Secs. 1311; 1314(b), (c), (e), (g); 136(b), (c); 137(b), (c) [as of 8/2/06])
RCRA	Resource Conservation Recovery Act (42 USC Sec. 6921; 40 CFR Part 261 App VIII)
SARA	Superfund Amendments and Reauthorization Title III Section 302 Extremely Hazardous Substances (42 USC secs. 11023, 13106; 40 CFR Sec. 372.65) and Section 313 Toxic Chemicals (42 USC secs. 11023, 13106; 40 CFR sec. 372.65 [as of 6/30/05])
TSCA	Toxic Substance Control Act (15 U.S.C. s/s 2601 et seq. [1976])
SDWA	Safe Drinking Water Act (42 U.S.C. s/s 300f et seq. [1974])

This information should be included in all MSDSs that are copied and distributed for this material.

State Regulations: The product, **Fly Ash** as a whole is not listed in any state regulations. However, individual components of the product are listed in various state regulations:

Pennsylvania:	The product, Fly Ash as a whole is not listed. However, individual components of the product are listed. <ul style="list-style-type: none"> • Hazardous Substances: Iron Oxide and Quartz • Environmental Hazards: Barium • Special Hazard Substances: None Listed
California Prop. 65:	The product, Fly Ash as a whole is not listed. However, individual components of the product are listed. Silica-crystalline
New Jersey:	The product, Fly Ash as a whole is not listed. However, individual components of the product are listed: <ul style="list-style-type: none"> • Hazardous Substances: Barium, Iron Oxide, and Silica Quartz • Special Hazard Substances: Silica Quartz
Minnesota:	The product, Fly Ash as a whole is not listed. However, individual components of the product are listed: Iron Oxide, Silica Crystalline-Quartz, and Barium
Massachusetts:	The product, Fly Ash as a whole is not listed. However, Individual components of the product are listed. Barium, Silica (Crystalline, Quartz), and Iron Oxide

Other Regulations: The product, **Fly Ash** as a whole may not be listed in other regulations. However, individual components of the product may be listed, check appropriate regulations for further regulatory compliance.

WHMIS Classification This product is not classified, however the following ingredients are classified: Quartz: D2A, Barium: B6, D2B (Canadian):

WHMIS - Workplace Hazardous Materials Information System

Section 16 - Other Information

Prepared By: RRI, Energy

Revision History: Original

Hazardous Material Identification System (HMIS) Classification

Health Hazard	1
Fire Hazard	0
Physical hazards	0

HEALTH= 1, * Denotes possible chronic hazard if airborne dusts or fumes are generated Irritation or minor reversible injury possible.

FIRE= 0, Materials that will not burn

PHYSICAL HAZARDS = 0, Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Non-explosives

National Fire Protection Association (NFPA)



HEALTH = 1, Exposure could cause irritation but only minor residual injury even if no treatment is given.

FIRE = 0, Materials that will not burn

INSTABILITY = 0, Normally stable, even under fire exposure conditions, and are not reactive with water.

ABBREVIATIONS/ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists	NIF	No Information Found
BEIs	Biological Exposure Indices	NIOSH	National Institute for Occupational Safety and Health
CAS	Chemical Abstracts Service	NTP	National Toxicology Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	ORC	Organization Resources Counselors
CFR	Code of Federal Regulations	OSHA	Occupational Safety and Health Administration
CNS	Central Nervous System	PEL	Permissible Exposure Limit
GI, GIT	Gastro-Intestinal, Gastro-Intestinal Tract	PNOR	Particulate Not Otherwise Regulated
HMIS	Hazardous Materials Identification System	PNOC	Particulate Not Otherwise Classified
IARC	International Agency for Research on Cancer	PPE	Personal Protective Equipment
LC50	Median Lethal Concentration	ppm	parts per million
LD50	Median Lethal Dose	RCRA	Resource Conservation and Recovery Act
LD _{Lo}	Lowest Dose to have killed animals or humans	RTECS	Registry of Toxic Effects of Chemical Substances

Section 16 - Other Information (continued)

ABBREVIATIONS/ACRONYMS (continued):

LEL	Lower Explosive Limit	SARA	Superfund Amendment and Reauthorization Act
µg/m³	microgram per cubic meter of air	SCBA	Self-contained Breathing Apparatus
mg/m³	milligram per cubic meter of air	STEL	Short-term Exposure Limit
mppcf	million particles per cubic foot	TLV	Threshold Limit Value
MSDS	Material Safety Data Sheet	TWA	Time-weighted Average
MSHA	Mine Safety and Health Administration	UEL	Upper Explosive Limit
NFPA	National Fire Protection Association		

Disclaimer: This information is taken from sources or based upon data believed to be reliable. Our objective in sending this information is to help you protect the health and safety of your personnel and to comply with the OSHA Hazard Communication Standard and Title III of the Superfund Amendment and Reauthorization Act of 1986. RRI Energy Inc. makes no warranty as to the absolute correctness, completeness, or sufficiency of any of the foregoing, or any additional, or other measures that may not be required under particular conditions. RRI ENERGY INC. MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY, OR ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTIES OTHERWISE ARISING FROM COURSE OF DEALING OR TRADE

CEMENT MILL TEST REPORT



Cement

CONSIGNEE:

Date:

Aug '11

Plant:

ALPENA

Cement Type:

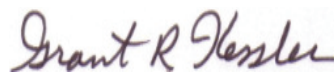
II

Manufacture Period:

July '11

PHYSICAL DATA		CHEMICAL DATA (C-114)	Percent
Specific Surface (Blaine) (C-204)		Silicon Dioxide (SiO ₂).....	20.0
(sq. cm./gm.).....	3720	Aluminum Oxide (Al ₂ O ₃).....	4.8
(sq. m./kg.).....	372	Ferric Oxide (Fe ₂ O ₃).....	2.8
Percent Passing 45 µm (C-430)..	97.2	Calcium Oxide (CaO).....	63.5
Compressive Strength (psi) (C-109)		Magnesium Oxide (MgO).....	2.8
Mortar Cubes		Sulphur Trioxide (SO ₃).....	2.6
1 day.....	2170	Ignition Loss (%).....	2.4
3 day.....	3620	Insoluble Residue (%).....	0.29
7 day.....	4420	Free Lime (%).....	0.8
28 day.....	5660	Tricalcium Silicate (C ₃ S).....	57
Vicat Setting Time (C-191)		Tricalcium Aluminate (C ₃ A).....	8
Initial (min.).....	125	Equivalent Alkalis (%).....	0.58
Final (min.).....	235	C ₃ S + 4.75C ₃ A.....	94
Air Content (%) (C-185).....	6.7		
Autoclave Expansion (%) (C-151)..	0.02		
Heat of Hydration (kJ/kg) 7 days...	337		
(Date tested: March 29, 2011)			
LIMESTONE PERCENTAGE			
CO ₂ (%) (C-114).....	1.4		
CaCO ₃ in Limestone (%).....	94		
Limestone (%) (C-150).....	3.6		

CERTIFIED BY:



Quality Manager- Alpena

We hereby certify that this cement complies with current ASTM C 150 specification.

GREAT LAKES REGION – ALPENA PLANT

1435 Ford Avenue, PO Box 396, Alpena, MI 49707

OFFICE: (989) 354-4171 FAX: (989) 354-2223

Web: www.lafargenorthamerica.com

Material Safety Data Sheet

Section 1: PRODUCT AND COMPANY INFORMATION

Product Name(s): Lafarge Blended Cement (cement)

Product Identifiers: MaxCem[®], SF[™] Cement, Silica Fume Cement, TerraCem[™], Tercem 3000[™], Terraflow Cement, PozzMod Plus[™], , FortiPave[®], FortiMax[™], LowDense[™] Lightweight Well Cement, Type IS, IP, IT, GUb, HEb, MSb, HSb, MHb, LHb, GULb, MSLb, MHLb, HELb, HSLb.

Manufacturer:
Lafarge North America Inc.
12018 Sunrise Valley Drive, Suite 500
Reston, VA 20191

Information Telephone Number:
703-480-3600 (9am to 5pm EST)
Emergency Telephone Number:
1-800-451-8346 (3E Hotline)

Product Use: Cement is used as a binder in concrete and mortars that are widely used in construction. Cement is distributed in bags, totes and bulk shipment.

Note: This MSDS covers many types of Cement. Individual composition of hazardous constituents will vary between types of Cement.






Section 2: COMPOSITION/INFORMATION ON INGREDIENTS

Component	Percent (By Weight)	CAS Number	OSHA PEL -TWA (mg/m ³)	ACGIH TLV-TWA (mg/m ³)	LD ₅₀ (mouse, intraperitoneal)	LC ₅₀
Portland Cement*	5-95	65997-15-1	15 (T); 5 (R)	1 (R)	NA	NA
Calcium Carbonate* (Limestone)	0-20	1317-65-3	15 (T); 5 (R)	3 (R); 10 (T)	NA	NA
Calcium Sulfate* (Gypsum)	1-10	13397-24-5	15 (T); 5 (R)	10 (T)	NA	NA
Silica Fume (Amorphous Silica)	0-10	69012-64-2	NA	3 (R); 10 (T)	NA	NA
Crystalline Silica	0-10	14808-60-7	[(10) / (%SiO ₂ +2)] (R); [(30) / (%SiO ₂ +2)] (T)	0.025 (R)	NA	NA
Portland Cement Kiln Dust	0-10	68475-76-3	NA	NA	NA	NA
Fly Ash	0-40	68131-74-8	NA	NA	NA	NA
Slag	0-95	65996-69-2	NA	NA	NA	NA
Metakaolin	0-20	1332-58-7	NA	NA	NA	NA

Note: Exposure limits for components noted with an * contain no asbestos and <1% crystalline silica

Cement is made from materials mined from the earth and is processed using energy provided by fuels. Trace amounts of chemicals may be detected during chemical analysis. For example, cement may contain trace amounts of titanium oxide, potassium and sodium sulfate compounds, chromium compounds, nickel compounds, arsenic compounds and other trace compounds.

Section 3: HAZARD IDENTIFICATION

WARNING			
	Corrosive - Causes severe burns. Toxic - Harmful by inhalation. (Contains crystalline silica)	 Respiratory Protection	 Eye Protection
	Use proper engineering controls, work practices, and personal protective equipment to prevent exposure to wet or dry product. Read MSDS for details.	 Waterproof Gloves	 Waterproof Boots

Section 3: HAZARD IDENTIFICATION (continued)

Emergency Overview: Cement is a solid, grey, odorless powder. It is not combustible or explosive. A single, short-term exposure to the dry powder presents little or no hazard. Exposure of sufficient duration to wet cement, or to dry cement on moist areas of the body, can cause serious, potentially irreversible tissue (skin, eye, respiratory tract) damage due to chemical (caustic) burns, including third degree burns.

Potential Health Effects:

Eye Contact: Airborne dust may cause immediate or delayed irritation or inflammation. Eye contact with large amounts of dry powder or with wet cement can cause moderate eye irritation, chemical burns and blindness. Eye exposures require immediate first aid and medical attention to prevent significant damage to the eye.

Skin Contact: Cement may cause dry skin, discomfort, irritation, severe burns, and dermatitis.

Burns: Exposure of sufficient duration to wet cement, or to dry cement on moist areas of the body, can cause serious, potentially irreversible damage to skin, eye, respiratory and digestive tracts due to chemical (caustic) burns, including third degree burns. A skin exposure may be hazardous even if there is no pain or discomfort.

Dermatitis: Cement is capable of causing dermatitis by irritation and allergy. Skin affected by dermatitis may include symptoms such as, redness, itching, rash, scaling, and cracking.

Irritant dermatitis is caused by the physical properties of cement including alkalinity and abrasion.

Allergic contact dermatitis is caused by sensitization to hexavalent chromium (chromate) present in cement. The reaction can range from a mild rash to severe skin ulcers. Persons already sensitized may react to the first contact with cement. Others may develop allergic dermatitis after years of repeated contact with cement.

Inhalation (acute): Breathing dust may cause nose, throat or lung irritation, including choking, depending on the degree of exposure. Inhalation of high levels of dust can cause chemical burns to the nose, throat and lungs.

Inhalation (chronic): Risk of injury depends on duration and level of exposure.

Silicosis: This product contains crystalline silica. Prolonged or repeated inhalation of respirable crystalline silica from this product can cause silicosis, a seriously disabling and fatal lung disease. See Note to Physicians in Section 4 for further information.

Carcinogenicity: Cement is not listed as a carcinogen by IARC or NTP; however, cement contains trace amounts of crystalline silica and hexavalent chromium which are classified by IARC and NTP as known human carcinogens.

Autoimmune Disease: Some studies show that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis may be associated with the increased incidence of several autoimmune disorders such as scleroderma (thickening of the skin), systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys.

Tuberculosis: Silicosis increases the risk of tuberculosis.

Renal Disease: Some studies show an increased incidence of chronic kidney disease and end-stage renal disease in workers exposed to respirable crystalline silica.

Section 3: HAZARD IDENTIFICATION (continued)

Ingestion: Do not ingest cement. Although ingestion of small quantities of cement is not known to be harmful, large quantities can cause chemical burns in the mouth, throat, stomach, and digestive tract.

Medical Conditions Aggravated by Exposure: Individuals with lung disease (e.g. bronchitis, emphysema, COPD, pulmonary disease) or sensitivity to hexavalent chromium can be aggravated by exposure.

Section 4: FIRST AID MEASURES

Eye Contact: Rinse eyes thoroughly with water for at least 15 minutes, including under lids, to remove all particles. Seek medical attention for abrasions and burns.

Skin Contact: Wash with cool water and a pH neutral soap or a mild skin detergent. Seek medical attention for rash, burns, irritation, dermatitis, and prolonged unprotected exposures to wet cement, cement mixtures or liquids from wet cement.

Inhalation: Move person to fresh air. Seek medical attention for discomfort or if coughing or other symptoms do not subside.

Ingestion: Do not induce vomiting. If conscious, have person drink plenty of water. Seek medical attention or contact poison control center immediately.

Note to Physician: The three types of silicosis include:

- Simple chronic silicosis – which results from long-term exposure (more than 20 years) to low amounts of respirable crystalline silica. Nodules of chronic inflammation and scarring provoked by the respirable crystalline silica form in the lungs and chest lymph nodes. This disease may feature breathlessness and may resemble chronic obstructive pulmonary disease (COPD).
- Accelerated silicosis – occurs after exposure to larger amounts of respirable crystalline silica over a shorter period of time (5-15 years). Inflammation, scarring, and symptoms progress faster in accelerated silicosis than in simple silicosis.
- Acute silicosis – results from short-term exposure to very large amounts of respirable crystalline silica. The lungs become very inflamed and may fill with fluid, causing severe shortness of breath and low blood oxygen levels.

Progressive massive fibrosis may occur in simple or accelerated silicosis, but is more common in the accelerated form. Progressive massive fibrosis results from severe scarring and leads to the destruction of normal lung structures.

Section 5: FIREFIGHTING MEASURES

Flashpoint & Method: Non-combustible

General Hazard: Avoid breathing dust.
Wet cement is caustic.

Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Firefighting Equipment:

Cement poses no fire-related hazard. A SCBA is recommended to limit exposures to combustion products when fighting any fire.

Combustion Products:

None.

Section 6: ACCIDENTAL RELEASE MEASURES

General: Place spilled material into a container. Avoid actions that cause the cement to become airborne. Avoid inhalation of cement and contact with skin. Wear appropriate protective equipment as described in Section 8. Scrape wet cement and place in container. Allow material to dry or solidify before disposal. Do not wash cement down sewage and drainage systems or into bodies of water (e.g. streams).

Waste Disposal Method: Dispose of cement according to Federal, State, Provincial and Local regulations.

Section 7: HANDLING AND STORAGE

General: Keep bulk and bagged cement dry until used. When slag or slag containing materials are kept wet for long periods of time, the leachate may be discolored and have a sulfurous odor. When this liquid is exposed to oxygen, elemental sulfur may precipitate out leaving a solution of calcium thiosulfate.

Stack bagged material in a secure manner to prevent falling. Bagged cement is heavy and poses risks such as sprains and strains to the back, arms, shoulders and legs during lifting and mixing. Handle with care and use appropriate control measures.

Engulfment hazard. To prevent burial or suffocation, do not enter a confined space, such as a silo, bin, bulk truck, or other storage container or vessel that stores or contains cement. Cement can buildup or adhere to the walls of a confined space. The cement can release, collapse or fall unexpectedly.

Properly ground all pneumatic conveyance systems. The potential exists for static build-up and static discharge when moving cement powders through a plastic, non-conductive, or non-grounded pneumatic conveyance system. The static discharge may result in damage to equipment and injury to workers.

Usage: Cutting, crushing or grinding hardened cement, concrete or other crystalline silica-bearing materials will release respirable crystalline silica. Use all appropriate measures of dust control or suppression, and Personal Protective Equipment (PPE) described in Section 8 below.

Housekeeping: Avoid actions that cause the cement to become airborne during clean-up such as dry sweeping or using compressed air. Use HEPA vacuum or thoroughly wet with water to clean-up dust. Use PPE described in Section 8 below.

Storage Temperature: Unlimited. **Storage Pressure:** Unlimited.

Clothing: Promptly remove and launder clothing that is dusty or wet with cement. Thoroughly wash skin after exposure to dust or wet cement.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls: Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits.

Personal Protective Equipment (PPE):

Respiratory Protection: Under ordinary conditions no respiratory protection is required. Wear a NIOSH approved respirator that is properly fitted and is in good condition when exposed to dust above exposure limits.

Eye Protection: Wear ANSI approved glasses or safety goggles when handling dust or wet cement to prevent contact with eyes. Wearing contact lenses when using cement, under dusty conditions, is not recommended.

Section 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION (continued)

Skin Protection: Wear gloves, boot covers and protective clothing impervious to water to prevent skin contact. Do not rely on barrier creams, in place of impervious gloves. Remove clothing and protective equipment that becomes saturated with wet cement and immediately wash exposed areas.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid (powder).	Evaporation Rate:	NA.
Appearance:	Gray or white powder.	pH (in water):	12 – 13
Odor:	None.	Boiling Point:	>1000° C
Vapor Pressure:	NA.	Freezing Point:	None, solid.
Vapor Density:	NA.	Viscosity:	None, solid.
Specific Gravity:	3-3.2	Solubility in Water:	Slightly (0.1 - 1.0%)

Section 10: STABILITY AND REACTIVITY

Stability: Stable. Keep dry until use. Avoid contact with incompatible materials.

Incompatibility: Wet cement is alkaline and is incompatible with acids, ammonium salts and aluminum metal. Cement dissolves in hydrofluoric acid, producing corrosive silicon tetrafluoride gas. Cement reacts with water to form silicates and calcium hydroxide. Silicates react with powerful oxidizers such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, and oxygen difluoride.

Hazardous Polymerization: None.

Hazardous Decomposition: None.

Section 11 and 12: TOXICOLOGICAL AND ECOLOGICAL INFORMATION

For questions regarding toxicological and ecological information refer to contact information in Section 1.

Section 13: DISPOSAL CONSIDERATIONS

Dispose of waste and containers in compliance with applicable Federal, State, Provincial and Local regulations.

Section 14: TRANSPORT INFORMATION

This product is not classified as a Hazardous Material under U.S. DOT or Canadian TDG regulations.

Section 15: REGULATORY INFORMATION


OSHA/MSHA Hazard Communication: This product is considered by OSHA/MSHA to be a hazardous chemical and should be included in the employer's hazard communication program.

CERCLA/SUPERFUND: This product is not listed as a CERCLA hazardous substance.

**EPCRA
SARA Title III:** This product has been reviewed according to the EPA Hazard Categories promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 and is considered a hazardous chemical and a delayed health hazard.

**EPRCA
SARA Section 313:** This product contains none of the substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Section 15: REGULATORY INFORMATION (continued)

RCRA:	If discarded in its purchased form, this product would not be a hazardous waste either by listing or characteristic. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal, whether a material containing the product or derived from the product should be classified as a hazardous waste.
TSCA:	Blended cement and crystalline silica are exempt from reporting under the inventory update rule.
California Proposition 65:	Crystalline silica (airborne particulates of respirable size) and Chromium (hexavalent compounds) are substances known by the State of California to cause cancer.
WHMIS/DSL: 	Products containing crystalline silica and calcium carbonate are classified as D2A, E and are subject to WHMIS requirements.

Section 16: OTHER INFORMATION

Abbreviations:

>	Greater than	NA	Not Applicable
ACGIH	American Conference of Governmental Industrial Hygienists	NFPA	National Fire Protection Association
CAS No	Chemical Abstract Service number	NIOSH	National Institute for Occupational Safety and Health
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	NTP	National Toxicology Program
		OSHA	Occupational Safety and Health Administration
CFR	Code for Federal Regulations	PEL	Permissible Exposure Limit
CL	Ceiling Limit	pH	Negative log of hydrogen ion
DOT	U.S. Department of Transportation	PPE	Personal Protective Equipment
EST	Eastern Standard Time	R	Respirable Particulate
HEPA	High-Efficiency Particulate Air	RCRA	Resource Conservation and Recovery Act
HMIS	Hazardous Materials Identification System	SARA	Superfund Amendments and Reauthorization Act
IARC	International Agency for Research on Cancer	T	Total Particulate
		TDG	Transportation of Dangerous Goods
LC ₅₀	Lethal Concentration	TLV	Threshold Limit Value
LD ₅₀	Lethal Dose	TWA	Time Weighted Average (8 hour)
mg/m ³	Milligrams per cubic meter	WHMIS	Workplace Hazardous Materials Information System
MSHA	Mine Safety and Health Administration		

This MSDS (Sections 1-16) was revised on August 1, 2011.

An electronic version of this MSDS is available at: www.lafarge-na.com under the Sustainability section.

Lafarge North America Inc. (LNA) believes the information contained herein is accurate; however, LNA makes no guarantees with respect to such accuracy and assumes no liability in connection with the use of the information contained herein which is not intended to be and should not be construed as legal advice or as insuring compliance with any federal, state or local laws or regulations. Any party using this product should review all such laws, rules, or regulations prior to use, including but not limited to US and Canada Federal, Provincial and State regulations.

NO WARRANTY IS MADE, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE.

Description

MEYCO SA 160 admixture is a high performance alkali-free shotcrete accelerator for use in the wet-mix spraying process. It is a liquid additive whose dosage can be varied to the desired setting and hardening times.

Applications

Recommended for use in shotcrete mixtures for:

- Rock support
- Tunnels
- All wet shotcrete mixtures

MEYCO® SA 160

Shotcrete Accelerating Admixture

Later changed to
SA430

Features

- Overhead layer thickness of 6-12 in. (150-300 mm) in a single application (as with aluminate based accelerators)
- Good early strength development
- Limited decrease of final strength

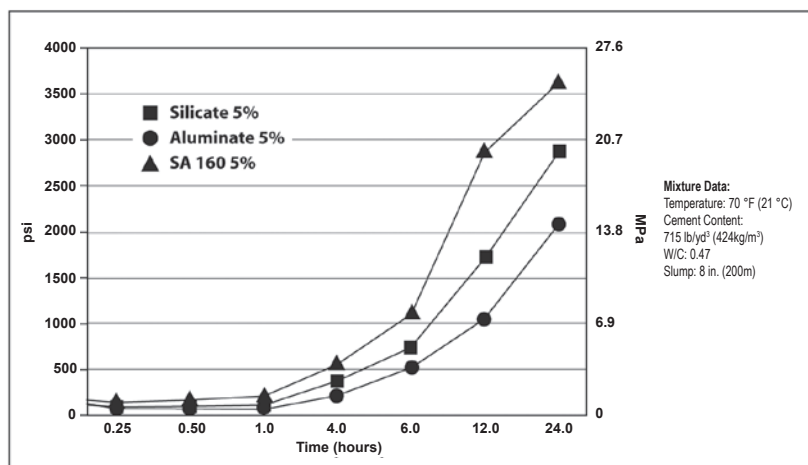
Benefits

- Easy handling, as well as easy and efficient addition to the sprayed concrete
- Little dust and therefore a better working environment
- Reduces required handling precautions, improving economics

Performance Characteristics

Form	Liquid
Color	Beige
Density	1.41 plus or minus 0.03
pH value	2.5-3
Viscosity (Haake Sp. 1)	450 MPa • s (cps) plus or minus 50
Thermal Stability	41-95 °F (5-35 °C)
Chloride Content	<0.1%

Compressive Strength



Product Data: MEYCO® SA 160

Guidelines for Use

Preparation of Substrate: The substrate must be clean and free from loose particles.

Dosage: The dosage of MEYCO SA 160 admixture depends on the temperature of concrete, air and substrate. Another important factor influencing the dosage is the reactivity of the cement. Depending on required setting time and early strength requirements, the consumption of MEYCO SA 160 admixture normally ranges between 4-8% of the binder weight. Overdosing (> 10%) may result in decreased final strength.

Application: MEYCO SA 160 admixture is added at the nozzle. MEYCO SA 160 admixture is a suspension and therefore not all types of dosing pumps will work properly. To secure a constant and adequate dosage is of crucial importance in order to achieve a good result. We recommend the following dosing pump types: Rotor-stator pumps, Peristaltic pumps (Bredel), and MEYCO Dosa. **It may be used with:** membrane pumps, MEYCO Mix and Gear pumps.

Do Not Use With: Piston pumps, all pumps with seat valve system, or pressure tanks.

Do not use a filter on the suction hose as this causes obstructions. Avoid suction directly off the bottom of the drum/container.

Cleaning of Dosing Pump: Prior to the use of MEYCO SA 160 admixture, the dosing pump and accelerator hose must be thoroughly cleaned with plenty of water. Failure to do this promotes blockages in the dosing system. Make sure all operators involved in testing and application are informed.

Product Notes

Compatibility: Do not mix MEYCO SA 160 admixture with other accelerators as this will cause immediate clogging of pumps and hoses.

Safety: Avoid eye and skin contact and wear rubber gloves and chemical goggles. If contact occurs, rinse with plenty of water. In case of eye contact seek medical advice immediately. Refer to the MSDS for MEYCO SA 160 admixture for further information.

Storage and Handling

Storage Temperature: MEYCO SA 160 admixture should be stored at a temperature range of 41-95 °F (5-35 °C). It is recommended that your local BASF Construction Chemicals representative be consulted prior to the use of any products that were frozen. Performance tests should always be carried out prior to use.

MEYCO SA 160 admixture must be kept in closed plastic drums/containers or closed tanks made of plastic/glass fiber. Do not store in steel containers as the pH can cause corrosion which might affect the performance of the product. Containers must be tightly closed every day to avoid contact with air which can cause a chemical reaction (skin building on top and lumps which cause problems with dosing pumps) **Stir MEYCO SA 160 admixture before use after prolonged storage. It can have a settlement not visually detectable.**

Shelf Life: MEYCO SA 160 admixture has a minimum shelf life of 3 months. Depending on storage conditions, the shelf life may be greater than stated. Please contact your BASF Construction Chemicals representative regarding suitability for use and dosage recommendations if the shelf life of MEYCO SA 160 admixture has been exceeded.

Packaging

MEYCO SA 160 admixture is supplied in 49 gal (185 L) drums, 269 gal (1018 L) totes and by bulk delivery.

Related Documents

Material Safety Data Sheets: MEYCO SA 160 admixture.

Additional Information

For additional information on MEYCO SA 160 admixture, contact your BASF Construction Chemicals representative.

The Admixture Systems business of BASF's Construction Chemicals division is a leading provider of innovative admixtures for specialty concrete used in the ready-mixed, precast, manufactured concrete products, underground construction and paving markets throughout the North American region. The Company's respected Master Builders brand products are used to improve the placing, pumping, finishing, appearance and performance characteristics of concrete.

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MEYCO

Safety Data Sheet

MEYCO SA 160

Revision date : 2012/04/18

Version: 3.1

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(30339517/SDS_GEN_US/EN)

1. Product and Company Identification

Company

BASF CORPORATION
100 Campus Drive
Florham Park, NJ 07932, USA

24 Hour Emergency Response Information

CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP

2. Hazards Identification

Emergency overview

WARNING:
MODERATELY TO SEVERELY IRRITATING TO THE EYE.
MAY CAUSE SKIN IRRITATION.
MAY CAUSE RESPIRATORY TRACT IRRITATION.
Ingestion may cause irritation to mucous membranes.
Avoid contact with the skin, eyes and clothing.
Wash thoroughly after handling.
Keep container tightly closed.

State of matter: liquid
Colour: white to beige
Odour: characteristic

Potential health effects**Primary routes of exposure:**

Routes of entry for solids and liquids include eye and skin contact, ingestion and inhalation. Routes of entry for gases include inhalation and eye contact. Skin contact may be a route of entry for liquified gases.

Acute toxicity:

Virtually nontoxic after a single ingestion.

Irritation / corrosion:

May cause severe damage to the eyes. The product has not been tested. The statement has been derived from the properties of the individual components.

Sensitization:

No sensitizing effect.

Chronic toxicity:

Genotoxicity: The chemical structure does not suggest such an effect.

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Signs and symptoms of overexposure:
Eye irritation

Potential environmental effects

Aquatic toxicity:
At the present state of knowledge, no negative ecological effects are expected.

Degradation / environmental fate:
Not applicable for inorganic substances.

Bioaccumulation / bioconcentration:
The product has not been tested. The statement has been derived from the properties of the individual components.

3. Composition / Information on Ingredients

<u>CAS Number</u>	<u>Content (W/W)</u>	<u>Chemical name</u>
10043-01-3	10.0 - 30.0 %	Aluminium sulphate
111-42-2	1.0 - 5.0 %	2,2'-iminodiethanol

4. First-Aid Measures

General advice:
First aid personnel should pay attention to their own safety. Remove contaminated clothing.

If inhaled:
If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

If on skin:
After contact with skin, wash immediately with plenty of water and soap. Under no circumstances should organic solvent be used. If irritation develops, seek medical attention.

If in eyes:
Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

If swallowed:
Rinse mouth immediately with water. Seek medical attention if necessary. Do not induce vomiting unless told to by a poison control center or doctor.

5. Fire-Fighting Measures

Flash point: Non-flammable.
Autoignition: not applicable

Suitable extinguishing media:
foam, water spray, dry powder, carbon dioxide

Unsuitable extinguishing media for safety reasons:
water jet

Hazards during fire-fighting:
carbon monoxide, carbon dioxide, harmful vapours, nitrogen oxides, fumes/smoke, carbon black

Protective equipment for fire-fighting:
Wear a self-contained breathing apparatus.

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Further information:

The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

6. Accidental release measures

Personal precautions:

Use personal protective clothing. Do not breathe vapour/aerosol/spray mists. Handle in accordance with good building materials hygiene and safety practice.

Environmental precautions:

Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Cleanup:

For small amounts: Pick up with inert absorbent material (e.g. sand, earth etc.). Dispose of contaminated material as prescribed.

For large amounts: Pump off product.

7. Handling and Storage

Handling

General advice:

Avoid aerosol formation. Avoid inhalation of mists/vapours. Avoid skin contact. No special measures necessary provided product is used correctly.

Protection against fire and explosion:

The product does not contribute to the spreading of flames, nor is it self combustible, not explosive.

Storage

General advice:

Containers should be stored tightly sealed in a dry place. Keep away from heat. Protect against moisture. Store protected against freezing. Keep only in the original container.

Storage incompatibility:

General advice: Segregate from metals. Segregate from bases. Segregate from oxidants. Segregate from foods and animal feeds.

Temperature tolerance

Protect from temperatures below: 0 °C

The packed product must be protected from temperatures below the indicated one.

Protect from temperatures below: 32 °F

The packed product must be protected from temperatures below the indicated one.

8. Exposure Controls and Personal Protection

Components with workplace control parameters

2,2'-iminodiethanol

ACGIH

TWA value 1 mg/m³ Inhalable fraction and vapor ;
Skin Designation Inhalable fraction and vapor ;
The substance can be absorbed through the skin.

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Personal protective equipment

Respiratory protection:

Wear the following respiratory protection if exposure limits may be exceeded: Wear a NIOSH-certified (or equivalent) organic vapour respirator.

Hand protection:

Wear chemical resistant protective gloves., Suitable materials may include, butyl rubber, fluoroelastomer (Viton)

Eye protection:

Wear face shield or tightly fitting safety goggles (chemical goggles) if splashing hazard exists.

Body protection:

depending upon conditions of use., Cover as much of the exposed skin as possible to prevent all skin contact., light protective clothing

General safety and hygiene measures:

Avoid contact with the skin, eyes and clothing. In order to prevent contamination while handling, closed working clothes and working gloves should be used. Handle in accordance with good building materials hygiene and safety practice. When using, do not eat, drink or smoke. Hands and/or face should be washed before breaks and at the end of the shift. At the end of the shift the skin should be cleaned and skin-care agents applied. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks).

9. Physical and Chemical Properties

Form:	suspension	
Odour:	characteristic	
Colour:	white to beige	
pH value:	2.0 - 3.0	(20 °C)
Density:	approx. 1.43 g/cm3	(20 °C)
Partitioning coefficient n-octanol/water (log Pow):		not applicable
Viscosity, dynamic:	approx. 500 - 1,000 mPa.s	(20 °C)
Solubility in water:		soluble
Miscibility with water:		(20 °C) miscible

10. Stability and Reactivity

Conditions to avoid:

Avoid extreme temperatures.

Substances to avoid:

base metal alloys, base metals, strong bases

Hazardous reactions:

The product is stable if stored and handled as prescribed/indicated.

Explosion hazard when product reacts with metals and forms hydrogen. Reacts with base metals, with evolution of hydrogen.

Decomposition products:

No hazardous decomposition products if stored and handled as prescribed/indicated.

Thermal decomposition:

No decomposition if stored and handled as prescribed/indicated.

11. Toxicological information

Acute toxicity

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Oral:

Type of value: LD50
Species: rat
Value: > 5,000 mg/kg

Irritation / corrosion

Information on: 2,2'-iminodiethanol
Assessment of irritating effects:
Skin contact causes irritation. May cause severe damage to the eyes.

Information on: Aluminium sulphate
Assessment of irritating effects:
Not irritating to the skin. Irritating to eyes.

Other Information:

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statements on toxicology have been derived from the properties of the individual components.

12. Ecological Information

Fish

Acute:
Fish/LC50 (96 h): > 100 mg/l

Other adverse effects:

According to experience, the material has no harmful effect on the environment. Do not discharge substance/product into sewer system. Do not release untreated into natural waters.

13. Disposal considerations

Waste disposal of substance:

Recommendations: Use excess product in an alternate beneficial application. Dispose of in accordance with local authority regulations. Do not discharge into drains/surface waters/groundwater.

Container disposal:

Contaminated packaging should be emptied as far as possible; then it can be passed on for recycling after being thoroughly cleaned.

14. Transport Information

Land transport
USDOT

Not classified as a dangerous good under transport regulations

Sea transport
IMDG

Not classified as a dangerous good under transport regulations

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Air transport

IATA/ICAO

Not classified as a dangerous good under transport regulations

Further information

DOT: This product is regulated if the amount in a single receptacle exceeds the Reportable Quantity (RQ). Please refer to Section 15 of this MSDS for the RQ for this product.

15. Regulatory Information

Federal Regulations

Registration status:

Chemical TSCA, US released / listed

EPCRA 313:

CAS Number

111-42-2

Chemical name

2,2'-iminodiethanol

State regulations

State RTK

MA, NJ, PA
MA, NJ, PA

CAS Number

10043-01-3
111-42-2

Chemical name

Aluminium sulphate
2,2'-iminodiethanol

CA Prop. 65:

THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

16. Other Information

HMIS III rating

Health: 2 Flammability: 0 Physical hazard: 0

NFPA and HMIS use a numbering scale ranging from 0 to 4 to indicate the degree of hazard. A value of zero means that the substance possesses essentially no hazard; a rating of four indicates extreme danger. Although similar, the two rating systems are intended for different purposes, and use different criteria. The NFPA system was developed to provide an on-the-spot alert to the hazards of a material, and their severity, to emergency responders. The HMIS system was designed to communicate workplace hazard information to employees who handle hazardous chemicals.

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MSDS Prepared by:

BASF NA Product Regulations

msds@basf.com

MSDS Prepared on: 2012/04/18

Safety Data Sheet

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(30339517/SDS_GEN_US/EN)

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END OF DATA SHEET

Description

Pozzolith 100 XR ready-to-use liquid admixture is used for producing more uniform and predictable quality concrete. Placing and finishing requirements are facilitated because this admixture retards setting time. Pozzolith 100 XR admixture meets ASTM C 494/ C 494M requirements for Type B, retarding, and Type D, water-reducing and retarding, admixtures.

Applications

Recommended for use in:

- Prestressed concrete
- Precast concrete
- Reinforced concrete
- Shotcrete
- Lightweight or normal weight concrete
- Pumped concrete
- 4x4™ Concrete
- Pervious Concrete
- Rheodynamic®Self-Consolidating Concrete
- All paving-related concrete requiring retarded set

POZZOLITH® 100 XR

Set Retarding Admixture

Features

- Reduced water content required for a given workability
- Retarded setting characteristics
- Controlled retardation – depending on the addition rate
- Dead-load deflection can take place (before concrete sets) in extended pours for bridge decks, cantilevers, nonshored structural elements, etc.

Benefits

- Improved workability
- Reduced segregation
- Superior finishing characteristics for flatwork and cast surfaces
- Flexibility in scheduling of placing and finishing operations
- Offsets effects of early stiffening during extended delays between mixing and placing
- Helps eliminate cold joints
- Peak temperature and/or rate of temperature rise in mass concrete lowered thereby reducing thermal cracking
- Increased compressive and flexural strength

Performance Characteristics

Rate of Hardening: The temperature of the concrete mixture and the ambient temperature (forms, earth, reinforcement, air, etc.) affect the hardening rate of concrete. At higher temperatures, concrete stiffens more rapidly which may cause problems with placing and finishing. Pozzolith 100 XR admixture retards the set of concrete. Within the normal dosage range, it will generally extend the setting time of concrete containing normal portland cement approximately 1-1/2 to 8 hours compared to that of a plain concrete mixture, depending on job materials and temperatures. Trial mixtures should be made with materials approximating job conditions to determine the dosage required.

Compressive Strength: Concrete produced with Pozzolith 100 XR admixture will have rapid strength development after initial set occurs. If retardation is within the normal ASTM C 494/C 494M Types B and D specifications, Pozzolith 100 XR admixture will develop higher early (24-hour) and ultimate strengths than plain concrete when used within the recommended dosage range and under normal, comparable curing conditions.

When Pozzolith 100 XR admixture is used in heat-cured concrete, the length of the preheating period should be increased until initial set of the concrete is achieved. The actual heat-curing period is then reduced accordingly to maintain existing production cycles without sacrificing early or ultimate strengths.

Product Data: POZZOLITH® 100 XR

Guidelines for Use

Dosage: Pozzolith 100 XR admixture is recommended for use at a dosage of 3 ± 1 fl oz/cwt (195 ± 65 mL/100 kg) of cementitious materials for most concrete mixtures using typical concrete ingredients. Because of variations in job conditions and concrete materials, dosage rates other than the recommended amounts may be required. In such cases, contact your local sales representative.

Pozzolith 100 XR admixture may be used at less than the recommended dosage for the purpose of retardation only.

Product Notes

Corrosivity – Non-Chloride, Non-Corrosive: Pozzolith 100 XR admixture will neither initiate nor promote corrosion of reinforcing steel in concrete. This admixture does not contain intentionally-added calcium chloride or other chloride-based ingredients.

Compatibility: Pozzolith 100 XR admixture may be used in combination with any BASF Construction Chemicals admixtures. When used in conjunction with other admixtures, each admixture must be dispensed separately into the mix.

Storage and Handling

Storage Temperature: If this product freezes, thaw at 35 °F (2 °C) or above and completely reconstitute by mild mechanical agitation. **Do not use pressurized air for agitation.**

Shelf Life: Pozzolith 100 XR admixture has a minimum shelf life of 18 months. Depending on storage conditions, the shelf life may be greater than stated. Please contact your local sales representative regarding suitability for use and dosage recommendations if the shelf life of Pozzolith 100 XR admixture has been exceeded.

Packaging

Pozzolith 100 XR admixture is supplied in 55 gal (208 L) drums, 275 gal (1040 L) totes and by bulk delivery.

Related Documents

Material Safety Data Sheets: Pozzolith 100 XR admixture.

Additional Information

For additional information on Pozzolith 100 XR admixture or its use in developing a concrete mix with special performance characteristics, contact your local sales representative.

The Admixture Systems business of BASF's Construction Chemicals division is a leading provider of innovative admixtures for specialty concrete used in the ready-mixed, precast, manufactured concrete products, underground construction and paving markets throughout the North American region. The Company's respected Master Builders brand products are used to improve the placing, pumping, finishing, appearance and performance characteristics of concrete.

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**Master
Builders**

Safety Data Sheet

POZZOLITH 100 XR

Revision date : 2012/01/24

Version: 1.1

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(30337845/SDS_GEN_US/EN)

1. Product and Company Identification

Company

BASF CORPORATION
100 Campus Drive
Florham Park, NJ 07932, USA

24 Hour Emergency Response Information

CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP

2. Hazards Identification

Emergency overview

CAUTION:

NO PARTICULAR HAZARDS KNOWN.

Keep container tightly closed.

Avoid ingestion.

Avoid contact with the skin, eyes and clothing.

Wash thoroughly after handling.

State of matter: liquid

Colour: dark brown

Odour: musty

Potential health effects**Primary routes of exposure:**

Routes of entry for solids and liquids include eye and skin contact, ingestion and inhalation. Routes of entry for gases include inhalation and eye contact. Skin contact may be a route of entry for liquified gases.

Acute toxicity:

Ingestion may cause gastrointestinal disturbances. The product has not been tested. The statement has been derived from the properties of the individual components.

Irritation / corrosion:

May cause slight irritation to the eyes. May cause slight irritation to the skin. May cause slight irritation to the respiratory tract. The product has not been tested. The statement has been derived from products of a similar structure or composition.

Sensitization:

No sensitizing effect.

Chronic toxicity:

Carcinogenicity: The chemical structure does not suggest a specific alert for such an effect.

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Repeated dose toxicity: No reliable data was available concerning repeated dose toxicity.

Reproductive toxicity: The chemical structure does not suggest such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Teratogenicity: The chemical structure does not suggest such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Genotoxicity: The chemical structure does not suggest a specific alert for such an effect. The product has not been tested. The statement has been derived from the properties of the individual components.

Potential environmental effects

Aquatic toxicity:

At the present state of knowledge, no negative ecological effects are expected. There is a high probability that the product is not acutely harmful to aquatic organisms. The product has not been tested. The statement has been derived from products of a similar structure or composition.

Bioaccumulation / bioconcentration:

Discharge into the environment must be avoided.

3. Composition / Information on Ingredients

This product is not regarded as hazardous under current OSHA Hazard Communication standard; CFR 29 Part 1910.1200.

4. First-Aid Measures

General advice:

First aid personnel should pay attention to their own safety. Remove contaminated clothing.

If inhaled:

If difficulties occur after vapour/aerosol has been inhaled, remove to fresh air and seek medical attention.

If on skin:

After contact with skin, wash immediately with plenty of water and soap. If irritation develops, seek medical attention.

If in eyes:

Wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.

If swallowed:

Rinse mouth immediately and then drink plenty of water, seek medical attention. Do not induce vomiting unless told to by a poison control center or doctor.

Note to physician

Treatment:

Treat according to symptoms (decontamination, vital functions), no known specific antidote.

5. Fire-Fighting Measures

Flash point:

A flash point determination is unnecessary due to the high water content.

Autoignition:

not applicable

Flammability:

does not ignite

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Suitable extinguishing media:

foam, water spray, dry powder, carbon dioxide

Unsuitable extinguishing media for safety reasons:

water jet

Hazards during fire-fighting:

carbon monoxide, carbon dioxide, harmful vapours, nitrogen oxides, fumes/smoke, carbon black

Protective equipment for fire-fighting:

Firefighters should be equipped with self-contained breathing apparatus and turn-out gear.

6. Accidental release measures

Personal precautions:

Use personal protective clothing. Do not breathe vapour/aerosol/spray mists. Sources of ignition should be kept well clear. Handle in accordance with good building materials hygiene and safety practice.

Environmental precautions:

Contain contaminated water/firefighting water. Do not discharge into drains/surface waters/groundwater.

Cleanup:

For small amounts: Pick up with inert absorbent material (e.g. sand, earth etc.). Dispose of contaminated material as prescribed.

For large amounts: Pump off product.

7. Handling and Storage

Handling

General advice:

Avoid aerosol formation. Avoid inhalation of mists/vapours. Avoid skin contact. No special measures necessary provided product is used correctly.

Protection against fire and explosion:

No special precautions necessary.

Storage

General advice:

Keep only in the original container in a cool, dry, well-ventilated place away from ignition sources, heat or flame. Store protected against freezing. Protect from direct sunlight.

Temperature tolerance

Protect from temperatures below: 0 °C

The packed product must be protected from temperatures below the indicated one.

Protect from temperatures below: 32 °F

The packed product must be protected from temperatures below the indicated one.

8. Exposure Controls and Personal Protection

Personal protective equipment

Respiratory protection:

Wear respiratory protection if ventilation is inadequate. Wear a NIOSH-certified (or equivalent) respirator as necessary.

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Hand protection:

Chemical resistant protective gloves

Eye protection:

Safety glasses with side-shields.

Body protection:

Body protection must be chosen based on level of activity and exposure.

General safety and hygiene measures:

In order to prevent contamination while handling, closed working clothes and working gloves should be used. Handle in accordance with good building materials hygiene and safety practice. When using, do not eat, drink or smoke. Hands and/or face should be washed before breaks and at the end of the shift. At the end of the shift the skin should be cleaned and skin-care agents applied. Gloves must be inspected regularly and prior to each use. Replace if necessary (e.g. pinhole leaks).

9. Physical and Chemical Properties

Form:	liquid		
Odour:	musty		
Colour:	dark brown		
pH value:	approx. 8.0	(20 °C)	
Melting temperature:	approx. -5 °C		
Boiling point:	approx. 100 °C		
<i>Information on: Water</i>			
Vapour pressure:	23.4 hPa	(20 °C)	Literature data.

Density:	approx. 1.255	(20 °C)	
	g/cm ³		
Relative density:	1.22		
Vapour density:			Heavier than air.
Viscosity, dynamic:			No data available.
Solubility in water:		(20 °C)	miscible
Miscibility with water:		(20 °C)	miscible
Other Information:	If necessary, information on other physical and chemical parameters is indicated in this section.		

10. Stability and Reactivity

Conditions to avoid:

See MSDS section 7 - Handling and storage.

Substances to avoid:

strong acids, strong bases, strong oxidizing agents

Hazardous reactions:

The product is stable if stored and handled as prescribed/indicated.

Decomposition products:

No hazardous decomposition products if stored and handled as prescribed/indicated.

Thermal decomposition:

No decomposition if stored and handled as prescribed/indicated.

11. Toxicological information

Other Information:

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(30337845/SDS_GEN_US/EN)

Based on our experience and the information available, no adverse health effects are expected if handled as recommended with suitable precautions for designated uses. The product has not been tested. The statements on toxicology have been derived from products of a similar structure and composition.

12. Ecological Information

Degradability / Persistence Biological / Abiological Degradation

Evaluation: Inherently biodegradable.
The insoluble fraction can be removed by mechanical means in suitable waste water treatment plants.

Other adverse effects:

Ecological data are not available. Do not allow to enter soil, waterways or waste water channels.

13. Disposal considerations

Waste disposal of substance:

Do not discharge into drains/surface waters/groundwater. Dispose of in a licensed facility.

Container disposal:

Contaminated packaging should be emptied as far as possible; then it can be passed on for recycling after being thoroughly cleaned.

14. Transport Information

Land transport

USDOT

Not classified as a dangerous good under transport regulations

Sea transport

IMDG

Not classified as a dangerous good under transport regulations

Air transport

IATA/ICAO

Not classified as a dangerous good under transport regulations

15. Regulatory Information

Federal Regulations

Registration status:

Chemical TSCA, US released / listed

OSHA hazard category: No data available.;

Safety Data Sheet

POZZOLITH 100 XR

Revision date : 2012/01/24

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(30337845/SDS_GEN_US/EN)

EPCRA 311/312 (Hazard categories):

Not hazardous;

16. Other Information

Suitable for use in industrial sector: cement industry;

HMIS III rating

Health: 1 Flammability: 0 Physical hazard: 0

NFPA and HMIS use a numbering scale ranging from 0 to 4 to indicate the degree of hazard. A value of zero means that the substance possesses essentially no hazard; a rating of four indicates extreme danger. Although similar, the two rating systems are intended for different purposes, and use different criteria. The NFPA system was developed to provide an on-the-spot alert to the hazards of a material, and their severity, to emergency responders. The HMIS system was designed to communicate workplace hazard information to employees who handle hazardous chemicals.

We support worldwide Responsible Care® initiatives. We value the health and safety of our employees, customers, suppliers and neighbors, and the protection of the environment. Our commitment to Responsible Care is integral to conducting our business and operating our facilities in a safe and environmentally responsible fashion, supporting our customers and suppliers in ensuring the safe and environmentally sound handling of our products, and minimizing the impact of our operations on society and the environment during production, storage, transport, use and disposal of our products.

MSDS Prepared by:

BASF NA Product Regulations

msds@basf.com

MSDS Prepared on: 2012/01/24

IMPORTANT: WHILE THE DESCRIPTIONS, DESIGNS, DATA AND INFORMATION CONTAINED HEREIN ARE PRESENTED IN GOOD FAITH AND BELIEVED TO BE ACCURATE, IT IS PROVIDED FOR YOUR GUIDANCE ONLY. BECAUSE MANY FACTORS MAY AFFECT PROCESSING OR APPLICATION/USE, WE RECOMMEND THAT YOU MAKE TESTS TO DETERMINE THE SUITABILITY OF A PRODUCT FOR YOUR PARTICULAR PURPOSE PRIOR TO USE. NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, DATA OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY OUR COMPANY HEREUNDER ARE GIVEN GRATIS AND WE ASSUME NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.

END OF DATA SHEET

1. Identification

Product identifier CLB F5 - US

Other means of identification

Product code NC01349

Recommended use See Technical Data Sheet.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Company name CONDAT CORPORATION
Address 250 South Industrial
 Saline, MI 48176 US
Telephone Tel: +1 734-944-4994
Website www.condatcorp.com
E-mail arp-us@condatcorp.com
Contact person Products Regulatory Affairs Dpt.
Emergency phone number Emergency Tel. (24h): +1 734-944-4994

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Skin corrosion/irritation Category 2
 Serious eye damage/eye irritation Category 1

OSHA defined hazards Not classified.

Label elements



Signal word Danger

Hazard statement Causes skin irritation. Causes serious eye damage.

Prevention Wear protective gloves/protective clothing/eye protection/face protection.

Response If on skin: Wash with plenty of water/. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Take off contaminated clothing and wash before reuse.

Storage Store away from incompatible materials.

Disposal Not applicable.

Hazard(s) not otherwise classified (HNOC) Not classified.

Supplemental information

Not applicable.

3. Composition/information on ingredients

Mixtures

Hazardous components			
Chemical name	Common name and synonyms	CAS number	%
2,4-Pentanediol, 2-methyl-		107-41-5	10 - 20
Alcool C12-C14 éthoxylés sulfatés, sel de sodium		68891-38-3	10 - 20
Mono-C10-16-alkyl, sodium sulfate		68585-47-7	10 - 20
Alcohols, C10-18		85711-71-3	1 - 2.5

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

Material name: CLB F5 - US

18345 Version #: 1.0 Revision date: 03-17-2016 Issue date: 03-17-2016

SDS US

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4. First-aid measures

Inhalation	Remove to fresh air. Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Take off contaminated clothing and wash before reuse. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.
Ingestion	Rinse mouth. If swallowed, do NOT induce vomiting. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Skin irritation.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	According to GHS criteria, Not classified as Flammable liquids.
Specific hazards arising from the chemical	See also section 10.
Special protective equipment and precautions for firefighters	None (non-combustible). Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire-fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes.
Specific methods	In the event of fire and/or explosion do not breathe fumes.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the MSDS.
Methods and materials for containment and cleaning up	<p>This product is miscible in water.</p> <p>Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Use water spray to reduce vapors or divert vapor cloud drift. Prevent entry into waterways, sewer, basements or confined areas. Following product recovery, flush area with water.</p> <p>Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.</p> <p>Never return spills in original containers for re-use. For waste disposal, see section 13 of the MSDS.</p>
Environmental precautions	Avoid release to the environment. Contact local authorities in case of spillage to drain/aquatic environment. Local authorities should be advised if significant spillages cannot be contained. Prevent further leakage or spillage if safe to do so. Do not contaminate water. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Do not get this material in contact with eyes. Avoid contact with skin. Avoid prolonged exposure. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Wash hands thoroughly after handling. Avoid release to the environment. Do not empty into drains. Wash hands after handling. Handle in accordance with good industrial hygiene and safety practice. Adequate ventilation should be provided so that exposure limits are not exceeded.
Conditions for safe storage, including any incompatibilities	Storage temperature: between 5°C and 50°C. Store in a cool, dry place out of direct sunlight. Store in closed original container in a dry place. Store away from incompatible materials (see Section 10 of the MSDS). Keep from freezing.

8. Exposure controls/personal protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
2,4-Pentandiol, 2-methyl- (CAS 107-41-5)	Ceiling	25 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
2,4-Pentandiol, 2-methyl- (CAS 107-41-5)	Ceiling	125 mg/m3
		25 ppm

Biological limit values

No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls

Ensure adequate ventilation, especially in confined areas. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection

Wear safety glasses with side shields (or goggles) and a face shield.

Hand protection

Use protective gloves made of: Nitrile. Polyvinyl chloride (PVC).

Other

Wear appropriate chemical resistant clothing.

Respiratory protection

In case of insufficient ventilation, wear suitable respiratory equipment. In case of inadequate ventilation, use respiratory protection.

Thermal hazards

Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations

Keep away from food and drink. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

See below.

Physical state

Liquid.

Form

Liquid.

Color

Colorless. - Yellow

Odor

Slight.
Alcoholic.

Odor threshold

Not available.

pH

8 - 9

Kinematic viscosity

Not available.

Viscosity

Not available.

Viscosity temperature

Not available.

Melting point/freezing point

32 °F (0 °C)

Initial boiling point and boiling range

212 °F (100 °C)

Flash point

Not applicable.

Evaporation rate

Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)

Not applicable.

Flammability limit - upper (%)

Not applicable.

Explosive limit - lower (%)

Not available.

Explosive limit - upper (%)

Not available.

Vapor pressure

Not available.

Vapor density

Not available.

Relative density

1.04

Relative density temperature	68 °F (20 °C)
Solubility(ies)	Soluble
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Other information	
pH in aqueous solution	7 - 8 @5%

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Contact with incompatible materials. Avoid frost.
Incompatible materials	Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Sulphur compounds.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Expected to be a low ingestion hazard.
Inhalation	When workers are facing concentrations above the exposure limit, Prolonged inhalation may be harmful.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye damage.

Symptoms related to the physical, chemical and toxicological characteristics Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity Not classified.

Product	Species	Test Results
---------	---------	--------------

CLB F5 - US (CAS Mixture)

Acute

Oral

LD50

Rat

> 2500 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye damage.

Respiratory sensitization Not classified.

Skin sensitization Not classified.

Germ cell mutagenicity Not classified.

Carcinogenicity Not classified.

Reproductive toxicity Not classified.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not classified.

Chronic effects When workers are facing concentrations above the exposure limit, Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity

Product		Species	Test Results
CLB F5 - US (CAS Mixture)			
<i>Acute</i>			
Algae	IC50	Algae	22.5 mg/l, 72 Hours
Crustacea	EC50	Daphnia	35.8 mg/l, 48 Hours
Fish	LC50	Fish	10 - 22.5 mg/l, 96 Hours
<i>Chronic</i>			
Algae	NOEC	Algae	6.25 mg/l, 72 Hours, Growth rate
Crustacea	NOEC	Daphnia	12.5 mg/l, 48 Hours
Fish	NOEC	Fish	10 mg/l, 96 Hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability	The product is easily biodegradable.
Bioaccumulative potential	No data available.
Mobility in soil	No data available.
Mobility in general	This product is miscible in water.
Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Do not discharge into drains, water courses or onto the ground. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging	Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as a hazardous material by DOT.

IATA

Not regulated as a dangerous good.

IMDG

Not regulated as a dangerous good.

15. Regulatory information

US federal regulations	All the components of this product comply with the U.S. EPA TSCA inventory requirements.
TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)	Not regulated.
CERCLA Hazardous Substance List (40 CFR 302.4)	Not listed.
US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)	Not listed.
SARA 304 Emergency release notification	Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
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SARA 302 Extremely hazardous substance	No
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SARA 311/312 Hazardous chemical	No
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Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.
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Food and Drug Administration (FDA)	Not regulated.
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US state regulations

US. Massachusetts RTK - Substance List

2,4-Pentanediol, 2-methyl- (CAS 107-41-5)

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

2,4-Pentanediol, 2-methyl- (CAS 107-41-5)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins above 0,1%.

16. Other information, including date of preparation or last revision

Issue date	03-17-2016
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Revision date	03-17-2016
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Version #	1.0
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Further information	Not available.
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HMIS® ratings	Health: 3 Flammability: 0 Physical hazard: 0
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Disclaimer	This document complements the technical sheets but does not replace them. The information contained herein is based on our knowledge of the concerned product on the date indicated. It is offered in good faith. Furthermore, the regulatory requirements referred to must not be considered as exhaustive. They do not exempt in any form the user from knowing and applying all regulations related to the possession and use of the product. The user takes as their sole responsibility the implementation of precautions relating to storage and their use of the product. The information in the sheet was written based on the best knowledge and experience currently available.
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APPENDIX G

Westridge Marine Terminal Construction Water Quality Monitoring Plan

	<p>Trans Mountain Expansion Project</p> <p>Westridge Marine Terminal Construction Water Quality Monitoring Plan Phase 3</p>	<p>Page: 1 of 12</p>
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Trans Mountain Expansion Project

Westridge Marine Terminal Construction Water Quality Monitoring Plan Phase 3

TMC Document # 01-13283-TW-WT00-RG-PLN-0

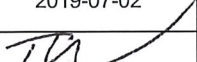

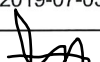

Rev No.	Prepared by/ Date	Reviewed by/ Date	Approved by/ Date	Reviewed by TMEP	Pages Revised	Issued Type
0	Tim Wilde 2019-07-02	Aman Oberoi 2119-07-03	Andrew Allan 2019-07-03	Bronwyn Pountney 2019-07-04		Issued for Information
						



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1. INTRODUCTION

The Westridge Marine Terminal (WMT) is the western coastal loading and shipping facility for the Trans Mountain Pipeline. It is an existing facility that has been in operation for over 50 years, providing distribution of refined and crude oil products.

As part of the Trans Mountain Expansion Project (TMEP), the TMEP proponent, Trans Mountain Corp. (TMP) plans to expand the Westridge Marine Terminal to include a new dock complex, access road, substation and transmission line, product lines, as well as a utility dock, decommissioning of the existing berth and the construction of a tunnel to convey two new 30 inch delivery lines from the Burnaby Terminal under the Burnaby Mountain.

On behalf of TMP, Kiewit-Ledcor Transmountain Partnership (KLTP) has prepared this Construction Water Quality Monitoring Plan (CWQMP) for the construction activities at the WMT. The Plan covers monitoring the effectiveness of Erosion and Sediment Control (ESC) measures and the associated treatment systems.

Water discharged from the construction site into ditches or stormwater drainage systems will be monitored to confirm that levels of turbidity, total suspended solids (TSS), pH, Total Extractable Hydrocarbon (TEH), Poly Aromatic Hydrocarbons (PAH), metals (total and dissolved), residual chitosan, meet environmental performance indicators during construction (*Daphnia magna* 48hr LC50 also required). Water that does not meet performance indicators will be contained and treated prior to discharge or collected, transported and disposed offsite at an approved facility. Water quality monitoring frequency, parameters and treatment requirements will follow the permitted and approved plans and environmental regulatory authorizations and orders.

2. SITE DESCRIPTION

Figure 1 provides an overview of the drainage and water quality sampling locations at the WMT that will be maintained through Phases 3.1 to 3.3 of construction. At the WMT site, a ditch running parallel to the south side of the CP Rail line (and parallel to the existing shoreline), collects surface stormwater run-off from a number of drainages within and outside of the WMT site boundary. Note that due to scheduling and permitting constraints, at the commencement of Phase 3 construction activities there will also be a continuation of Phase 2.2 activities that have yet to be completed.

Figure 2 provides an overview of the drainage and water quality sampling locations that will be maintained through Phases 3.4 to 3.6 of construction.

No outlet culvert exists for the CP Rail ditch east of the foreshore access road. Any water that is collected in this portion of the ditch flows subsurface into the rail ballast. A standpipe (approximately 30 cm high) is located in the middle of the ditch. Should water accumulate in the ditch at a depth greater than 30 cm, the standpipe would over top releasing the ditch water into the existing outfall north of the standpipe. Field observations of the east CP Rail ditch during heavy rainfall events have indicated that surface water in this ditch flows subsurface into the rail ballast. Water that collects in the ditch west of the foreshore access road flows west to a culvert under the CP Rail line. The lower terminal road runoff makes its way overland across the foreshore access road to the west end of the CP Rail ditch.

An existing culvert conveys a small non-classified drainage south to north under the Terminal property to Burrard Inlet. A catch basin mid-way within the terminal directs the upper terminal road runoff into this

culvert. Treated surface water collected within the WMT dyked tank farm's secondary containment facilities is isolated from the CP Rail ditch and discharged to Burrard Inlet through separate permitted outfalls. By the end of Phase 3, this permitted outfall will be redirected and joined to the east outfall.

WESTRIDGE MARINE TERMINAL
CONSTRUCTION WATER QUALITY MONITORING PLAN – PHASE 3

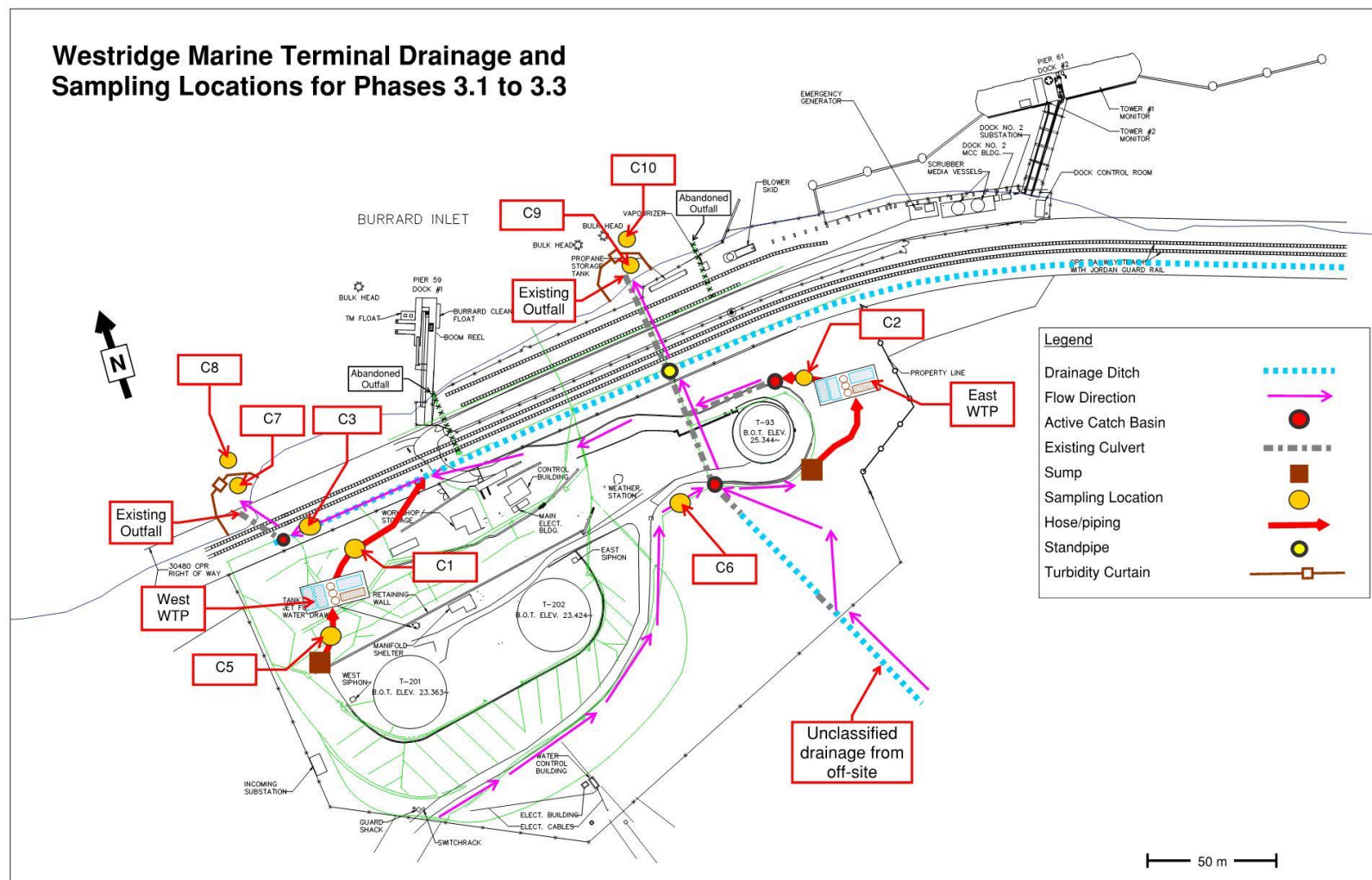


Figure 1 Westridge Marine Terminal Drainage and Sampling Locations for Phases 2.2 and 3.1 to 3.3

**WESTRIDGE MARINE TERMINAL
CONSTRUCTION WATER QUALITY MONITORING PLAN – PHASE 3**

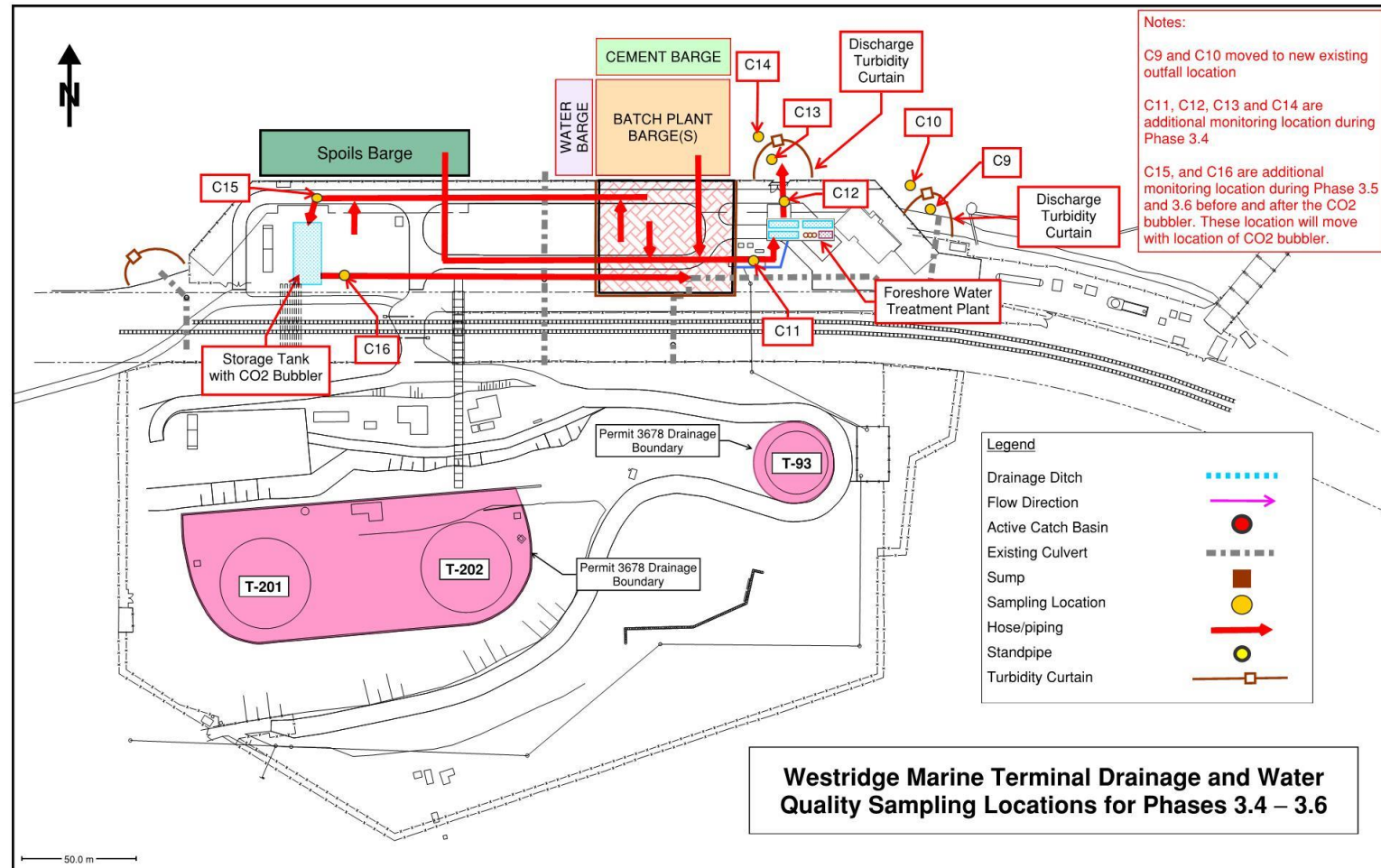


Figure 2 Westridge Marine Terminal Drainage and Water Quality Sampling Locations for Phases 3.4 – 3.6

3. WATER MANAGEMENT AND MONITORING STRATEGY

Trans Mountain Pipeline ULC received Approval 109085 from the BC Ministry of Environment and Climate Change Strategy (MoECCS) under the *Environmental Management Act* to permit stormwater discharges from the WMT site for Phase 2 construction outside the existing dyked tank farm. This Approval is associated with Permit 3678, and an amendment to Permit 3678 will merge the new areas of stormwater discharge for Phase 3 construction with the existing total area covered by the Permit.

Stormwater will be monitored to confirm that targeted water quality parameters are compliant with the limits set in the amended Permit. While sampling locations, parameters, frequency and methodologies discussed below are in the context of the existing Approval's requirements, ultimately the Phase 3 water quality monitoring program will be governed by requirements stipulated in the amended Permit.

Effects of construction activities on water quality will be monitored at individual sites by comparing the water quality of construction contact water to the limits of the amended Permit. The existing Approval and associated water quality limits are provided in Appendix A of this report. Construction contacted water quality will be monitored for compliance with the amended Permit at the outlets of the water treatment plants (WTPs) and C02 bubbler tanks where utilized. The locations of these compliance sampling locations are indicated in Figure 1 as C1 (west WTP outlet) and C2 (east WTP outlet) and in Figure 2 as C12 (foreshore WTP outlet).

Water leaving the tunnel will be monitored at sampling location C6 upstream of the east WTP then C2 downstream of the east WTP to confirm both the appropriateness and effectiveness of the WTP. If, during this process, some previously unexpected contaminant is discovered for which the WTP is not effective, the Tunnel Boring Machine can be idled and sealed, the WTP stopped, and upgrades made to treatment systems to handle the previously unanticipated contaminant to assure regulatory compliance. Once upgraded to treat for the new contaminant, tunneling can resume.

Water draining from the construction site will be controlled through erosion and sediment control measures into ditches, stormwater drainage systems and WTPs for treatment. Water will be contained and redirected through the WTPs and monitored to confirm compliant water quality prior to discharge to the existing drainage infrastructure or CP Rail ditch. Small turbidity curtains at the outlets of the outfalls will remain throughout construction. KLTP will also use the results of the monitoring plan for continuous improvement of the ESC measures and on-site water management practices.

pH will be monitored per the amended Permit, and if values show an increasing trend of greater than 8.0 at the WTP or measurements exceed 8.7, then a plan will be developed to treat and cause effluent to reduce or maintain pH to 8.7 or below. PAH testing will occur at the outlets of the east, west and foreshore WTPs once in the first two months of their respective operation.

Chitosan residual testing will be conducted at C1, C2 and C12 at the frequency provided in the amended Permit. When in operation, a grab sample will be taken from the outlet of each WTP. Chitosan testing will be completed by use of a field-testing kit (indicates presence/absence to a detection limit meeting the permit limit). Should the chitosan residual test show concentrations greater than the detection limit, the discharge will be re-sampled within 24 hours and subject to a test for toxicity with a 96-hr LC50, 100% concentration rainbow trout pass-fail test. In the event of a toxicity test failure, resampling and analysis will occur immediately until two consecutive tests have passed.

Also, a *Daphnia magna* 48 hour LC50 at 100% concentration pass fail test will also be conducted at C1, C2 and C12 at the frequency provided in the amended Permit. Similar to the Chitosan rainbow trout toxicity test, in the event of failure the effluent will be immediately resampled and analyzed until two consecutive tests have passed.

The existing Approval also requires that samples be taken for total extractable hydrocarbon (TEH). TEH will be sampled at C1, C2 and C12 weekly or daily dependent on rainfall as required in the amended Permit. Any additional TEH monitoring would be done opportunistically. Spill response clean-up efforts will be used for all hydrocarbon contaminated stormwater. Should these efforts not be entirely effective, the hydrocarbon contaminated water will be shipped off site to a third party facility approved to accept hydrocarbon contaminated water that exceeds amended Permit limits.

4. SAMPLING LOCATIONS AND FREQUENCY

Figures 1 and 2 show the proposed site-specific water quality sampling locations as well as the locations of the WTPs that will be used during Phase 3 construction. KLTP will perform water quality monitoring for effluent and the receiving environment. TMEP will continue to be responsible for water quality monitoring at the permitted outfalls. Daily visual monitoring for correct installation on the turbidity curtains will be carried out when the WTPs are discharging.

As summarized in Table 1, fifteen water quality sampling locations have been identified for WMT during construction. Stations C1, C2 and C12 will be located at the outlets of the west, east and foreshore WTPs, respectively. To confirm the WTPs are operating as intended, water quality sampling stations will be located prior to stormwater entering the WTPs (C6 east WTP, C5 west WTP, C11 foreshore WTP). It should be noted that sampling as identified in Table 1 is not required when there is no discharge from the WTPs. Water quality sampling site C3 is in a location prior to potential discharge to the existing west outfall. This site will be able to capture influences to the ditch water quality other than from the WTPs. Monitoring at C3 must be completed when the WTPs are discharging and there is standing or flowing water as per Table 1 of the existing Approval.

The amended Permit will also require water quality sampling in the receiving environment of Burrard Inlet. Specifically, the Permit will require water quality sampling locations within and 5m outside of the west and east outfall turbidity curtains as identified in Table 1 and Figure 2. For Phase 3 construction this sampling requirement will also include an additional outfall turbidity curtain associated with the foreshore WTP and the newly located east outfall location, both shown in Figure 2. Sampling stations C15 and C16 will be implemented as additional monitoring locations before and after a C02 bubbler used in conjunction with concrete works for foreshore flatworks.

The WTPs include an in situ turbidity monitor that automatically logs turbidity and pH levels at 15 minute intervals during operation. The sampling station downstream of the water treatment systems will verify the NTU and pH levels reported by the plant data logger. An explanation of the relationship between TSS and NTU and the KLTP field monitoring approach is provided in Section 5.

Table 1 Water Quality Monitoring Plan Sampling Locations.

Location ID	Description	Subphase
C1*	Permit compliance location – Outlet of west WTP (effluent)	3.1

**WESTRIDGE MARINE TERMINAL
CONSTRUCTION WATER QUALITY MONITORING PLAN – PHASE 3**

C2*	Permit compliance location – Outlet of east WTP (effluent)	3.2, 3.3
C3*	CP Rail ditch west of foreshore access road prior to discharge into the existing outfall (effluent)	3.1
C5	Upstream of west WTP (effluent).	3.1
C6	Upstream of middle catch basin and east WTP (effluent).	3.2, 3.3
C7	Within the west outfall turbidity curtain (receiving environment)	3.1
C8	5m outside the west outfall turbidity curtain (receiving environment)	3.1
C9	Within the east outfall turbidity curtain (receiving environment)	3.2 – 3.6
C10	5m outside the east outfall turbidity curtain (receiving environment)	3.2 – 3.6
C11	Upstream of foreshore WTP (effluent)	3.4.1, 3.4.2
C12*	Permit compliance location (anticipated) – Outlet of foreshore WTP (effluent)	3.4.1, 3.4.2
C13	Within the foreshore outfall turbidity curtain (receiving environment)	3.4.1, 3.4.2
C14	5m outside the foreshore outfall turbidity curtain (receiving environment)	3.4.1, 3.4.2
C15	Upstream of C02 bubbler (effluent)	3.5, 3.6
C16*	Approval compliance location (anticipated) - Outlet of C02 bubbler (effluent)	3.5, 3.6

*Stations subject to Authorized Discharge limits

Water quality parameters and sampling frequency for both effluent and receiving environment monitoring are outlined in Tables 1 and 2 of the existing Approval. During Phase 3 construction, additional water quality sampling (i.e., apart from the sampling required under the amended Permit) may be required to confirm that ESC measures and concrete-affected water mitigation measures in place are functioning as intended. The frequency and location of this sampling will depend on the weather conditions (i.e., predicted and actual prevailing rainfall and storm conditions) and construction activities. This will allow for the adaptive management of construction activities, mitigation measures and the treatment plants (e.g., discharge rate) to protect water quality in Burrard Inlet. Sampling will be more frequent during storm conditions (minimum daily) and will be monitored hourly (i.e., during hours of active construction). Per the existing Approval, frequency of effluent monitoring is increased when the threshold of 30mm of rainfall is exceeded in Environment Canada's forecast. The key is to be sampling at a frequency that will allow adjustments in construction activities, erosion and sediment controls and WTPs use to ensure compliance for discharge entering Burrard Inlet. Ultimately, these requirements will be dictated in the amended Permit.

The existing Approval also details water quality monitoring requirements for the receiving environment within and outside the turbidity curtains. The parameters and frequency are provided in Table 2 of the existing Approval.

5. ANALYSIS AND SAMPLING METHODS

Initially, all grab water samples required by the amended Permit will be sent to an environmental lab accredited by the Canadian Association for Laboratory Accreditation (CALA). All grab samples will be field analyzed for pH using a LaMotte 2020we handheld pH tester.

All water quality sampling activities will follow the procedures described in the *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples* (B.C. Ministry of Water, Land and Air Protection, 2013). Additional water quality sample handling and labeling procedures are detailed in Section 6. Quality Assurance/Quality Control (QA/QC) procedures are detailed in Sections 7 and 8.

Estimates of TSS concentrations in water requires that water samples are sent to a laboratory for analysis; in contrast, turbidity can be measured in real-time in the field, allowing for rapid modification of ESC measures in the event of elevated TSS. Use of field turbidity monitoring as a surrogate for TSS will require development of a site-specific relationship between TSS and turbidity, potentially at each sampling location. This relationship is determined by taking samples over the range of TSS concentrations that occur during a sediment event and analyzing for both TSS and turbidity. A statistical regression relationship can be established between TSS and turbidity. This relationship can be used to predict TSS concentrations based on field turbidity measurements. Once a relationship has been established, the TSS of the water quality sample will be estimated using a handheld turbidity meter and grab samples will be sent to the laboratory to be analyzed for TSS so that TSS based on NTU measurements can be confirmed. The TSS/turbidity relationship must be reviewed by MoECCS prior to being used on site.

The WTPs include an *in situ* turbidity (NTU) monitor that automatically logs NTU and pH levels at 15 minute intervals. The sampling station at the discharge of the water treatment systems will verify the NTU levels reported by the plant data logger. The WTP *in-situ* turbidity monitor will be read and recorded when a grab sample is taken for laboratory analysis and the results will be compared when the laboratory reports are received. The frequency of the grab sample laboratory analysis for comparison to the WTP turbidity data will be weekly for a duration that captures variations in soil types and volumes through a sufficient number of samples to provide confidence in the TSS/turbidity relationship. Ongoing sampling will follow the minimum frequencies required within the amended Permit.

6. SAMPLE HANDLING AND LABELING

This program is consistent with the Environmental Data Quality Assurance Regulation and guidance provided in the *British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emissions, Water, Wastewater, Soil, Sediment, and Biological Samples* (BC MWLAP 2013), the *British Columbia Laboratory Methods Manual for the Analysis of Water, Wastewater, Sediment, Biological Materials and Discrete Ambient Air* (Austin 2015) and the BC *Environmental Data Quality Assurance Regulation* (2017).

KLTPs general sample handling and labeling procedure includes:

- All samples are handled using disposable nitrile gloves that are discarded between samples.
- All samples are labeled immediately after sampling.
- All water samples are submitted without headspace in the sample container.

- In the field, all samples are stored in coolers supplied with ice packs. Water samples need will be submitted and analyzed within specified handling times and will be preserved as required by the analyzing laboratory and the BC Laboratory Requirements. Sampling, when practicable, will be collected at a time of day to prevent the need for overnight storage.
- The sampling containers and required preservatives are provided by the laboratory for the sample parameter requested.
- Field duplicates are collected to quantify environmental variability. A quality check for grab sampling procedures will be done through field and equipment blanks. The existing Approval outlines the specific requirements for the number and frequency of replicates and blanks that must be adhered to.
- Field duplicates are generally submitted at a rate of approximately 10% to assess the reproducibility of analytical results and sampling method.
- The chain of custody including sampling information and shipment information is recorded on a form supplied by the laboratory.
- Samples for rush analysis are announced to the laboratory ahead of time.

7. FIELD QUALITY ASSURANCE/QUALITY CONTROL

KLTP's field quality assurance and quality control (QA/QC) sampling program generally adheres to the requirements stated in the *British Columbia Field Sampling Manual* of 2013 and standard industry practices. The program includes:

- The analytical laboratory personnel are involved in study planning and data interpretation.
- Only laboratories accredited by the Canadian Association for Laboratory Accreditation (CALA) and are listed in the Ministry's Directory of Qualified Laboratories will be utilized. All laboratories are must be accredited to ISO 17025 standards for that test method(s).
- The Environmental Coordinator and field staff are responsible to ensure that the sampling and post-sampling process follows documented protocols.
- All samples are labeled with unambiguous identification of sample identification, date, and name of sampler.
- Field personnel will record all details relevant to the sampling in a field notebook. Unusual conditions and variations from usual sampling techniques especially require thorough documentation.
- All field records (e.g., field notes, chain of custody forms, analytical reports, communications, and reports) are kept in a central filing place.
- All instruments and equipment are regularly maintained and calibrated per the manufacturer's manual. All maintenance and calibration logs are kept on file.
- Duplicate samples and field blanks will be prepared and submitted for laboratory analysis for each parameter sampled at two duplicates per monitoring event and one field blank every second monitoring event. The minimum duplicate sampling schedule will be rotated through all the monitoring sites and will apply to both the receiving environment monitoring and the effluent monitoring.
- The relative percent difference (RPD) is calculated for all duplicated samples.
- Sample collection equipment is regularly decontaminated in the field to avoid contaminating samples.
- Equipment cleanliness and performance is checked by running equipment blanks. An equipment blank is a sample of de-ionized water from the lab that has been allowed to contact the sampling equipment.

- Any travel blanks will be prepared by the laboratory using de-ionized water, and are shipped with the other sample bottles to and from the field. These travel blank bottles are not to be opened in the field.

The water quality QA/QC Program will follow KLTP Project quality procedures as provided in the KLTP Quality Management Plan (QMP). The following KLTP quality procedures are pertinent to the water quality sampling program.

- Quality Audits (KLTP-PRO-QA-20.01);
- Quality Assurance Plan (KLTP-PRO-QA-20); and,
- Measurement and Test Equipment (KLTP-PRO-MTE-16.01).

As recommended in the British Columbia Field Sampling Manual, the water quality sampling program will be subject to internal audit not less than once per year.

8. LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

KLTP requires that the environmental lab used for sample analysis has a well-defined QA/QC program consistent with the BC *Environmental Data Quality Assurance Regulation* (2017). This program must include:

- Clearly defined QA/QC objectives and QA/QC documentation. These include method blanks, laboratory replicates, surrogate spike recovery, blank spike recoveries and matrix spike recovery.
- The laboratory analytical report includes QA/QC documentation and is reviewed and compared to the quality objectives set by the laboratory.
- The analytical results of the field duplicates are compared and evaluated for reproducibility.

9. REPORTING AND COMPLIANCE

Per section 4 of the existing Approval, water quality monitoring reports will be submitted to TMP on a monthly basis in an electronic format, commencing with the first month of WTP operation. Monthly report submissions will occur before the end of the following month. Reports will be submitted by TMP. The reports will detail the water quality monitoring results of the construction monitoring program and will include all laboratory reports. If applicable, each report will include a statement outlining the sampling locations (as per Section 3 of the existing Approval), the number of exceedances of permitted levels that occurred during the reporting period, as well as the date(s) of exceedances and an explanation as to the cause of the exceedance, and description of measures taken to prevent reoccurrence. If no exceedances occurred over the reporting period, a statement to that effect will be included in the report. Should any results indicate an exceedance of authorized limits, TMP will follow the regulatory agency notification and reporting requirements identified in the amended Permit.

Within three months of the amended Permit expiry date, a Final Report will be produced and submitted to the Director in a form that is tabulated, graphically represented and interpreted. The report will be comprised of the following:

- Summary of exceedances of permitted discharges, including date(s) and reference to the associated noncompliance report(s). Should no exceedances occur, a statement to that effect will be provided.
- All data collected per Section 3, as well as stormwater effluent TSS/turbidity data, and any additional verification data collected for the purposes of developing TSS/turbidity relationships.

- Summary of the average daily and the annual flows in comparison to limits specified in Sections 1.1 and 1.2.
- Summary of significant storm events, monthly precipitation and related effects on the Authorized Works and discharges (tabular or graphical).
- Receiving environment monitoring data (tabular or graphical) and discussion of related actions taken with turbidity curtains.
- Review of the QA/QC program results.
- Summary and review of the operation of the Authorized Works and any improvements implemented.

10. REFERENCES

Austin, Joyce. (Editor). 2015. British Columbia Environmental Laboratory Manual. Environmental Monitoring, Reporting & Economics Section, Knowledge Management Branch, B.C. Ministry of Environment, Victoria, BC.

BC ENV. 2017. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture: Summary Report. January 2017. Water Protection & Sustainability Branch, BC Ministry of Environment. 36p. Accessed November 29, 2017.

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2013. British Columbia Field Sampling Manual. 2013 Edition. Water, Air and Climate Change Branch. Accessed November 27, 2017.

APPENDIX A

**Westridge Marine Terminal
BC Ministry of Environment
Waste Discharge Approval # 109085**



August 14, 2018

Tracking Number: 364072
Authorization Number: 109085

REGISTERED MAIL

TRANS MOUNTAIN PIPELINE ULC
Suite 2600 Three Bentall Centre
595 Burrard Street
Vancouver, BC V7X 1L3

Dear Approval Holder:

Enclosed is Approval 109085 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the approval.

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

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

Administration of this permit will be carried out by staff from the Authorizations North - LNG Team. Plans, data, reports, non-compliance notifications and non-compliance reports pertinent to the permit are to be submitted to the Environment Protection Division via email or electronic means as directed in the following web link:

<http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions>

Yours truly,

A handwritten signature in dark ink, appearing to read "Ed A. Hoffman". The signature is written in a cursive, slightly slanted style.

Ed A. Hoffman
for Director, *Environmental Management Act*
Authorizations North

Enclosure

cc: Bronwyn Pountney



**MINISTRY OF
ENVIRONMENT**

APPROVAL

109085

Under the Provisions of the Environmental Management Act

TRANS MOUNTAIN PIPELINE ULC

**Westridge Marine Terminal
7065 Bayview Drive
Burnaby BC**

is authorized to discharge effluent to Burrard Inlet from a jet fuel storage and crude oil shipping facility located at the location above, subject to the terms and conditions listed below.

Specific capitalized terms referred to in the authorization are defined in the Approval Glossary. Other terms used in the authorization have the same meaning as those defined in the *Environmental Management Act* and applicable regulations.

Where the authorization provides that the Director may require an action to be carried out, the Approval Holder must carry out the action in accordance with the requirements of the Director.

Contravention of any of these requirements is a violation of the *Environmental Management Act* and may lead to prosecution.

This discharge is authorized to occur from the issue date of this authorization to November 14, 2019.

APPROVAL GLOSSARY

Authorized Works means erosion and sediment control works as per the Erosion, Sediment Control Plan for Phase 2 dated January 30, 2018, stormwater collection ditches, culverts, pipes, the WTPs designed to meet the daily discharge capacity, outfalls to Burrard Inlet, turbidity curtains and related appurtenances. Canadian Pacific Rail (CP Rail) ditches are not part of authorized works.

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for Director, *Environmental Management Act*
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Phase 2.1 Construction means access road widening and tunnel portal excavation and construction as shown in Site Plan A and as defined in the Application document under Section 4.1.1.1 of the Trans Mountain Pipeline ULC Westridge, Attachment 3 – Phase 2: Westridge Marine Terminal Technical Assessment Report dated April 20, 2018, prepared by Stantec Consulting Ltd.

Phase 2.2 Construction means pipe rack excavation and pipe bore pit excavation shown in Site Plan B and as defined in Section 4.1.2.1 of the same document as identified in Phase 2.1 Construction.

Qualified Professional means an applied scientist or technologist specializing in an applied science or technology applicable to the duty or function, including, if applicable and without limiting this, agrology, biology, chemistry, engineering, geology or hydrogeology and who:

- i. is registered with the appropriate professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization, and
- ii. through suitable education, experience, accreditation and/or knowledge, may be reasonably relied on to provide advice within their area of expertise. All documents submitted to the Director by a Qualified Professional must be signed by the author(s).

Water Treatment Plant (WTP) means treatment equipment that minimally consists of Chitosan Enhanced Sand Filtration (CESF) treatment system, water storage feature such as tanks, in-line continuous monitoring system to monitor flow volumes and water quality readings of turbidity and pH, and a discharge pipe.

1. AUTHORIZED DISCHARGES

1.1 Authorized Source-East WTP

This section applies to the discharge of effluent from the Authorized Works identified in Site Plan C as the east WTP.

- 1.1.1 The maximum rate of discharge is 777,600 cubic metres per year.
- 1.1.2 The maximum daily rate of discharge is 4320 cubic meters.
- 1.1.3 The authorized discharge period is continuous.

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for Director, *Environmental Management Act*
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- 1.1.4 The characteristics of the discharge must be equivalent to or better than:

Total Extractable Hydrocarbon (TEH)
Maximum: 5 mg/L

Total Suspended Solids (TSS)
Maximum: 75 mg/L

- 1.1.5 The location of the facilities from which the discharge is authorized to originate is Lot 186 PL 38021 DL 216 LD 37 New Westminster Group 1.

1.2 **Authorized Source-West WTP**

This section applies to the discharge of effluent from the Authorized Works identified in Site Plan C as the west WTP.

- 1.2.1 The maximum rate of discharge is 388,800 cubic metres per year.
- 1.2.2 The maximum daily rate of discharge is 2160 cubic meters.
- 1.2.3 The authorized discharge period is continuous.
- 1.2.4 The characteristics of the discharge must be equivalent to or better than:

Total Extractable Hydrocarbon
Maximum: 5 mg/L

Total Suspended Solids
Maximum: 75 mg/L

- 1.2.5 The location of the facilities from which the discharge is authorized to originate is the same as specified in Section 1.1.5 above.

1.3 **Approval Discharges**

The Approval Holder cannot proceed with Phase 2.1 and 2.2 Construction activities until the Authorized Works are in place and functional. The Approval Holder must notify the Director when discharges from the WTPs initially commence.

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The Approval Holder must not discharge concrete wastewater.

2. **GENERAL REQUIREMENTS**

2.1 **Future Upgrading of Authorized Works**

The Director may require the Approval Holder to repair, alter, remove, improve or add to existing works, or to construct new works, and to submit plans and specifications for works specified in this authorization.

2.2 **Future Monitoring**

The Director may amend any requirements under this Approval, including an increase or decrease in monitoring based on data submitted by the Approval Holder and/or any other data gathered in connection with this authorization.

2.3 **Pollution Prevention**

Despite the limits imposed by this authorization, the Approval Holder must ensure at all times that stormwater from the site does not substantially alter or impair the usefulness of the environment outside of the turbidity curtains surrounding the outfalls.

2.4 **Other Agency Requirements**

This Approval does not relieve the Approval Holder from complying with requirements of federal, provincial, regional district or municipal authorities or any agreements made with First Nations.

2.5 **Maintenance of Works and Emergency Procedures**

The Approval Holder must regularly inspect the Authorized Works, and must inspect on a daily basis, at a minimum, the east and west WTPs when in operation. The Approval Holder must maintain all Authorized Works in good working order.

In the event of an emergency or condition beyond the control of the Approval Holder which prevents effective operation of the Authorized Works or leads to an unauthorized discharge, the Approval Holder must take remedial action to

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restore the effective operation of the Authorized Works and to prevent any unauthorized discharges. The Approval Holder must immediately report the emergency or condition and the remedial action that has and will be taken to the RAPP line (1-877-952-7277) #7277 from mobile phone) or electronically at this link: <http://www.env.gov.bc.ca/cos/rapp/form.html>.

The Director may require the Approval Holder to reduce or suspend operations until corrective steps have been taken to prevent unauthorized discharges.

2.6 **Bypasses**

The Approval Holder must not allow any discharge authorized by this authorization to bypass the Authorized Works, except with the prior written approval of the Director.

2.7 **Water Quality Monitoring Program**

The Approval Holder must carry out a construction water quality monitoring program while work is being completed on Phase 2.1 and Phase 2.2. The monitoring must include the daily visual inspection for integrity of the two turbidity curtains that surround the discharge outfalls when discharge from the water treatment plant(s) is taking place.

The Approval Holder must carry out a receiving environment monitoring program as outlined in Section 3.2 of this Approval. The plan for the program must include methods, monitoring equipment and QA/QC procedures which meet the requirements in Sections 3.3, 3.4 and 3.5.

A Water Quality Monitoring Plan which includes the construction water quality monitoring and receiving environment monitoring programs as described in Sections 3.1 and 3.2 must be submitted within 30 days of issuance of this Approval. The Director may require modifications to the Water Quality Monitoring Plan as necessary.

2.8 **TSS/Turbidity Curve Use**

The Approval Holder may create a TSS/turbidity relationship to manage the effluent discharge at the WTPs. In order to apply this relationship to the effluent from the WTPs the Approval Holder must submit, prior to use, a

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statistically viable TSS/turbidity curve for the discharges from the WTPs. In the absence of a statistically viable TSS/turbidity curve, the WTPs will assume a 1:1 ratio for TSS to turbidity. The Director may require adjustments to the TSS/turbidity curve and its use.

2.9 **Erosion and Sediment Control Plan (ESCP)**

To minimize and control the runoff of sediments in stormwater and to manage the treatment of stormwater, the Approval Holder must implement, maintain and comply with all aspects of the ESCP during construction Phases 2.1 and 2.2. The ESCP must be prepared by a Qualified Professional. Any modifications made to the ESCP must be submitted to the Director within 30 days of the modification. The Director may require modifications to the ESCP as necessary.

2.10 **Discharge Water Conveyance**

The Approval Holder must convey all effluent leaving the WTPs in such a way as to avoid erosion and the addition of sediment in stormwater discharges after treatment. The Approval Holder must ensure that all conveyances including ditches, culverts and pipes, both on and off site, used in transporting effluent to Burrard Inlet are in good working order. If a conveyance can no longer provide sufficient capacity for effluent discharge, an amendment to this Approval may be needed. The Approval Holder must have an agreement with CP Rail to use the ditches for stormwater conveyance and infiltration to the flow levels predicted by the hydrology report.

2.11 **Turbidity Curtain Use**

The use of the inner and outer turbidity curtains around the outfalls into Burrard Inlet is expected to coincide with the Fisheries and Oceans Canada *Fisheries Act* Authorization for the construction at the Westridge Marine Terminal. If the Fisheries and Oceans Canada *Fisheries Act* Authorization expires before this Approval end date, an application for an amendment may be required. If changes are needed regarding the location and/or use of the turbidity curtains to meet the *Fisheries Act* Authorization these changes must also be submitted to the Director.

If during the receiving environment monitoring it is noted that either of the inner turbidity curtains is not effectively containing turbid water, all stormwater

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for Director, *Environmental Management Act*
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discharges to that location must cease until the containment is re-established. The Director may require changes in the use of the inner turbidity curtains to protect the environment. The Director may require additional water quality monitoring in the receiving environment to verify the effectiveness of the turbidity curtain.

2.12 **Cease Work for Large Storm Events**

As the WTPs have been designed to meet a 2 year storm event, if Environment Canada forecasts a greater than 2 year storm event (>79.6mm in a 24 hour period) for the Burnaby area then all Phase 2 construction activities related to this Approval must cease and erosion and sediment control measures must be put into place to minimize sediment movement. Regardless of ceased construction related to the Approval, stormwater leaving areas of construction must still be treated using the Authorized Works.

The Approval Holder must submit to the Director a plan developed by a Qualified Professional that appropriately manages stormwater runoff during greater than 2 year events to be able to continue construction activities during these events. The Director may require modifications to this Large Storm Event Plan as necessary.

2.13 **License to Publish Documents**

2.13.1 Subject to Section 2.13.2, the Approval Holder authorizes the Province to publish on the Ministry of Environment and Climate Change Strategy website the entirety of any Regulatory Document. The Province will provide written notice to the Approval Holder of its intent to publish a Regulatory Document at least 14 days prior to publication.

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

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

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3. **MONITORING REQUIREMENTS**

The Director may, in writing, change the monitoring and reporting requirements in this authorization.

3.1 **Effluent Monitoring**

This Section applies to the monitoring of the effluent discharged from the east and west WTPs.

3.1.1 **Effluent Sampling**

The Approval Holder must initiate the collection of samples for testing in accordance with the requirements specified in Table 1 immediately upon commencement of operation of the WTPs. The Approval Holder must take due care in collection, storage and transportation of the samples to control temperature and avoid contamination, breakage, and any other factor or influence that may compromise the integrity of the sample.

3.1.2 **Flow Measurement**

The Approval Holder must maintain a flow measuring device, agreeable to the Director, to measure flow from the east and west WTPs and maintain a record of the effluent volume discharged under Section 1.1 and 1.2 at the frequencies specified in Table 1. The Approval Holder must report the daily flow in the monthly reports.

3.1.3 **Analysis and Measurement**

The Approval Holder must sample the discharges as detailed in Table 1 when discharge is occurring. When there is no discharge from the WTPs, no sampling is required.

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Table 1 Effluent Monitoring

Monitoring Locations as shown in Site Plan C	Parameters and Tests	Methods	Frequency	
			Rainfall ≤ 30 mm As predicted by Environment Canada for Burnaby	Rainfall > 30 mm As predicted by Environment Canada for Burnaby
C1 – Outlet of the west WTP	pH, TSS, turbidity, TEH	Grab	Weekly	Daily
	PAH	Grab	Once in the first two months of WTP operation	
	pH, turbidity	Inline Instrument	Continuous (15 minute increments)	Continuous (15 minute increments)
	Chitosan residual (detection limit ≤ 0.2 mg/L)	Grab	Weekly	Weekly
	<i>Daphnia magna</i> 48 hour LC50 at 100% concentration pass fail	Grab	One time during the third week of WTP operation	
	Flow	Inline Instrument	Continuous (15 minute increments)	Continuous (15 minute increments)
	Metals, total and dissolved	Grab	Once per month when discharging from WTP	
	pH, TSS, turbidity, TEH	Grab	Weekly	Daily
	PAH	Grab	Once in the first	

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C2 – Outlet of the east WTP			two months of WTP operation	
	pH, turbidity	Inline Instrument	Continuous (15 minute increments)	Continuous (15 minute increments)
	Chitosan residual (detection limit ≤ 0.2 mg/L)	Grab	Weekly	Weekly
	<i>Daphnia magna</i> 48 hour LC50 at 100% concentration pass fail	Grab	Once during the third week of WTP operation	
	Flow	Inline Instrument	Continuous (15 minute increments)	Continuous (15 minute increments)
	Metals, total and dissolved	Grab	Once per month when discharging from WTP	
C3 – CP Rail ditch west of foreshore access road prior to discharge into the existing outfall	pH, TSS, turbidity	Grab	Weekly when discharging from the west WTP	Daily when discharging from the west WTP
	Metals, total and dissolved	Grab	Once per month (when there is standing or flowing water)	Once every two weeks
C4 – CP Rail ditch east of foreshore access road and standpipe	pH, TSS, turbidity	Grab	Weekly (if water is discharging to the standpipe)	Daily (if water is discharging to the standpipe)
	Metals, total and dissolved	Grab	Once per month (when there is	

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			standing or flowing water)	
C5 – Upstream of west WTP	pH, TSS, turbidity	Grab	Weekly	Daily
C6 Upstream of middle catch basin and east WTP	pH, TSS, turbidity	Grab	Weekly	Daily

3.1.4 **Effluent Monitoring Results – Notification and Additional Sampling and Testing**

3.1.4.1 Pass-Fail Toxicity Tests

The Approval Holder must immediately notify the Director or designate by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the Director if any toxicity test fails. Upon failure of a toxicity test, the Approval Holder must, immediately resample, analyze and report to the Director the results. The Director may require alternative toxicity tests. The Approval Holder must submit a plan to the Director to identify the cause and determine mitigation to prevent toxicity in the effluent. Once the mitigation measures are implemented to the satisfaction of the Director and two consecutive toxicity tests are passed, testing can revert to the frequency specified in Table 1.

3.1.4.2 Chitosan Residual Detection and Follow-up Toxicity Testing

The Approval Holder must immediately notify the Director or designate by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the Director if the Chitosan residual test shows concentrations greater than the detection limit.

If the Chitosan residual test shows concentrations greater than the detection limit, the Approval Holder must sample the discharge within 24 hours and test for toxicity with a 96-hr LC50, 100% concentration rainbow trout pass-fail test or as otherwise instructed by the Director. Requirements of Section 4.1 apply to these toxicity tests.

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for Director, *Environmental Management Act*
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3.1.4.3 pH Plan

The Approval Holder must monitor the pH values during the effluent monitoring program. If pH shows an increasing trend of greater than 8.0 at the WTPs or measurements exceed 8.7 then a plan must be established to identify the cause and treat effluent to reduce or maintain the pH to 8.7 or below. The Director may require changes to this plan.

3.2 **Receiving Environment Monitoring**

The Approval Holder must carry out the receiving environment monitoring program as shown in Table 2. The Director may require adjustments to the locations of sampling.

Table 2 Receiving Environment Monitoring

Monitoring Locations	For initial 10 samples ¹		If 10 samples show turbidity curtain is effective ¹	
	Parameter	Frequency ²	Parameter	Frequency ²
Within the turbidity curtain around the west outfall location identified in Site Plan A and B	TSS and turbidity	Daily when discharging from the WTPs	TSS and turbidity	n/a
Outside the turbidity curtain for the west outfall but within 5 meters of the curtain edge	TSS and turbidity	Daily when discharging from the WTPs	TSS and turbidity	2 times per month when discharging from the WTPs
Within the turbidity curtain around the east outfall location as identified in Site Plan A and	TSS and turbidity	Daily when discharging from the WTPs and there is flow from the	TSS and turbidity	n/a

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B		outfall		
Outside the turbidity curtain for the east outfall but within 5 meters of the curtain edge	TSS and turbidity	Daily when discharging from the WTPs and when there is flow from the outfall	TSS and turbidity	2 times per month when discharging from the WTPs and where there is flow from the outfall

¹All samples must be grab sampled and laboratory analyzed.

²The inner and outer samples for each turbidity curtain must be completed on the same day.

3.3 **Sampling Procedures**

The Approval Holder must carry out sampling in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2013 Edition (Permittee)" or most recent edition, or by alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at <https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual>

3.4 **Analytical Procedures**

The Approval Holder must carry out analyses in accordance with procedures described in the "British Columbia Laboratory Manual (2015 Permittee Edition)", or the most recent edition or by alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at <https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-environmental-laboratory-manual>

3.5 **Quality Assurance**

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

3.5.2. The Approval Holder must prepare and submit for analysis by the analytical laboratory(ies) a duplicate sample and field blank for each parameter sampled following a schedule that results in a minimum of two duplicates per monitoring event and one field blank every second monitoring event. The minimum duplicate sampling schedule must be rotated through all the monitoring sites and is applicable to both the receiving environment monitoring and the effluent monitoring

3.5.3. The Approval Holder must submit samples to analytical laboratory(ies) that meet the definition of a qualified laboratory under the Environmental Data Quality Assurance Regulation.

4. **REPORTING REQUIREMENTS**

4.1 **Non-compliance Reporting**

The Approval Holder must immediately notify the Director or designate by email at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the Director of any non-compliance with the requirements of this authorization. The Approval Holder must then take remedial action to prevent further effects and/or remedy any effects of such non-compliance and undertake appropriate and timely sampling and testing to assess potential effects from such non-compliance. Subsequently (if not concurrently), the Approval Holder must undertake an investigation into the root cause(s) of the non-compliance and identify corrective action(s) to prevent a recurrence.

The Approval Holder must provide the Director with a follow-up report as soon as possible with an explanation of the non-compliance, an explanation of remedial actions taken to mitigate effects, any test results and interpretive analysis of effects associated with the non-compliance, results of the root-cause investigation of the non-compliance, and a description of the remedial action planned and/or taken by the Approval Holder to prevent similar non-compliance(s) in the future. If the follow-up report will take longer than two weeks after the event to submit to the Director, the Approval Holder must request an alternative timeline from the Director or designate by email at

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EnvironmentalCompliance@gov.bc.ca. For guidelines on how to report a non-compliance or for more information visit the Ministry website:

<https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/compliance-reporting-mailbox>

4.2 **Spill Reporting**

The Approval Holder must immediately report all spills to the environment (as defined in the Spill Reporting Regulation) in accordance with the Spill Reporting Regulation, which among other things, requires notification to Emergency Management BC at 1-800-663-3456.

4.3 **Monthly Reporting**

The Approval Holder must collect and maintain data and analyses of monitoring including flow measurements required under this authorization and must be available for inspection when requested by Ministry staff. The Approval Holder must make submissions of monthly monitoring data before the end of the following month to the Ministry's Routine Environmental Reporting Submission Mailbox at EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the Director. For guidelines on how to properly name the files and email subject lines or for more information visit the Ministry website: <http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/routine-environmental-reporting-submission-mailbox>.

The Approval Holder must include in the monthly submission a highlight of any non-compliance(s), and a reference to the follow-up report(s) submitted to address the non-compliance(s) required by Section 4.1

4.4 **Final Report**

The Approval Holder must collect and maintain all data of analysis and flow measurements and the analytical QA/QC for the duration of the Approval. The Approval Holder must submit such data and information to the Director, by email at EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the Director, in a form that is tabulated, graphically represented and interpreted. The Approval Holder must submit the Final Report within 3 months of the

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Approval expiry date. The Director may require adjustments to the final report.

The Final Report must include the following:

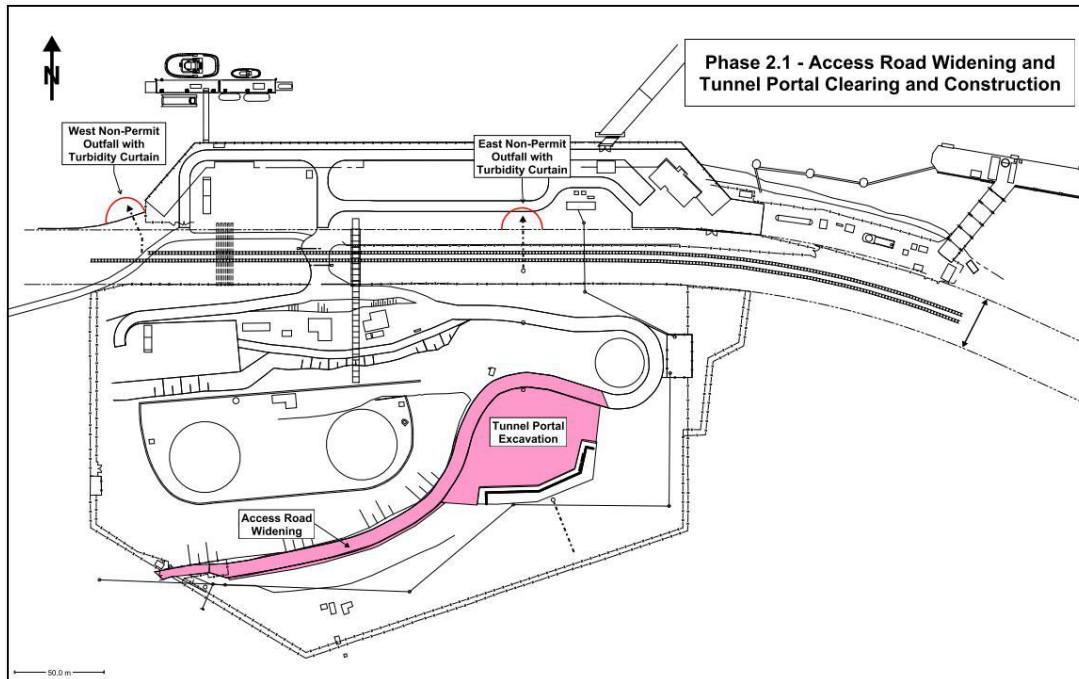
- A summary outlining all the exceedances of permitted discharges that occurred during the Approval period, including date(s) of occurrences and reference(s) to the non-compliance report(s) required by Section 4.1. If no exceedances occurred over the Approval period, a statement may be used to identify that no exceedance of the permitted discharges occurred;
- All data collected as required in Section 3, as well as stormwater effluent TSS/turbidity data collected for the purposes of developing TSS/turbidity relationships and any additional data collected for verification purposes. The data should be suitably tabulated, summarized with statistics, graphed if appropriate, and interpreted for review;
- A summary of the average daily and the annual flow with comparison to limits in Section 1.1 and 1.2
- A table or graphical summary of significant storm events and monthly precipitation and a discussion on the effects of these events on the operation of the Authorized Works and the related discharges;
- A table or graph of the receiving environment monitoring data and any actions taken regarding the turbidity curtains for the Approval discharges;
- A review of the results of the QA/QC program; and
- A summary and review of the operation of the Authorized Works, and any improvements taken.

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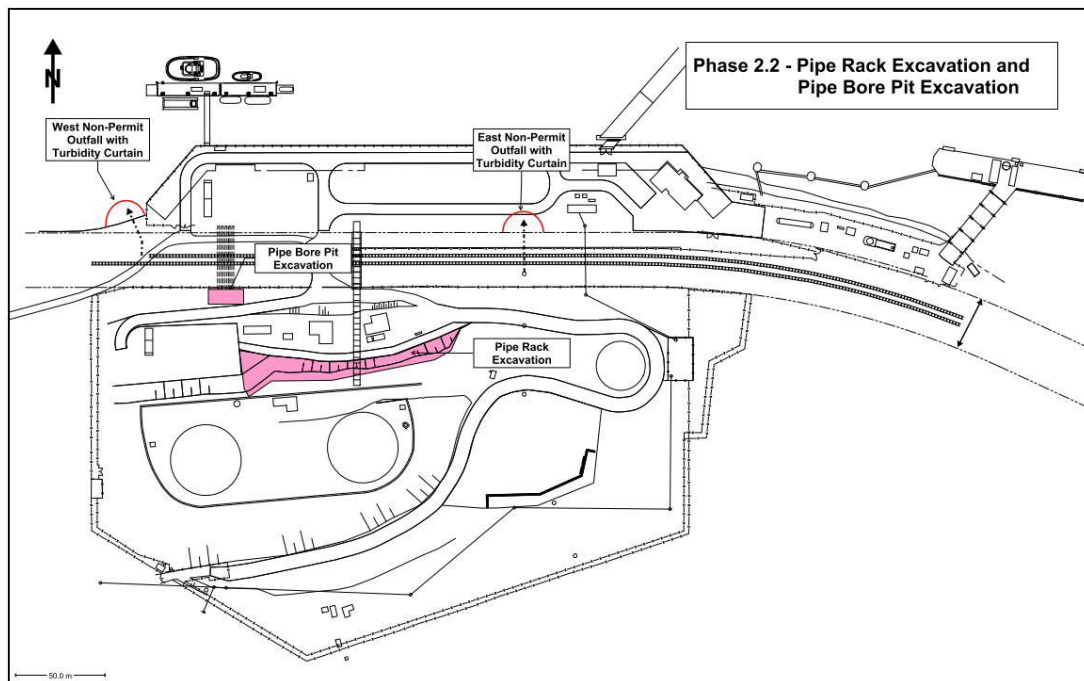
**SITE PLAN A:
PHASE 2.1 CONSTRUCTION AREAS**



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**SITE PLAN B:
PHASE 2.2 CONSTRUCTION AREAS**



Date issued: August 14, 2018

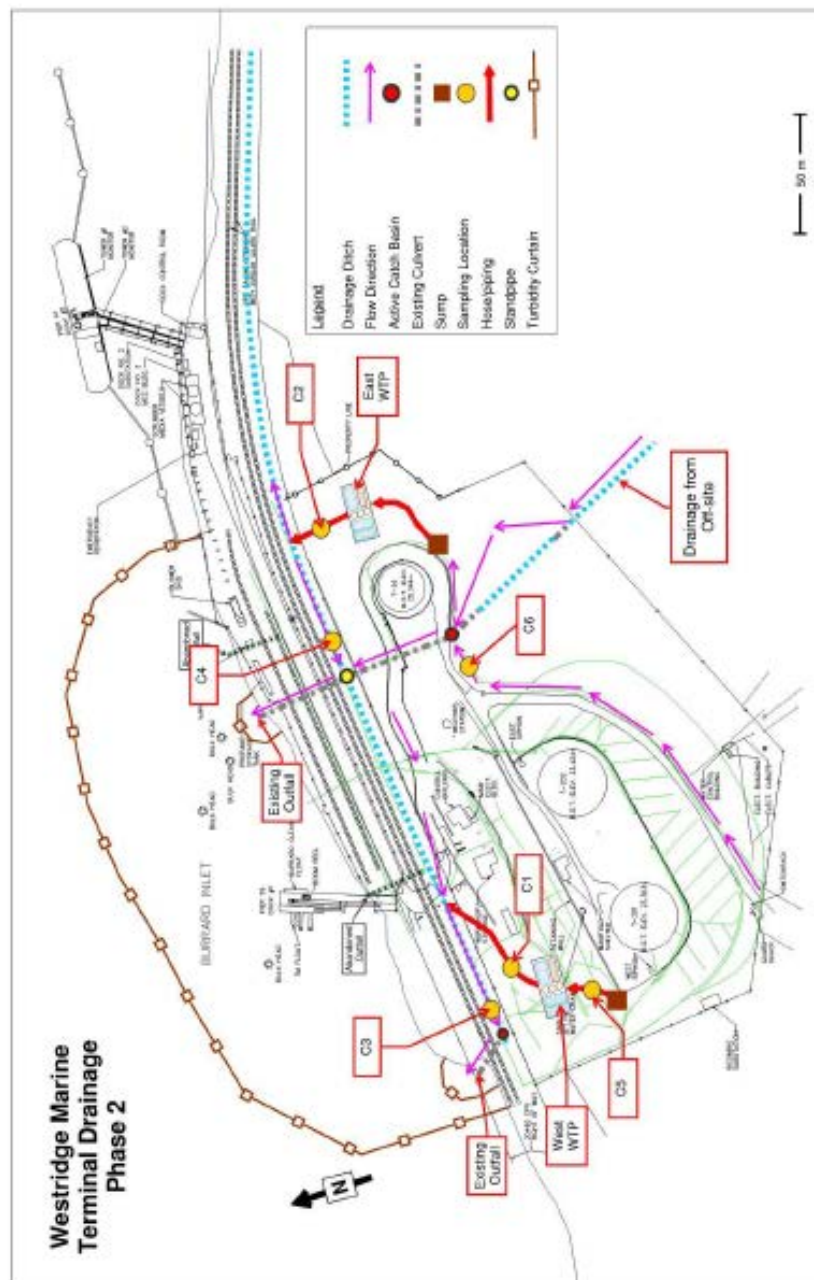
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**SITE PLAN C:
PHASE 2.1 AND 2.2 EFFLUENT MONITORING LOCATIONS**

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APPENDIX H

ChitoVan Product Specification Sheet and Material Safety Data Sheet



Revision: 01

Safety Data Sheet

ChitoVan™ 1.0%

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Manufacturer's Name: Dungeness Environmental
Corporate Address: 909 SE Everett Mall Way, Ste. A119, Everett, WA 98208
Manufacturer's Telephone: (425) 481-0600 (Monday-Friday, 8AM-5PM PDT)
Emergency Telephone (24 Hours): (206) 390-2432 (Domestic, North America)
(Country Exit Code) +1-(425) 481-0600 (International)
Material/Trade/Product Name: ChitoVan™ 1.0%
Synonyms: None
Chemical Name: Chitosan Acetate Solution
Chemical Formula: Not available
CAS No.: Not applicable
EPA Registration #: Not applicable
Product Use: Flocculates soil contamination in Stormwater.

SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS

CAS NO.	COMPONENT	%	OSHA HAZARDOUS?
Trade Secret	Trade Secret	4	NO
	<i>All other components are non-hazardous.</i>	96	NO

NOTE: See Section 8 for permissible exposure limits.

SECTION 3: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Clear to pale yellow viscous liquid with a pungent vinegar odor.
 May be mildly irritating to eyes. Not likely to be hazardous to skin, respiratory tract, or by ingestion.

POTENTIAL HEALTH EFFECTS

EYE: May be mildly irritating to eyes.

SKIN: Not hazardous to skin.

INHALATION: Not likely to be hazardous by inhalation.

INGESTION: Not likely to be hazardous by ingestion.

CHRONIC EXPOSURE/CARCINOGENICITY: None of the components present in this material at concentrations of equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

SIGNS AND SYMPTOMS OF OVEREXPOSURE: Eye irritation.

AGGRAVATION OF PRE-EXISTING CONDITIONS: None known.

POTENTIAL ENVIRONMENTAL EFFECTS: Material is 100% biodegradable and nontoxic.

SECTION 4: FIRST AID MEASURES

FIRST AID PROCEDURES

EYE CONTACT: Remove contact lenses (if applicable), flush with water for 15 minutes. Call a physician.

SKIN CONTACT: Cleansing the skin after exposure is advisable.

INHALATION: If large amounts of fumes are inhaled, remove to fresh air and consult a physician.

INGESTION: Consult a physician if necessary.

NOTE TO PHYSICIANS: None.

SECTION 5: FIRE FIGHTING MEASURES

FLASH POINT: Not available

UPPER FLAMMABLE LIMIT: Not available

FLAMMABILITY CLASS (OSHA): Not applicable

AUTOIGNITION TEMPERATURE: Not available

LOWER FLAMMABLE LIMIT: Not available

FLAME PROPAGATION/BURNING RATE: Not available

UNIQUE FIRE PROPERTIES: None known.

HAZARDOUS COMBUSTION PRODUCTS: None.

EXTINGUISHING MEDIA: Does not burn. Use water, dry chemicals, carbon dioxide, sand or foam. Use extinguishing media appropriate for surrounding fire.

PROTECTION OF FIREFIGHTERS: Do not enter confined fire space without full bunker gear (helmet with face shield, bunker coat, gloves and rubber boots), including a positive pressure NIOSH approved self-contained breathing apparatus. Water may be used to keep fire-exposed containers cool until fire is out.

SECTION 6: ACCIDENTAL RELEASE MEASURES

PERSONAL PROTECTIVE EQUIPMENT: See Section 8 (Personal Protective Equipment).

ENVIRONMENTAL PRECAUTIONS: Material is 100% biodegradable and nontoxic.

METHODS FOR CLEANING UP: Dilute with water and hose down.

SECTION 7: HANDLING AND STORAGE

SAFE HANDLING RECOMMENDATIONS

VENTILATION: General ventilation should be sufficient under normal conditions.

FIRE PREVENTION: Non-flammable, no special fire protection required.

SPECIAL HANDLING REQUIREMENTS: Avoid eye contact.

SAFE STORAGE RECOMMENDATIONS

CONTAINMENT: The container should be kept covered to prevent contamination.

STORAGE ROOM RECOMMENDATIONS: Store in a cool, dry, well-ventilated area away from direct heat.

INCOMPATIBLE MATERIALS: Strong oxidizing material and strong bases.

STORAGE CONDITIONS: 10-50°C (will freeze @ ~3°C). Indefinite Shelf Life; Viscosity will decrease over time.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: General ventilation should be sufficient under normal conditions.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

EYE/FACE PROTECTION: Safety glasses recommended.

SKIN PROTECTION: For operations where skin contact can occur, wear impervious clothing such as apron, boots, or whole bodysuit.

HAND PROTECTION: For operations where hand contact can occur, rubber gloves recommended.

RESPIRATORY PROTECTION: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.

Respirator use is not required for this product.

GOOD HYGIENE/WORK PRACTICES: Always follow good hygiene/work practices by avoiding vapors or mists and contact with eyes and skin. Thoroughly wash hands after handling and before eating or drinking. Always wear the appropriate PPE when repairing or performing maintenance on contaminated equipment.

EXPOSURE GUIDELINES

PERMISSIBLE EXPOSURE LIMITS						
INGREDIENT CAS NO.	OSHA		WISHA		ACGIH (TLV)	
	TWA	STEL	TWA	STEL	TWA	STEL
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

COLOR: Pale yellow to light amber

PHYSICAL FORM: Liquid

pH: 3.0 - 4.5

VAPOR DENSITY: Not available

MELTING POINT: Not available

SOLUBILITY IN WATER: None

SHAPE: Liquid

ODOR: Pungent vinegar odor

VAPOR PRESSURE: Not available

BOILING POINT: Not available

FREEZING POINT: Not available

SPECIFIC GRAVITY OR DENSITY: Not determined

NOTE: These physical data are typical values based on material tested but may vary from sample to sample. Values should not be construed as a guaranteed analysis of any specific lot or as specifications.

SECTION 10: STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.

CONDITIONS TO AVOID: Freezing temperatures or excess heat (for quality purposes).

MATERIALS TO AVOID (INCOMPATIBILITY): Strong oxidizing material and strong bases.

HAZARDOUS DECOMPOSITION PRODUCTS: Decomposition will not occur.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

ORAL LD₅₀ (rat): Not available.

DERMAL LD₅₀ (rabbit): Not available.

SKIN IRRITATION: Not available.

EYE IRRITATION: Not available.

SKIN SENSITIZATION: Not available.

ADDITIONAL INFORMATION: None

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICITY (in water):

Acute:

- Daphnia LC 50 – 1369 mg/ L
- Daphnia NOEC – 1000 mg/L
- Fathead minnows LC 50 – 642 mg/L
- Fathead minnows NOEC – 500 mg/L
- Rainbow Trout LC 50 – 173mg/L
- Rainbow Trout NOEC – 125 mg/L

Chronic:

- Rainbow Trout LC 50 – 154 mg /L
- Rainbow Trout LC 25 – 121 mg/L
- Fathead Minnow LC 50 - > 100mg/L
- Fathead Minnow LC25 – 932 mg/L

MOBILITY: Not available.

PERSISTENCE AND DEGRADABILITY: Not available.

BIOACCUMULATIVE POTENTIAL: Not available.

ADDITIONAL INFORMATION: Not available.

SECTION 13: DISPOSAL CONSIDERATIONS

If this product as supplied becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Please be advised that state and local requirements for waste disposal may be more restrictive or otherwise different from federal regulations. Consult state and local regulations regarding the proper disposal of this material.

NOTE: Chemical additions, processing or otherwise altering this material may make the waste management information presented in this SDS incomplete, inaccurate or otherwise inappropriate.

SECTION 14: TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT):

Proper Shipping Name: Not Regulated
Hazard Class: Not Regulated
Identification Number (UN Number): Not Regulated
Packing Group (PG): Not Regulated

SECTION 15: REGULATORY INFORMATION

TSCA STATUS: The substances in this preparation are included on or exempted from the TSCA 8(b) inventory (40 CFR 710).

CERCLA REPORTABLE QUANTITY (RQ):

CHEMICAL NAME	RQ
Not applicable	Not applicable

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (EHS):

CHEMICAL NAME	TPQ	RQ
Not applicable	Not applicable	Not applicable

SARA TITLE III SECTION 311/312 HAZARD CATEGORIES: Does this product/material meet the definition of the following hazard classes according to the EPA 'Hazard Categories' promulgated under Sections 311 and 312 of SARA Title III?

ACUTE HEALTH HAZARD	CHRONIC HEALTH HAZARD	FIRE HAZARD	REACTIVE HAZARD	SUDDEN RELEASE OF PRESSURE
NO	NO	NO	NO	NO

SARA TITLE III SECTION 313 TOXIC CHEMICALS INFORMATION:

CHEMICAL NAME	CAS NO.	CONCENTRATION (%)
Not applicable	Not applicable	Not applicable

al(s) is/are known to the state of
or

CALIFORNIA PROPOSITION 65:

reproductive toxicity:

CHEMICAL NAME	CAS NO.	CONCENTRATION (%)
Not applicable	Not applicable	Not applicable

SECTION 16: OTHER INFORMATION

REVISION INFORMATION:

MSDS sections(s) changed since last revision of document:

· None, this SDS is new, in accordance with OSHA's Hazard Communication Standard directive for GHS alignment.

DISCLAIMER:

***** The above information is based upon information Dungeness Environmental believes to be reliable and is supplied for informational purposes only. Dungeness Environmental disclaims any liability for damage which results from the use of the above information and nothing contained therein shall constitute a guarantee, warranty (including fitness for a particular purpose) or representation with respect to the accuracy or completeness of the data, the product described or their use for any specific purpose even if that purpose is known to Dungeness Environmental. The final determination of the suitability of the information, the manner of use of the information or product and potential infringement is the sole responsibility of the user.

SDS PREPARED BY: Joel Van Ornum, President

MATERIAL SAFETY DATA SHEET

1. Product Name/Identification

ChitoVan CF

2. Composition

Active Ingredient: Chitosan, dry flake	CAS # 90-12-76-4
Chemical names(s):	Chitosan
Source:	From recycled crab and shrimp shells

3. Physical/Chemical Properties

Appearance and Odor:	Dry oatmeal-like flakes
Solubility:	Completely insoluble in water
Specific Gravity	0.2±0.05 g/mL
Boiling Point:	NA
Chitosan Molecular Formula	C ₆ H ₁₁ NO ₄
Chitosan Molecular Weight	161
pH:	NA

4. Toxicological Data

Acute oral, LD50 (mice)	>g/kg
-------------------------	-------

5. Ecological Information

LOEC Acute Rainbow trout	>10,000 mg/l
NOEC Acute Rainbow trout	>10,000 mg/l
LC50 Acute Rainbow trout	>10,000 mg/l

6. Fire and Explosion Hazard Data

Flash Point:	n/a
Flammability:	Non-flammable.
Unusual Fire and Explosion Hazards:	There is no danger of fire or explosion
Fire Fighting Media:	Use water or foam (not flammable in nature).

7. Health Hazards Information

Acute Health Effects – Signs and Symptoms of Exposure, Emergency and First Aid Procedures:	Eye Contact: Chitosan may be mildly irritating to eyes. Flush with water for 15 minutes to remove and call a physician. Skin contact: Chitosan is not hazardous but cleansing the skin after use is advisable. Inhalation: If a large amount of dust is inhaled, remove to fresh air and call a physician. Ingestion: if swallowed, no specific intervention is indicated as the compound is not likely to be hazardous by ingestion. However, consult a physician if necessary.
Potential Chronic Health Effects:	There is no known effect from chronic exposure to this product.
Carcinogenicity	Not listed by ACGIH, IARC, NIOSH, NRP, or OSHA.

8. Person Protective Equipment

Respiratory Protection:	Not required.
Protective Gloves:	Rubber gloves are recommended.
Eye Protection:	Safety glasses are recommended.
Other Protective Clothing:	Not needed.

9. Regulatory

TSCA:	Not listed on the TSCA inventory.
OSHA:	Not considered hazardous.
EPA:	Exempt from EPA code.
SARA Section 302:	Does not have an RQ or TPQ
SARA Section 313:	Not reportable under Section 313
RCRA:	Under RCRA, it is the responsibility of the product user to determine at the time of disposal whether a waste material containing the product, or derived from the product should be classified as a hazardous waste

10. Storage, Handling and Disposal

Storage:	Store away from strong oxidizers.
For Spills:	Utilize protective clothing. Sweep up spilled Chitosan and dilute residual dust with water and hose down.
Waste Disposal Method:	Land disposal is acceptable as the compound is biodegradable. Follow local, state and federal regulations.
Work/Hygiene Practices:	Follow good hygienic and housekeeping practices. Clean up areas where Chitosan was used.

11. Transportation Information

DOT Shipping Name:	Chitosan
Technical Shipping Name:	Chitosan
DOT Hazard Class:	Class 55, not regulated
Product RQ (lbs.):	None
DOT Label:	None
DOT Placard:	None required
Product Label:	Chitosan

12. Stability and Reactivity

Chemical Family:	Natural polysaccharide.
Stability:	Stable.
Hazardous Polymerization:	Polymerization will not occur.
Incompatibility:	Incompatible with strong oxidants and strong bases.
Decomposition:	Decomposition will not occur.
Instability Conditions:	Stable at normal temperatures and storage conditions.
Decomposition Temperature:	211 ° F
Decomposition Products:	NA

Reviewed by: Joel Van Ornum – Dungeness Environmental May 2014

This information is furnished without warranty, expressed or implied, except that it is accurate to the best knowledge of Dungeness Environmental. The data on this MSDS relates only to the specific material designated herein. Dungeness assumes no legal responsibility for use or reliance upon these data.

Material Safety Data Sheet

Carbon Dioxide (Gas/Liquid)



Section 1. Chemical product and company identification

Commercial name(s).	: Carbon dioxide/ALIGAL™ 2/ALIGAL BEVERAGE
Material uses	: Various./Special atmospheres for food.
Supplier/Manufacturer	: Air Liquide Canada Inc. 1250, René-Lévesque West, Suite 1700, Montreal, QC H3B 5E6
In case of emergency	: (514) 878-1667

Section 2. Hazards identification

Physical state	: Gas or liquefied gas.
Emergency overview	: WARNING! HIGH PRESSURE GAS. GAS REDUCES OXYGEN AVAILABLE FOR BREATHING. Keep away from heat (<52°C/125°F). Use only with adequate ventilation. Extremely hazardous gas/liquid under pressure. Keep cylinder valve closed when the product is not used. Gas may accumulate in confined areas.
Routes of entry	: Inhalation. Dermal contact. Eye contact.
Potential acute health effects	
Inhalation	: Inhalation of this product may cause dizziness, an irregular heartbeat, narcosis, nausea or asphyxiation.
Skin	: Dermal contact with a rapidly evaporating liquid could result in freezing of the tissues or frostbite.
Eyes	: Liquid or rapidly evolving gas can cause burns similar to frostbite.
Ingestion	: Since the product is a gas, it will probably be inhaled rather than ingested. Consider first the preventive measures in case of inhalation. Ingestion of liquid can cause burns similar to frostbite.
Potential chronic health effects	: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available.
Medical conditions aggravated by over-exposure	: None known.
Over-exposure signs/symptoms	: Repeated or prolonged exposure to the substance can produce target organs damage.
See toxicological information (Section 11)	

Section 3. Composition, Information on Ingredients

	CAS number	mole %
Canada		
Carbon Dioxide	124-38-9	> 99.5

This material is classified hazardous under the WHMIS Controlled Product Regulation in Canada.
See Chapters 8, 11, 14 and 15 for details.

Section 4. First aid measures

Prompt medical attention is mandatory in all cases of overexposure to this gas. Rescue personnel should wear a self-contained breathing apparatus.

- Inhalation** : In case of inhalation, conscious persons should be assisted to an uncontaminated area and inhale fresh air. The person should be kept warmed and calm. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.
- Skin contact** : Remove contaminated clothing and rinse affected skin with lukewarm water. Do not rinse with hot water. Provide medical prompt attention, frozen tissue is painless and appear waxy, with a possible yellow color. Frozen tissue will become swollen, painful and prone to infection when thawed.
- Eye contact** : Individual in contact with a gas should not wear contact lenses. Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 20 minutes. Get medical attention if symptoms occur.
- Ingestion** : Since the product is a gas, it will probably be inhaled rather than ingested. Consider first the preventive measures in case of inhalation.
- Notes to physician** : The medical doctor must be warned that the person may suffer from anoxia.

Section 5. Fire-fighting measures

- Flammability of the product** : Non-flammable.
- Products of combustion** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
- Explosion hazards in the presence of various substances** : Container explosion may occur under fire conditions or when heated.
- Fire-fighting media and instructions** : Use an extinguishing agent suitable for the surrounding fire.

Not available.
Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

- Personal precautions** : EVACUATE ALL PERSONNEL FROM AFFECTED AREA.
Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is on cylinder or cylinder valve, contact the closest Air Liquide location.
- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Methods for cleaning up** : Immediately contact emergency personnel. Stop leak if without risk. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling

- Valve protection caps must remain in place unless cylinder is secured with valve outlet piped to usage point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure regulator when connecting cylinder to lower pressure piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow to the cylinder. Do not tamper with (valve) safety device. Close valve after each use and when empty.

Storage

- Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 52°C/125°F. Cylinders must be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in - first out" inventory system to prevent full cylinders being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no source of ignition in the storage or use area.

Section 8. Exposure controls/personal protection

Engineering controls

- Use only in well-ventilated areas. Gas is heavier than air and will therefore accumulate in low lying areas.

Personal protection

Respiratory

- Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Hands

- Wear leather gloves when handling cylinders of this gas mixture. Otherwise, wear glove protection appropriate to the specific operation for which this gas mixture is used.

Eyes

- Safety glasses with side shields.

Skin/Body

- Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Metal cap, safety shoes are recommended when handling cylinders.

Not available.



Some applications of this product may require additional or other specific protective clothing. Please consult your supervisor.

- Personal protection in case of a major leak** : Safety glasses, goggles or face shield. Impervious gloves. Full suit. Metal cap, safety boots. Wear MSHA/NIOSH-approved self-contained breathing apparatus or equivalent and full protective gear.

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling		
Ingredient	List name	ppm	mg/m ³	Other	ppm	mg/m ³	Other	ppm	mg/m ³	Other
Carbon dioxide	US ACGIH 2/2010	5000	9000	-	30000	54000	-	-	-	-
	AB 4/2009	5000	9000	-	30000	54000	-	-	-	-
	BC 9/2010	5000	-	-	15000	-	-	-	-	-
	ON 7/2010	5000	9000	-	30000	54000	-	-	-	-
	QC 6/2008	5000	9000	-	30000	54000	-	-	-	-

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Physical state	: Gas or liquefied gas.
Color	: Colorless.
Odor	: Odorless.
Molecular weight	: 44.01 g/mole
Molecular formula	: CO ₂
Boiling/condensation point	: -78.55°C (-109.4°F)
Melting/freezing point	: Sublimation temperature: -78.5°C (-109.3°F)
Critical temperature	: 30.9°C (87.6°F)
Specific gravity	: 1.56 (Air = 1)
Vapor density	: 1.53 [Air = 1]
Solubility	: Partially soluble in the following materials: cold water.

Section 10. Stability and reactivity

Stability and reactivity	: The product is stable.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

<u>Acute toxicity</u>	
IDLH	: 40000 ppm
Acute Effects	
Inhalation	: Inhalation of this product may cause dizziness, an irregular heartbeat, narcosis, nausea or asphyxiation.
Skin	: Dermal contact with a rapidly evaporating liquid could result in freezing of the tissues or frostbite.
Eyes	: Liquid or rapidly evolving gas can cause burns similar to frostbite.
Ingestion	: Since the product is a gas, it will probably be inhaled rather than ingested. Consider first the preventive measures in case of inhalation. Ingestion of liquid can cause burns similar to frostbite.
Potential chronic health effects	: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available.

Section 12. Ecological information




<u>Aquatic ecotoxicity</u>	
Products of degradation	: This gas is released as is in the atmosphere.

Section 13. Disposal considerations

Disposal	: Do not attempt to dispose of the container or of its content. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to Air Liquide Canada for proper disposal. For emergency disposal, contact the closest Air Liquide Canada location.
----------	--

Section 14. Transport information

NAERG : 120

Regulatory information	UN number	Proper shipping name	Classes	PG*	Label
TDG Classification	GAS: UN1013 LIQUID: UN2187	CARBON DIOXIDE CARBON DIOXIDE, refrigerated liquid	2.2 2.2	-	
IMDG Class	GAS: UN1013 LIQUID: UN2187	CARBON DIOXIDE CARBON DIOXIDE, refrigerated liquid	2.2 2.2	-	
IATA-DGR Class	GAS: UN1013 LIQUID: UN2187	CARBON DIOXIDE CARBON DIOXIDE, refrigerated liquid	2.2 2.2	-	

PG* : Packing group

Additional information

Cylinders should be transported in a secure position, in a well ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards and should be discouraged.

UN

-

TDG

Explosive Limit and
Limited Quantity Index
0.12

IMDG

Emergency schedules
(EmS)
F-C, S-V

IATA

Passenger and Cargo Aircraft
Quantity limitation: 75 kg
Packaging instructions: 200
Cargo Aircraft OnlyQuantity
limitation: 150 kg
Packaging instructions: 200
Limited Quantities - Passenger
AircraftQuantity limitation:
Forbidden
Packaging instructions: Forbidden

Passenger Carrying Road
or Rail Index
75

Section 15. Regulatory information

Canada**WHMIS (Canada)**

: Class A: Compressed gas.

**Canadian lists**

: **CEPA Toxic substances:** This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is not listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

**Canada inventory
(DSL/NDSL)**

: This material is listed or exempted.

Date of issue : 06/15/2011

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Gas.	
Health	1
Fire hazard	0
Physical Hazard	0
Personal protection	G

Liquid.	
Health	3
Fire hazard	0
Physical Hazard	2
Personal protection	X

HAZARD RATINGS

4- Extreme
3- Serious
2- Moderate
1- Slight
0- Minimal

National Fire Protection Association (U.S.A.)



See section 8 for more detailed information on personal protection.

References

- : ANSI Z400.1, MSDS Standard, 2004. - Manufacturer's Material Safety Data Sheet. - Canada Gazette Part II, Vol. 122, No. 2. Registration SOR/88-64, 31 December 1987. Hazardous Products Act "Ingredient Disclosure List" - Canadian Transport of Dangerous Goods, Regulations and Schedules, Clear Language version 2005. CGA C-7 Guide to the Preparation of Precautionary Labels and Marking of Compressed Gas Containers. CGA P-20 Standard for Classification of Toxic Gas Mixtures. CGA P-23 Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components.

Date of issue : 06/15/2011
Date of previous issue : 06/30/2008
Version : 5

Notice to reader

THE INFORMATION, RECOMMENDATIONS AND DATA CONTAINED IN THIS DOCUMENT ARE INTENDED TO BE USED BY PROPERLY TRAINED AND QUALIFIED PERSONNEL ONLY AND AT THEIR SOLE RISKS AND DISCRETION. THE INFORMATION, RECOMMENDATIONS AND DATA HEREIN CONTAINED ARE DERIVED FROM SOURCES WHICH WE BELIEVE TO BE RELIABLE. HOWEVER, AIR LIQUIDE CANADA INC. MAKES NO REPRESENTATION AND GIVES NO WARRANTY OF ANY KIND WHATSOEVER WITH RESPECT TO THEIR ACCURACY OR COMPLETENESS AND ASSUMES NO LIABILITY FOR DAMAGES OR LOSS ARISING DIRECTLY OR INDIRECTLY FROM THEIR USE, WHETHER PROPER OR IMPROPER.

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- : ALIGAL™ : Trademark of L'Air Liquide S.A.

APPENDIX I

Water Treatment Plant Design Information

FACT SHEET

SITE WIDE WATER MANAGEMENT SERVICES



SITE WIDE WATER MANAGEMENT SERVICES

Tervita provides a full realm of water/sludge treatment and management for major infrastructure upgrade projects including LNG early works, facility expansions, dam construction and upgrades and large tunneling projects. These services are provided to clients who realize the benefits of having a complete water/sludge management plan and the right team to execute it. Tervita is prepared to work on behalf of the client during the planning phase of operations right through the complete project duration. Tervita is also set-up to respond quickly to unforeseen water problems that materialize as site conditions change, helping manage the customers risk.

SERVICES

Tervita provides a full spectrum of water / sludge treatment services to our clients. Our management and technical services in water/ sludge treatment include:

- Storm Water Management & Treatment
- Fixed Facility Operations & Maintenance
- Hydrocarbon Contaminated Water Treatment
- Concrete Cure Water pH Adjustment
- Dredgeate Processing
- Chemical Supply
- Reverse Osmosis Treatment
- Mobile Plug & Play Solutions
- Metals Contamination Treatment
- Construction Water Treatment
- Lab Analysis & Bench Testing
- Residual Management from Tunneling

INTEGRATED SERVICES

Tervita operates a group of specialty service lines, further providing value to our client. Through these specialized teams, Tervita can provide additional site services including demolition and deconstruction of on site structures, remediation of contaminated sites, and transportation and disposal of contaminated material.





PROJECT EXPERIENCE

Tervita has been providing water treatment services for over 15 years with project operational parameters ranging from 10 – 2,500 gpm. Tervita has the personnel and equipment to address your site wide water management challenges. Some examples include:

WANETA DAM EXPANSION WATER TREATMENT

DATE

2010 - 2014

LOCATION

Trail, BC

CLIENT

ASL JV

PROJECT SCOPE

Tervita was contracted to provide 3 mobile water treatment systems during the Waneta Dam expansion. Each system removed suspended solids generated from construction activity and monitored and data logged NTU and pH for the customer. The mobile systems were phased in and out over the 4 year project.



KITIMAT MODERNIZATION PROJECT WATER MANAGEMENT

DATE

2011 - 2013

LOCATION

Kitimat, BC

CLIENT

Bechtel Corporation

PROJECT SCOPE

Tervita was retained to complete a Design/Build project to provide construction and contaminated water management for the Kitimat Modernization Project. Tervita was responsible for ensuring that all impacted water on the construction site was treated and data logged to meet the established criteria prior to discharge while keeping the project on schedule.



EVERGREEN LINE RAPID TRANSIT PROJECT WATER MANAGEMENT

DATE

2014

LOCATION

Port Moody, BC

CLIENT

SSJV

PROJECT SCOPE

Tervita was contracted to treat water generated during tunneling work for the Evergreen Line Rapid Transit construction project. Utilizing a purpose built CESF system, Tervita collects, treats and data logs the construction water and discharges to storm once water quality criteria is met. Tervita's plug and play design allowed the addition of a mobile filterpress to address unexpected grout sediment generated from the Tunnel.





KITIMAT LNG CONSTRUCTION WATER MANAGEMENT

DATE

2013 - Present

LOCATION

Kitimat, BC

CLIENT

JGC-Fluor

PROJECT SCOPE

Tervita has been contracted to manage the treatment and discharge of construction water to environment during early works of the Kitimat LNG Facility. Due to the site topography and work plan the high pH/turbidity water generated from construction activity is treated using 3 separate CESF systems complete with ponds. Each system removes suspended solids, adjusts pH and monitors and data logs NTU and pH for the customer prior to discharge.



JOHN HART DAM CONSTRUCTION WATER MANAGEMENT

DATE

2014 - Present

LOCATION

Campbell River, BC

CLIENT

ASL JV

PROJECT SCOPE

Tervita was contracted for construction water treatment systems at BC Hydro's John Hart Dam upgrade project. Due to site limitations, Tervita provided a mobile CESF system utilizing tanks rather than ponds. Each system removes suspended solids, adjusts pH and monitors and data logs NTU and pH for the customer prior to discharge.



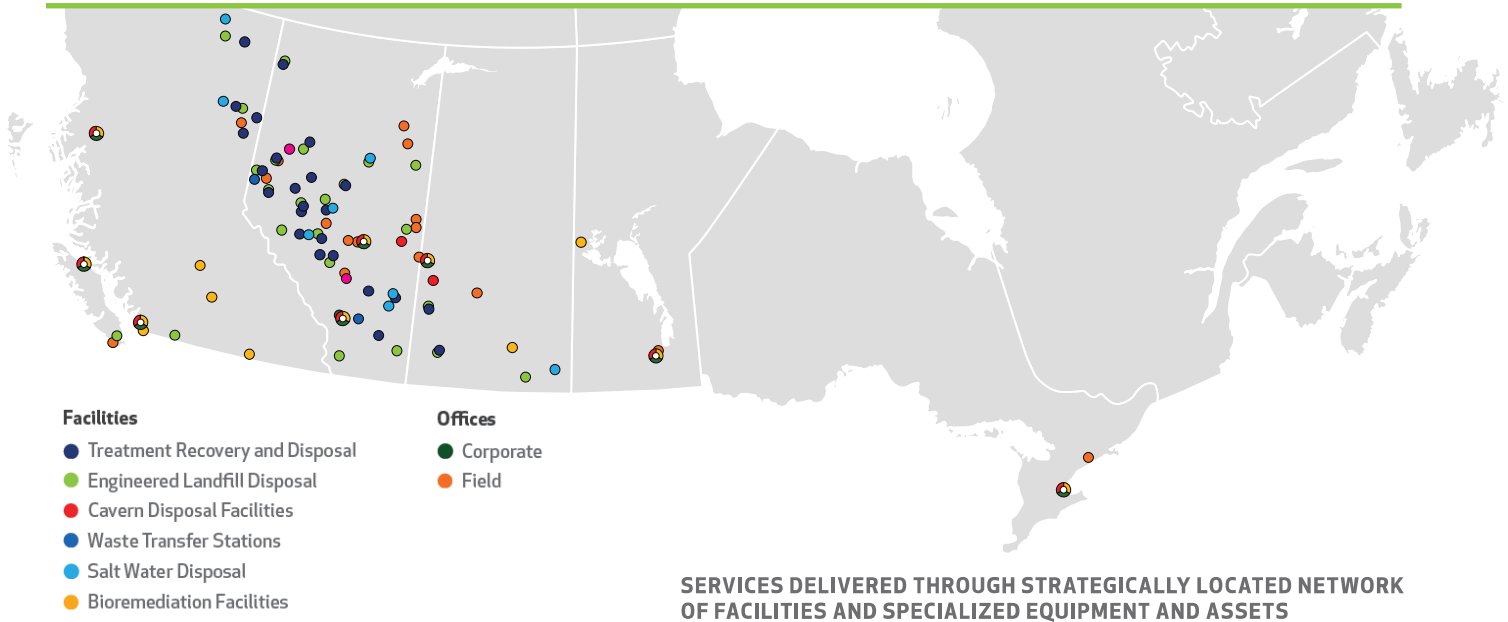
Tervita's
Chitosan
Enhanced
Sand Filtration
(CESF)
systems
minimize
environmental
risk ensuring
established
criteria is
met prior to
discharge.



EARTH MATTERS

OUR LOCATIONS

To support the full range of our solutions for natural resource and industrial customers across Canada, Tervita owns and operates a network of nearly 100 strategically located facilities with specialized, state-of-the-art equipment. This includes treatment recovery and disposal (TRD) facilities, engineered landfill and waste transfer stations, bioremediation facilities, cavern and disposal well facilities, salt water disposal facilities and regional offices.



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EARTH MATTERS

Tervita is a leading North American environmental solutions provider. With more than 4,000 dedicated employees, we are a trusted sustainability partner to oil and gas, industrial and mining companies and to the communities where we operate.
tervita.com | 1-855-837-8482 (CANADA) | 1-855-787-8376 (USA)

APPENDIX J

Chitosan Enhanced Sand Filtration (CESF) Operations Manual



CHITOSAN-ENHANCED SAND FILTRATION (CESF)

OPERATIONS MANUAL

VERSION 2.3
UPDATED DECEMBER 2017

Tervita Corporation
13511 Vulcan Way
Richmond, BC Canada
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EARTH MATTERS

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1 Revision History

#	Date	Section(s)	Page(s)	Revised By	Revision Description
00	Oct 31, 2017	All	All	MH	2017 Update Published
01	Nov. 28, 2017	All	All	MB/MH	Reviewed, Edits
02	Dec. 6, 2017			CP	Reviewed, Edits
03	Dec 7, 2017	All	All	MH	Reformat Sections, Review
04					
05					
06					
07					

2 Manual Distribution List

Tervita Environmental Services (2 Copies)

1. To be kept on site.
2. To be kept on file at Tervita Richmond Office.

3 Acronyms Used

CESF	Chitosan-Enhanced Sand Filtration
GFI	Ground Fault Interrupter
HP	Horsepower
OEM	Original Manufacturer Manual
PLC	Process Logic Controller
PRV	Pressure Relief Valve
PSI	Pounds per Square Inch
SRFO	System Requirements for Operation
SVE	Soil Vapor Extraction

4 Disclaimer

This manual is intended to provide reference to system safety, maintenance and operational procedures for a Tervita Environmental Services Ltd. (Tervita) CESF water treatment system. Upon receipt of this manual the operator and any other staff associated with the machinery, should **CAREFULLY** read the manual. This manual is to be made readily available to qualified operating and maintenance personnel responsible for the system. It is the responsibility of all employees involved with the operations of a CESF water treatment system to become fully acquainted with the information contained herein.

Qualified personnel should be experienced and knowledgeable of Safety Standards, be recognized by the safety department manager as capable and effective with any safety issues, should the need arise.

The system is to be used only for the applications specified in the order documentation and associated materials. In the event that the system is used for a different application or setting, please consult Tervita personnel knowledgeable in the design and operation of the system.

Tervita cannot guarantee repairs or alterations by the user or other unauthorized personnel, without the consultation of Tervita.

If there are any questions regarding the information contained in this manual, contact your supervisor.

The information contained herein belongs to Tervita and it is to be considered proprietary and confidential. Except when expressly provided by Tervita in a written consent, reproduction, disclosure or re-distribution of the Confidential Information is prohibited.

5 Contacts

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Michael Balasescu, Mechanical Engineer

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Chris Ptak, Manager – Water Solutions
Stephanie DaSilva, Project Manager

6 Safety Instructions

Please read the following instructions. Strictly adhere to the instructions listed below to prevent personal injuries and/or equipment damage.

- Electrical connections on any motors or electrical controls must ALWAYS be conducted by qualified and authorized personnel and in accordance with local and national codes.
- When approaching the pump(s) the operator must be properly dressed (avoid the use of clothes with wide sleeves, neckties, and jewelry) and wear safety equipment adequate for the work to be performed. Please refer to the plant safety plan for further PPE requirements.
- Always stop the pump(s) prior to touching.
- Always disconnect the power to the pump prior to working or removing the pump(s) from the installation.
- Always follow lock-out / tag-out procedures in place.
- Never work on or disconnect pumps or process piping when hot, under a vacuum or pressurized.
- Always replace the coupling and motor guards when previously removed.
- Do not operate any pump in the wrong direction.
- Never put your hands or any appendages in any openings or cavities.
- Never operate any pump without priming it first.
- Never step or stand on any pump, motor or process piping.

NOTE!

Maintenance personnel should familiarize themselves with the treatment process and component parts of the equipment to be serviced as hazardous materials may be encountered. These hazards may include the following:

- Grease used for operation and general lubrication (possible allergic reaction or skin and eye irritation).
- Plastic and elastomer components used in O-rings, V-Ring, splash ring, oil seals, stators and the like (possible release of fumes and vapours when overheated).
- Varnishes from exterior pump and equipment surfaces (potential release of powder and fumes in case of rework).
- Liquid compounds found between gasket and flat surfaces (skin, eye and lung irritation).
- Untreated wastewater, sludge and chemicals used in treatment (present in piping or pumping chambers of chemical pumps).

7 System Overview

The Chitosan-Enhanced Sand Filtration system (CESF) is a mobile module water treatment plant. This system uses chitosan flocculent to remove suspended solids and impurities from water prior to filtration. The modular system is built into standard 20' seacans for ease of shipping and configuration. Many different flow and layout configurations are possible. The Control Module houses all the electronics, measuring and dosing equipment. This can be paired with a number of Filter Modules depending on the flow requirements of the site.



Figure 1 - Monitoring station module

The Filter Modules and the pumps required are external and separate from the Control Module. The number of Filter Modules and the size of pumps to be used will be selected specifically for each site application.



Figure 2 - Water treatment system

The water treatment system is comprised of the following subsystems and equipment:

- **Stage 1 – Pretreatment**
 - Pre-Treat Holding Tank (or Pond)
 - Allows particulate to settle out before the water is pumped to the CESF Pretreatment
 - Pretreatment pump
 - Low pressure high flow pump
 - Chitosan Dosing
 - Dosing liquid Chitosan using peristaltic metering pump through a static injection mixer for low flow units, generally under 300 GPM
 - Dosing Chitosan flakes (CF) using an educator for high flow units, generally over 300 GPM
 - Monitoring
 - pH and flow monitoring
 - pH can be adjusted
- **Stage 2 - Influent treatment**
 - Main Holding Tank (or Pond)
 - Allows chitosan floc to set up and particulate to settle out
 - Process pump
 - High pressure high flow pump
 - Low secondary liquid Chitosan dosing using peristaltic metering pump through a static injection mixer
 - Monitoring
 - pH, flow and turbidity monitoring
 - pH can be adjusted
 - Sand Filters
 - Manual butterfly valve to adjust back pressure for optimum filtration
- **Stage 3 - Discharge Compliance Check**
 - pH, flow and turbidity monitoring
 - Water is discharged to environment if compliant, or recirculated to pre-treatment holding tank (or pond) based on results
- **Auxiliary Systems**
 - Chitosan Injection System
 - Chitosan Flakes (CF) injection is achieved using an educator installed in line with the pre-treat system
 - Liquid Chitosan injection is achieved using peristaltic metering pumps and static injection mixers
 - Pneumatic System
 - Air compressor
 - Pneumatic valves
 - Electronic System

- PLC
- Power Distribution

Each of these process units are described in detail in the following sections.

7.1 Pretreatment Stage



Figure 3 – CESF System

7.1.1 Pre-Treat Holding Tank/Pond [Not Included]

The Pre-Treat Holding Tank (or Pond) is designed for run-off water collection. The particulate matter in the run-off water will settle before being pumped through the pretreatment stages of the CESF system to allow the chitosan floc and for particulate to settle out of the water.

7.1.2 Pre-Treatment Pump

This is a low pressure, high flow pump to be designed to pump through the system into the Main Holding Tank (or Pond).

7.1.3 Pre-Treatment

Water is given initial dose of chitosan using a peristaltic metering pump or chitosan flake auger through a static injection mixer to begin flocculating and settling. The flow and pH are measured using a flowmeter and pH probe. If necessary, the pH can be adjusted by injecting carbon dioxide (CO₂). Subsequently, the water is discharged into the main pond.

7.2 Influent Treatment

7.2.1 Main Holding Tank/Pond [Not Included]

The Main Holding Tank (or Pond) is designed to allow the sediment in the water injected with chitosan during the Pre-Treatment stage to settle before being pumped through the Influent treatment and Discharge/Recirculation Stages.

7.2.2 Process Pump [Not Included]

This is a high pressure, high flow pump to be designed to pump through the control module, the sand filters and back through the control module to the discharge. The pump is located in the main pond and is controlled by high, low and high-level alarm switches through the PLC.



Figure 4 - Influent treatment

7.2.3 Influent Treatment

Water is given a secondary dose of liquid chitosan using a peristaltic metering pump to adjust the concentration of chitosan and to promote flocculation. A flow and pH meter measure the flow and pH respectively. If necessary, the pH can be adjusted by injecting carbon dioxide (CO₂). A turbidity meter measures the turbidity.

7.3 Discharge/Recirculation

6.3.1 Sand Filters

Sand filters are intended to remove solids from the water before being discharged. Sand filters are arranged in pods of four sand filters called Sand Pods, and placed inside a seacan. This arrangement is a Filter Module. Depending on the flow requirements of the system more Filter Modules can be added in parallel. Each sand filter contains a base layer of support gravel under the main layer of filter medium. The filter medium is a specially designed washed and graded filtration sand. Each Sand Pod has an electro-pneumatic back flush system that purges filtered particulate from the sand bed to sanitary discharge. Back flushing requires back pressure with the amount dependent on the size of the sand pods being back flushed. A manually operated butterfly valve on the discharge line is adjusted when back flushing to create the proper amount of back pressure. The Sand Pods can be set to back flush manually or automatically by either time or pressure differential. The back-flush status is monitored through the PLC.

7.3.2 Discharge Compliance Check

After passing through the sand filters the water is monitored in real-time for compliance. The flow and pH are measured using a flowmeter and a pH probe. The turbidity is measured using a turbidity meter. The treated water is discharged to the environment, or re-circulated if non-compliant with the Client's permit requirements. The PLC controls the discharge and recirculation via two pneumatic actuated valves one dedicated to discharge and the other to recirculation.

7.4 Chitosan Injection System



Figure 5 - Chitosan injection system

This system doses liquid chitosan into the treatment water using peristaltic metering pumps for proper dispersion in the water being treated. A dedicated peristaltic pump and static injection mixer assist with the chitosan injection process into each line, depending on the requirements of the water. Each pump has a calibration cylinder for manual flow calibration. Liquid chitosan is pumped from a 1000-liter chemical tote.

In some cases, the pretreatment system uses chitosan flakes instead of liquid for treating the water that is circulated from the Pre-Treat Tank (or Pond) to the main pond. The chitosan flakes are delivered to the system via a screw feeder and an in-line eductor installed in the water line.

7.5 Pneumatic System

This system uses a compressor to feed the pneumatic valves to direct flow to either discharge to environment if in compliance with the permit or to recirculation to the Pre-Treat Tank (or Pond) if non-compliant with the permit.

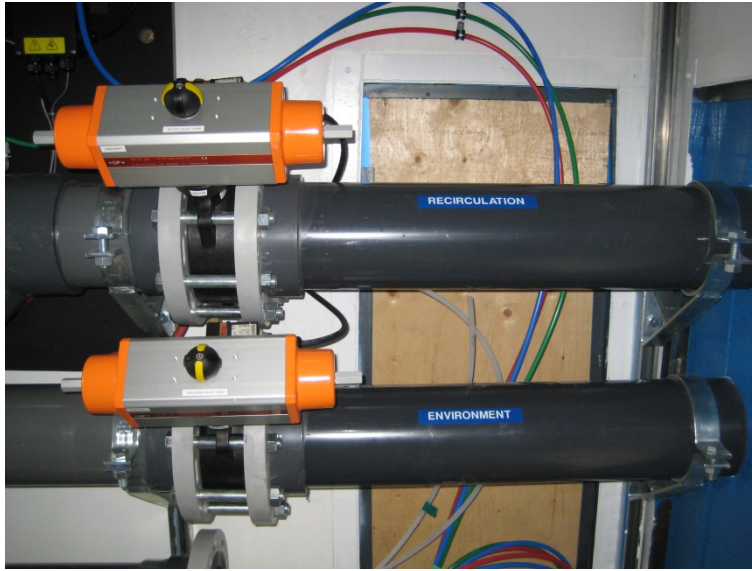


Figure 6 - Pneumatic valves

7.5.1 Compressor

The 1.5 HP 20-gallon air compressor is rated up to 150 PSI maxis normally set via the regulator to 90 PSI. It supplies compressed air to the pneumatic valves.

7.5.2 Pneumatic Valves

The pneumatic valves are controlled by the PLC but are actuated by the air pressure generated by the compressor. The water is directed by two pneumatic valves, one on the recirculation side of the discharge line, and the other on the discharge to environment side of the discharge line. These two valves are not interchangeable. They control the path of the discharged water, diverting it from discharging to the environment to recirculating back to the Pre-Treat Tank (or Pond) if it is out of compliance. In case of a loss in air pressure, the recirculation valve will fail open and the discharge valve will fail closed. This provides a path for the water preventing a dangerous build-up of pressure and recirculates the water so that no non-compliant water is discharged when there is no control to the valves.

7.6 Electrical System

The purpose of the electrical system is to distribute power and control the systems with the PLC Controller.

7.6.1 PLC System

The PLC system acts to control the system. The PLC controls pumps and discharge valves by monitoring pH, turbidity, and tank (or pond) level alarms. The operator controls the system via a touch screen. The interface allows the operator to view the pH, flow, turbidity and pressure of the three lines; view the status of the various pump alarms and the backwash cycle; control the pumps; and set pH and turbidity limits for discharge compliance.



Figure 7 - PLC system

7.6.2 Power Distribution

The power distribution system acts to distribute power to the system.



Figure 8 - Power distribution panel

8 System Maintenance

For the CESF Treatment System, there are several maintenance checks and operations that must be completed on a daily, weekly, quarterly, and yearly basis. The maintenance tasks, listed in Tables 1 and 2 will be discussed in the following sections of this report.

For performing the operations described within this manual, the safety and lock-out procedures in place must be followed at all times. To ensure that the control module is shut off, flip the power switches of the power panels on the outside of the control module to the OFF position and place a lock, or lockout clip for multiple locks, through the lockout holes so the power cannot be turned back on with the locks in place.

Table 1 - Maintenance Requirements

Reference	Task	Frequency
7.1	WATER TREATMENT SYSTEM	
7.1.1	pH sensor	
7.1.1.1	Clean electrode	Daily
7.1.1.2	Check calibration	Daily
7.1.1.3	Remote sensor calibration	Quarterly
7.1.2	Flow meter	Yearly
7.1.3	Turbidity meter	
7.1.3.1	Clean	Daily
7.1.3.2	Calibrate	Daily
7.1.3.3	Replace desiccant	As Required
7.1.4	Check the operation of the valves	Daily
7.1.5	Check for water leaks	Daily
7.2	CHITOSAN INJECTION SYSTEM	
7.2.1	Metering pump maintenance	
7.2.1.1	Quality inspection	Daily
7.2.1.2	Reverse rotor direction	Monthly
7.2.1.3	Tube replacement	As Required
7.2.2	Residual chitosan test	Daily
7.2.3	Check chitosan tote volume	Daily
7.2.4	Check the operation of the valves	Daily
7.2.5	Check for chitosan leaks	Daily
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7.3.1	Air compressor maintenance	
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8.1 Water Treatment System

Maintenance tasks relating to the water treatment system are discussed in the following sections of this manual. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- pH sensor maintenance
- Flow meter maintenance
- Turbidity meter maintenance
- Check the operations of the valves
- Check for water leaks

8.2 pH sensor

Maintenance tasks relating to the pH sensors are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Cleaning the electrode
- Checking the calibration
- Remotely calibrating the sensor



Figure 6 - pH sensors

8.2.1 Clean Electrode

The plant operator should clean each pH sensor on a daily basis to ensure accuracy and longevity of sensor and electrode.

1. Shut off the water supply line
2. Unscrew the pH sensor from the base
3. Spray or immerse the electrode tip in a mild detergent
4. For hard coatings soak for 2-5 minutes in a
 - a. dilute acid solution (HCL 5% or less) when pH higher than 7 or
 - b. dilute alkaline solution (NaOH 5% or less) when pH less than 7

5. Rinse the electrode tip with water
6. Soak electrode in a pH 4 buffer for at least 5 minutes

8.2.2 Check Calibration

The plant operator should check the calibration of each pH sensor on a daily basis to ensure accuracy and longevity of sensor and electrode.

1. Shut off the water supply line
2. Unscrew the pH sensor from the base
3. Immerse the electrode tip in a pH 7 buffer solution
4. Wait for the reading to stabilize
 - If measurement is within allowable deviations as specified in the manufacturer manual reinstall the probe.
 - If the measurement is not within allowable deviations as specified in the OEM documentation, then the probe must be calibrated or a new probe is necessary.

8.2.3 Remote Sensor Calibration

The operator should perform a remote calibration for each pH sensor every 3 months or as needed to ensure accuracy.

1. Shut off the water supply line.
2. Unscrew the pH sensor from the base.
3. Remove the cap on the top of the sensor for access.
4. With no electrode connected to the sensor press and hold SW1 until the LED (D1) comes on steady then goes off again (approx. 10 sec.).
5. Connect an electrode.
6. Place the electrode/sensor assembly into one inch of calibration liquid (pH 4.0, 7.0 or 10.0 buffer solutions). Wait for at least 30 seconds before calibration.
7. Press and hold SW1 for approx. 8 to 10 seconds The LED (D1) will come on steady then go back out.
8. Release SW1. If the LED blinks several times rapidly, the calibration was not successful. See the troubleshooting section in the included manufacturer's manual.
9. Remove the electrode/sensor assembly from the first buffer solution and rinse the electrode with clean water.
10. Place the electrode/sensor assembly into one inch of the second calibration liquid (pH 4.0, 7.0 or 10.0 buffer solutions, different from the first). Wait for at least 30 seconds before calibration.
11. Release SW1. If the LED blinks several times rapidly, the calibration was not successful. See the troubleshooting section in the included manufacturer's manual.
12. Remove the electrode/sensor assembly from the first buffer solution and rinse the electrode with clean water.

8.2.4 Flow Meter

The flow meters are attached directly to the main lines via a saddle clamp. Servicing the flow meters during normal operations is not recommended. Only a trained Tervita Technician should service the flow meters. If the flow meter stops working or the measurements become erratic the operator should shut down the plant and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.



Figure 7 - Flow meters

8.2.5 Turbidity Meter

Maintenance tasks relating to the turbidity meter are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Cleaning the Cuvette.
- Checking the Calibration.
- Replacing the Desiccant Pack

8.2.5.1 Clean

The turbidity meters should be cleaned daily to insure a correct and accurate reading. Each of the turbidity meters use an optic sensor, so the glass cuvette must be dry, free of dust fingerprints, marks or scratches.

1. Remove the flow through unit
2. Use a detergent solution to clean the glass flow through cuvette
3. Rinse several times with distilled or de-ionized water

4. Use a Kim cloth or an optics cloth to wipe down the surface of the glass
5. The surface of the glass should be free of dust, fingerprints, marks or scratches

8.2.5.2 Calibration

The turbidity meters should be calibrated every 3 months or as needed.

1. Shut off the water supply line
2. Select the calibration function by pressing the Mode/Exit button
3. The lower display will flash alternately the standard requested (1000 NTU or 100 NTU) and the 'Enter' Symbol.
4. Remove the flow through unit
5. Insert the requested Standard
6. Index the standard to the lowest value on the upper display
7. Press the 'Enter' button to accept the calibration
8. The lower display will count down the progress of the calibration
9. The lower display will flash alternately the next standard requested (10.0 NTU) and the 'Enter' Symbol. Insert the requested Standard
10. Index the standard to the lowest value on the upper display
11. Press the 'Enter' button to accept the calibration
12. The lower display will count down the progress of the calibration
13. The lower display will flash alternately the next standard requested (0.02 NTU) and the 'Enter' Symbol.
14. Insert the requested Standard
15. Index the standard to the lowest value on the upper display
16. Press the 'Enter' button to accept the calibration
17. The lower display will count down the progress of the calibration
18. The instrument will return to AUTO mode

8.2.5.3 Replace Desiccant

The desiccant only needs to be changed when the DESC alarm is displayed on the lower portion of the display. The desiccant is necessary to keep condensation off the cuvette which would compromise the accuracy of the turbidity measurement.

1. Unscrew four corner thumbscrews and remove the electronics half of the instrument
2. Open the bag protecting the new desiccant pouch and install in the instrument base assembly
3. Disconnect the sensor interconnect cable for 2 seconds and then reconnect to reset desiccant recognition

8.2.5.4 Check for Water Leaks

The operator should perform a daily visual check of all the particular components of the water treatment system for leaks, paying special attention to connection points. Should a leak be present, the operator should stop the leak. Shutting down the plant may be

necessary. Immediately contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.2.6 Chitosan Injection System

Maintenance tasks relating to the chitosan Injection System are discussed in the following sections of this manual. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Metering pump maintenance
- Residual chitosan test
- Check chitosan tote volume
- Check the operations of the valves
- Check for chitosan leaks

8.2.6.1 Metering Pump

Maintenance tasks relating to the metering pump are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Quality inspection
- Reverse rotor direction
- Tube replacement

8.2.6.2 Quality Inspection

Inspect metering pump condition daily. Inspect all components for signs of leaking, swelling, cracking, discoloration or corrosion. Replace worn or damaged parts immediately. Ensure the pump head chamber, roller assembly, and pump head cover is free of /debris and is properly lubricated.

8.2.6.3 Reverse Rotor Direction

Every month the rotation direction of the pump rotor should be reversed. Reversing the direction of rotation increases the life of the tubing assembly by changing the outlet/pressure side of the tubing, which is the typical failure point. This simple procedure is completed by the following steps:

1. Disconnect the discharge and suction lines from the pump
2. Switch the discharge and suction lines and reattach
3. Press the REVERSE ROTATION button.

8.2.6.4 Tube replacement

In case of a tube failure the pump will display TFD (tube failure detection) and stop pumping. If a tube fails, the tube must be replaced, and the pump head and roller assembly

must be thoroughly cleaned. Failure to clean the roller assembly will void warranty. The Steps to replace the tube are:

1. Remove the pump head cover by unscrewing the four thumb screws. The pump will automatically go into MAINTENANCE MODE when it detects the pump head cover has been removed and will rotate at a maximum of 6rpm for safety.
2. Pull out the suction side of the tube assembly.
3. If the rotor is not rotating (press START), pull out the old tube assembly. Guide the tubing out between two rollers letting the rotor do the work.
4. Stop the pump
5. Insert the suction fitting into the pump head
6. Start the pump
7. Using the tube assembly tool, guide the tubing into the pump head, letting the rotor do the work and keeping fingers clear of the rotor.
8. Pull on the tube assembly till you can insert the discharge fitting into the slot in the pump head.
9. Reinstall the head cover making sure it has been greased, and the discharge and suction lines. The pump will detect the head cover and will ask you if the tube was replaced (Y/N). If yes, the pump will ask you to reset the tube timer (Y/N).

8.2.7 Residual Chitosan Test

Discharge water should be checked daily for residual chitosan. This ensures that excess amounts of chitosan are not being discharged to the environment as well as to reduce chitosan waste. The following steps are to check for residual chitosan. This is a quantitative test with a positive result occurring when ≥ 1.0 ppm of chitosan present.

1. Collect a 1 L sample from the outflow
2. Add 5 drops of color enhancement solution
3. Fill the syringe with 50 ml with the sample
4. Attach the three-piece filter housing with a filter inserted to the end of the syringe
5. Filter the liquid by depressing the plunger (do not keep the filtered liquid; only the filter itself)
6. Remove the filter using tweezers and place the side that was facing the syringe up
7. Add 1-2 drops of iodine and compare to chart
 - A positive result (≥ 1.0 ppm) will appear dark brown or purple

8.2.8 Check Chitosan Tote Volume

The operator should check the volume of chitosan left in the chemical tote daily. The daily usage should be recorded and can be used to estimate when to order more chitosan. When ordering more chitosan, Tervita Environmental Services requires five (5) days for delivery, if necessary.

8.2.9 Check for Chitosan Leaks

The operator should perform a daily visual check all the components of the chitosan Injection System for leaks, paying special attention to connection points. Should a leak be

present, the operator stops the leak and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.3 Pneumatic System

Maintenance tasks relating to the Pneumatic System are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Air compressor maintenance
- Air Actuated (Pneumatic) valves

8.3.1 Air Compressor

On a daily basis the condition of the air compressor should be checked. A visual inspection of the air compressor should be completed to ensure no leaks are present at connection points and that there are no worn or broken parts. The pressure switch should be in the ON position during normal plant operations. Maintenance tasks relating to the metering pump are discussed in the following sections. These maintenance tasks include:

- Check the air intake filter
- Check for condensation
- Check operation of PRV
- Check operation of pressure switch
- Inspect the oil

8.3.1.1 Check the Air Intake Filter

The air intake filter provides clean air to the pump. It must always be kept clean and free of debris. This must be checked daily. To check the air filter, remove the air filter cap on the compressor housing.

8.3.1.2 Check for Condensation

The tank should be checked and drained of condensation daily. To check and drain condensation from the air tank use the following steps:

1. Unscrew drain plug located on the bottom of the compressed air tank
2. Tighten the drain plug only when no liquid comes out of the bleeder

8.3.1.3 Check Operation of Pressure Relief Valve

The operator should check the operation of pressure relief valve daily. If the PRV is not functioning properly, there could be a dangerous build-up of pressure. To check the operation of the PRV use the following step:

1. Pull the split ring on the end of the PRV till it vents air
 - Ensure the valve is not seized and is free of grit or obstructions

8.3.1.4 Check Operation of Pressure Switch

The operator should check the operation of pressure switch daily. The pressure switch shuts off the compressor when the tank is full and reaches operating pressure. If the pressure switch is not functioning properly, there could be a dangerous build-up of pressure. Flip the switch to the OFF position then back to the ON position. The compressor should shut off then come back on. The compressor should come up to operating pressure and shut off. The pressure switch should be kept in the ON position during normal plant operations. If there are any problems with the Pressure switch shut down the system and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.3.1.5 Inspect the Oil

The condition of the oil should be checked daily. Check the quality and color of the oil through the site glass on the compressor housing. The oil should be clean and light in color and free of dirt and grit. If the oil is black or milky, the operator should shut down the plant and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.3.2 Air Actuated Valves

The operator should lubricate the pneumatics of the air actuated valves weekly. Only use air tool oil for lubricating pneumatic equipment. The steps to lubricate the air actuated valves are the following:

1. Remove the air feed line from the compressor
2. 5 drops of oil into the air fitting
3. Cycle the valve open and closed 5-10 times to work-in lubricant



Figure 8 – Air actuated butterfly valve

8.3.3 Check the Operation of Valves

The Operation of the various valves should be checked during every maintenance visit.

These valves include any:

- Air actuated valves
- Pressure release valves

It is necessary that all valves be capable of opening or closing as the operator requires. The functionality of each valve should be tested daily by closing it all the way, followed by opening it all the way. Should there be any problems with the valves, the valves should be removed from the circuit, disassembled, cleaned, and lubricated. If the problem persists with the valve, the valve should be replaced. Contact the manufacturer listed on the valve for information on how to find a replacement valve or contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

NOTE: The time between opening either one of the air actuated valves and closing of the other one shall be set at a minimum of 20 seconds to avoid pressure surges in the piping that could lead to water hammer effects.

8.3.4 Check Operation of Needle Valves

The operation of needle valves shall be checked during every maintenance visit.

The Needle Valves tags NV-1080 and NV-1081 are installed as follows:

1. NV-1080 is installed on the air vent of port of solenoid valve SV-1080. The role of NV-1080 is to slow down the air release from the air actuator of BFV-1041 and subsequently slow down the closing time of the pneumatic valve.
IMPORTANT: NV-1080 should only be opened 1/4 turn or less. The operator shall check the speed of closing for BVF-1041 and adjust NV-1080 to maintain a slow closing of pneumatic valve.
2. NV-1081 is installed on the air supply line from solenoid valve SV-1081 to air actuator of valve BFV-1042. The role of NV-1081 is to slow down the opening/closing time of the pneumatic valve.
IMPORTANT: NV-1081 should only be opened 1/4 turn or less. The operator shall check the speed of closing for BVF-1042 and adjust NV-1081 to maintain a slow opening/closing of the pneumatic valve.

The reason of the above setting is to ensure the slow closing of valves BFV-1041 and BFV-1042 to minimize and/or avoid any pressure surges in the piping that could lead to water hammer effect.

8.3.5 Check for Air Leaks

The operator should perform a daily visual check the piping and fittings of the pneumatic system for leaks, paying special attention to connection points and fittings. Should a leak be

present, the operator should stop the leak. Shutting down the plant may be necessary. Immediately contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.4 Electrical System

Maintenance tasks relating to the metering pump are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Inspect the Control Panel

8.4.1 Inspect the Control Panel

There are several maintenance checks relating to the control panel that the operator should perform during each maintenance visit to the treatment system. These maintenance tasks include:

- Checking for moisture and condensation
- Checking the fuses
- Smelling inside the panel for any odd odour
- Checking for any discoloration on wires, backplane, etc.
- Making sure the RUN light on the PLC is ON
- Checking the light bulbs for the alarm lights and replace if necessary
- Checking the panel fan and heater (if present) to ensure proper operation
- Checking the filter elements for fans and vents
- Testing the overload operation with the test button
- Cleaning out the panel of any debris or water build-up in the panel
- Testing the operation of all breakers
- Testing the GFI plugs
- Testing the critical alarm shutdowns
- Checking the operation of hour meters

Should there be any irregularities found, shut down the system immediately and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.5 Process Room

Maintenance tasks relating to the process room are discussed in the following sections. Should there be any problem with the operation of the equipment, contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual. These maintenance tasks include:

- Ensuring that the heater is working properly
- Checking the light bulbs and replacing as necessary

- Checking for leaks in the various pipelines
- Housekeeping

8.5.1 Ensure that the Heater is Working Properly

During the winter, the treatment system relies on internal heating to allow the system to operate smoothly. As such, it is important that the operator uses their judgment to determine whether the heating system is operating properly during the winter months. It is imperative that when the temperature is low that the heater work properly to prevent system shutdowns. Chitosan loses its ability to work effectively if frozen. Further information on the heating system is located on the side panel of the heater. If the heater stops working the operator should shut down the plant and contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.



Figure 9 - Process room air heater

8.5.2 Check Light Bulbs and Replace

It is imperative for daily operations as well as emergency response that there always be proper lighting in the process room. As such, the operator should be diligent in replacing any light bulb that may go out.

8.5.3 Check for Leaks

The operator should perform a daily visual check all the components and piping inside the process room for leaks, paying special attention to connection points and flanges. Should a

leak be present, the operator should stop the leak. Shutting down the plant may be necessary. Immediately contact the Maintenance Department at Tervita Environmental Services using the information provided in Section 1.0 of this manual.

8.5.4 Housekeeping

Housekeeping should be an ongoing task imperative for daily operations and emergency response. It is easier to detect leaks, find tools and equipment, and respond to problems in a clean process room. These maintenance tasks include:

- Make sure tools are put away and in the proper place
- Make sure there is an adequate amount of ear plugs and gloves
- Make sure that all glassware is clean and put away
- Make sure the table tops and floors are clean and free of spills
- Make sure there is an adequate amount of lab equipment and supplies

9 CONTROL STATION OPERATION

The following section provides an overview on the operation of the touch screen of the control station and plant operation. Prior to use it is recommended that the operator undergoes training from a Tervita technical representative.

Explanation of Process Logic

There are two components to the process logic, Alarm logic and operating logic of the output devices.

Alarm Logic: Any alarm in your system can be programmed 6 different ways:

System Shutdown Alarms: This alarm will stop the entire system and require a manual restart with the reset button.

Cascading Shutdown Alarms: This alarm must be manually reset. It will shut down part of the process and allow the system to continue to run until another critical system shutdown alarm stops the entire system.

Cascading Recoverable Alarms: This alarm will temporarily stop components in the system and allow them to restart once alarm condition has been corrected.

Water Treatment System Alarms: This is a shutdown alarm that will stop all components in the water treatment side of the process.

Air Treatment System Alarms: This is a shutdown alarm that will stop all components in the air treatment side of the process.

Non-Critical Warning Alarm: This is a warning alarm and will activate an alarm but not affect the process. It will remain on until the reset button is pressed.

Output Logic: This describes the operating logic of various Output Devices

System Requirements for Operation (SRFO): This describes the condition that the entire system must be in to allow the output to operate.

For example: The main SVE Blower may only run if the system is on while the building fan can operate at any time.

System On: This device can only run if the system is on and no system alarms are activated. It will shut off if these conditions are not met.

Air Treatment System On: This device can only run if the Air Treatment System is on and no Air Treatment Alarms are activated. It will shut off if these conditions are not met.

Water Treatment System On: This device can only run if the Water Treatment System is on and no Water Treatment System Alarms are activated. It will shut off if these conditions are not met.

Always On: This device will run regardless of if the system is on or not as long as the PLC is in run mode and there is power to the panel.

Note: If the system is not on or a system alarm occurs it will automatically prevent the air treatment system or water treatment system from operating.

Alarm Display Method: This describes the method of displaying the alarm to the operator. Some alarms will have different methods of display.

Rem: This alarm will be displayed on the remote access package.

Dis: This alarm will be user interface display on the front of the panel.

Light: This alarm will be displayed via a dedicated alarm light on the control pan

APPENDIX K

Westridge Marine Terminal Treatment Residuals Management Plan



Trans Mountain Expansion Project

Westridge Marine Terminal Treatment Residuals Management Plan

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TRANSMOUNTAIN

Trans Mountain Expansion Project

Westridge Marine Terminal Treatment Residuals Management Plan

TMC Document # 01-13283-TW-WT00-RG-PLN-0002

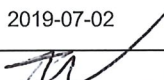
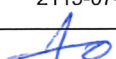


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1. INTRODUCTION

The Westridge Marine Terminal (WMT) is the western coastal loading and shipping facility for the Trans Mountain Pipeline. It is an existing facility that has been in operation for over 50 years, providing distribution of refined and crude oil products.

As part of the Trans Mountain Expansion Project (TMEP), the TMEP proponent, Trans Mountain Corp. (TMP) plans to expand the Westridge Marine Terminal to include a new dock complex, access road, substation and transmission line, product lines, as well as a utility dock, decommissioning of the existing berth and the construction of a tunnel to convey three new 30 inch delivery lines from the Burnaby Terminal under the Burnaby Mountain.

Trans Mountain Pipeline ULC has applied for an amendment to Permit 3678 for Phase 3 works from the BC Ministry of Environment and Climate Change Strategy under the *Environmental Management Act* (the Approval) to permit stormwater discharges from the WMT site. Treatment residuals management is part of the information requested by the Ministry during the pre-application process.

On behalf of TMP, Kiewit-Ledcor Transmountain Partnership (KLTP) has prepared a Treatment Residuals Management Plan for the Phase 3 construction activities at the WMT. Water Treatment Plant (WTP) tanks will accumulate sediment/sludge (residuals) as part of the treatment process, which will require periodic removal via hydrovac truck and disposal offsite at a facility licensed to receive the material as characterized. In total there will be three treatment systems: East Water Treatment Plant, West Water Treatment Plant and the Foreshore Water Treatment Plant.

2. TREATMENT RESIDUALS MANAGEMENT AND MONITORING STRATEGY

Hydrovac operations (removing accumulated material from WTPs) are incorporated into daily work routines to ensure that accumulated treatment residuals in WTP tanks are managed in accordance with TMEP requirements and applicable laws and regulations. This Treatment Residuals Management Plan has been developed in recognition of the unique use of hydrovac equipment for the removal and disposal of treatment residuals from WTPs.

The *Environmental Management Act* and its relevant regulations govern issues of waste generation, transportation and disposal. As such, treatment residuals from water treatment systems will receive specific handling, storage and disposal considerations. Treatment residual will be sampled and characterized as a precondition for removal from site, with parameters selected based on known contaminants of concern that the WTPs were configured to remove. Confirmed contaminated treatment residual will not be allowed to mix with non-contaminated treatment residuals. If contaminants are suspected, the suspect treatment residuals will either be treated as contaminated with disposal at a licensed facility, or temporarily quarantined on-site until analysis is complete and appropriate disposal plans are made. Non-contaminated treatment residuals can be transported to a TMP approved storage or disposal facility.

The hydrovac Contractor will follow the recording, reporting, and disposal guidelines set out in the *Waste Management Plan* (Section 3 of Volume 6 of the Environmental Plans) to ensure that appropriate documentation is completed, accurate, kept on file and transmitted to TMP, and to verify that the

contaminated treatment residuals will be disposed of in accordance with regulatory requirements and at approved facilities.

3. ANALYSIS AND SAMPLING

Material will be considered potentially contaminated where results from a QEP field-level risk assessment indicate a potential for contamination or sampling has confirmed the presence of contamination. If treatment residuals are determined to be potentially contaminated or confirmed to be contaminated, arrangements must be made for temporary storage onsite (as approved by the Lead Environmental Inspector), approved transportation, and final disposal. Known or potentially contaminated treatment residuals may be temporarily stored in a bermed and lined impermeable containment until a disposal location is approved. Known or potentially contaminated treatment residuals must not be allowed to drain onto or into the ground or surface water. Disposal facilities must have the required provincial permits to accept contaminated material.

Treatment residual samples will be sent to an environmental lab accredited by the Canadian Association for Laboratory Accreditation (CALA) to be analyzed for potential contaminants of concern associated with the treatment process and potential/known inputs. All sampling activities will follow the procedures described in the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples (B.C. Ministry of Water, Land and Air Protection, 2013).

4. REPORTING AND COMPLIANCE

As applicable, reporting will adhere to relevant requirements outlined in the amended waste discharge Permit 3678.

5. REFERENCES

BC MWLAP (British Columbia Ministry of Water, Land and Air Protection). 2013. British Columbia Field Sampling Manual. 2013 Edition. Water, Air and Climate Change Branch. Accessed November 27, 2017.

VOLUME 6 ENVIRONMENTAL MANAGEMENT PLANS SECTION 3.1 WASTE MANAGEMENT PLAN
FOR THE TRANS MOUNTAIN PIPELINE ULC TRANS MOUNTAIN EXPANSION PROJECT NEB
CONDITIONS 72, 78 AND 81 June 2017 REV 1
<https://apps.neb-one.gc.ca/REGDOCS/File/Download/3282208>

APPENDIX L

Westridge Marine Terminal—CESF Units—Decommissioning Plan



Kiewit Ledcor TMEP Partnership

Memorandum: Tervita CESF Decommissioning

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Client:	KLTP	Memo:	01
Attention:	Aman Oberoi	Date:	June 28, 2019
Phone:	(604) 828-9234	E-mail:	Aman.Oberoi@kltp.ca
From:	Mohsen Barkh	Pages:	2
Project:	CESF Units Decommissioning	Location:	Burnaby, B.C.

This memo provides the steps to be taken to decommission the Chitosan Enhanced Sand Filtration (CESF) water treatment systems and associated equipment proposed for Westridge Marine Terminal located at # 7065 Bayview Drive, Burnaby for storm water management in the safest and most cost-effective manner.

Upon being provided direction by Kiewit Ledcor TMEP Partnership (KLTP) to decommission Tervita owned equipment the following steps will be taken to decommission/demobilize:

Pre-Work Efforts

1. Prior to beginning the dismantling of equipment, Tervita will determine disposal options for liquid/solids from tanks, sand vessels and associated equipment. Waste characterization will be required and confirmed by the waste generator (client or consultant) to facilitate proper disposal in accordance with applicable municipal and provincial regulatory bodies. The decommissioning may commence after all regulatory requirements have been met and the method of disposal has been agreed upon by KLTP.
2. Tervita Project Manager & Operations team will review full scope of work to be completed and engage Tervita Health & Safety Advisor to ensure all safety documentation is in place. Tervita Safety Absolutes and SOPs will be followed and adhered to. Should KLTP standards exceed Tervita or WCB regulation, the more stringent policy will be applied.

Execution Efforts

Once water treatment for the applicable area if no further required or as directed by KLTP, the following decommissioning procedure will apply:

Mohsen Barkh
Sr. Project Manager,
Water Solutions
Environmental Services,
British Columbia
D: (604) 214-6047
C: (604) 788-7745

Tervita Corporation
13511 Vulcan Way
Richmond, BC
Canada
V6V 1K4
M: (604) 214-7000
F: (604) 214-7017



CONTRACT#: 7200000920

DATE: JUNE 28, 2019

PAGE 2 OF 2

1. Electrical disconnections of generators and distribution panels are to be completed by a certified electrician supplied and approved through Tervita's subcontractor application process.
2. Isolate all tanks and media vessel.
3. Third party vacuum truck required for the removal and cleaning of liquid/solids from tanks, sand vessels and associated equipment.
4. Disconnection of all hoses and pumps.
5. Client operator and loader required for the removal of pumps from the pond.
6. Client operator and loader required for the loading of all Tervita owned equipment on a third-party flat deck truck supplied and approved through Tervita's subcontractor application process.
7. Tervita's third-party transport company (winch truck) is required for the removal of all frac tanks and clarifier.
8. Total duration of decommissioning is expected to take 6 to 8 days.

Documents applicable to completing this work are as follows:

- Hand & Power Tool JSA
- Electrical Disconnections JSA & SOP
- Working Around Mobile Equipment JSA & SOP
- Hoisting & Rigging JSA & SOP (to be provided by client)
- FLHA (Field Level Hazard Assessment)
- Waste Approval Application (WAA) – Tervita Transfer Station document which allows for entry of waste into the facility located in Richmond BC)

If there are any questions or clarifications needed please contact the undersigned at Mohsen Barkh at (604) 214-6047 or mbarkh@tervita.com

Yours truly,

Mohsen Barkh
Sr. Project Manager, Water Solutions
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APPENDIX M

**Intensity-Duration-Frequency (IDF) Curve for Climate Station
Burnaby Mountain**

IDF_curve_110JA54.txt
 ATMOSPHERIC ENVIRONMENT SERVICE
 SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
 INTENSITE, DUREE ET FREQUENCE DES PLUIES

DATA INTEGRATION DIVISION
 LA DIVISION DU TRAITEMENT DES DONNEES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 1 BURNABY MTN BCHPA B.C. 110JA54

LATITUDE 4917 LONGITUDE 12255 ELEVATION/ALTITUDE 465 M

YEAR ANNEE	5 MIN	10 MIN	15 MIN	30 MIN	1 H	2 H	6 H	12 H	24 H
---------------	-------	--------	--------	--------	-----	-----	-----	------	------

1974	-99.9	-99.9	-99.9	-99.9	9.9	18.3	46.6	67.8	73.4
1975	-99.9	-99.9	-99.9	-99.9	13.2	19.8	35.3	50.5	69.8
1976	-99.9	-99.9	-99.9	-99.9	10.7	18.6	40.1	62.0	97.2
1977	-99.9	-99.9	-99.9	-99.9	8.6	14.0	32.0	48.0	72.4
1978	-99.9	-99.9	-99.9	-99.9	15.0	21.9	36.8	54.4	69.5
1979	-99.9	-99.9	-99.9	-99.9	9.8	17.6	43.2	47.4	66.2
1980	-99.9	-99.9	-99.9	-99.9	10.6	19.0	50.8	85.2	122.2
1981	-99.9	-99.9	-99.9	-99.9	9.6	16.8	40.0	64.8	87.8
1982	-99.9	-99.9	-99.9	-99.9	10.8	19.0	43.6	71.2	109.8
1983	-99.9	-99.9	-99.9	-99.9	14.4	21.0	29.2	47.2	55.2
1984	-99.9	-99.9	-99.9	-99.9	14.0	17.2	30.0	45.4	76.4
1985	-99.9	-99.9	-99.9	-99.9	11.2	13.8	27.0	47.6	63.8
1986	-99.9	-99.9	-99.9	-99.9	9.6	14.0	31.2	51.4	78.6
1987	-99.9	-99.9	-99.9	-99.9	12.4	20.0	40.4	61.4	68.6
1988	-99.9	-99.9	-99.9	-99.9	7.4	11.6	28.0	40.8	49.8
1989	-99.9	-99.9	-99.9	-99.9	13.2	22.0	44.8	63.8	72.8
1990	-99.9	-99.9	-99.9	-99.9	24.4	30.8	73.4	107.6	161.8
1991	-99.9	-99.9	-99.9	-99.9	15.0	19.6	39.2	54.6	97.8
1992	-99.9	-99.9	-99.9	-99.9	15.0	21.4	56.6	83.6	101.6

NOTE: -99.9 INDICATES MSG DATA
 DONNEES MANQUANTES

# YRS. ANNEES	0	0	0	0	19	19	19	19	19
MEAN MOYENNE	-99.9	-99.9	-99.9	-99.9	12.4	18.8	40.4	60.8	83.9
STD. DEV. ECART-TYPE	-99.9	-99.9	-99.9	-99.9	3.7	4.1	11.3	16.8	26.6
SKEW DISSYMETRIE	-99.90	-99.90	-99.90	-99.90	1.86	.98	1.42	1.40	1.54
KURTOSIS	-99.90	-99.90	-99.90	-99.90	8.47	6.37	6.15	5.33	6.22

WARNING / AVERTISSEMENT
 YEAR 1990 HAD VALUE GREATER THAN 100 YEAR STORM.
 EN 1990 L'INTENSITE DE LA PLUIE A DE PASSE
 CELLE POUR UNE PERIODE DE RETOUR DE 100 ANS
 DATA/LA VALEUR = 24.4 100 YEAR/ANNEE = 24.1

NOTE: -99.9 INDICATES LESS THAN 10 YEARS OF DATA AVAILABLE
 INDIQUE MOINS DE 10 ANNEES DE DONNEES DISPONIBLES

IDF_curve_110JA54.txt
 ATMOSPHERIC ENVIRONMENT SERVICE
 SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
 INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 2 BURNABY MTN BCHPA B.C. 110JA54

LATITUDE 4917 LONGITUDE 12255 ELEVATION/ALTITUDE 465 M

RETURN PERIOD RAINFALL AMOUNTS (MM)
 PERIODE DE RETOUR QUANTITIES DE PLUIE (MM)

DURATION	2	5	10	25	50	100	# YEARS
DUREE	YR/ANS	YR/ANS	YR/ANS	YR/ANS	YR/ANS	YR/ANS	ANNEES
5 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
10 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
15 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
30 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
1 H	11.7	15.0	17.2	20.0	22.0	24.1	19
2 H	18.1	21.7	24.2	27.2	29.5	31.8	19
6 H	38.6	48.6	55.2	63.5	69.7	75.9	19
12 H	58.0	72.9	82.7	95.2	104.4	113.6	19
24 H	79.6	103.0	118.6	138.2	152.8	167.3	19

RETURN PERIOD RAINFALL RATES (MM/HR)-95% CONFIDENCE' LIMITS
 INTENSITE DE LA PLUIE PAR PERIODE DE RETOUR (MM/H)-LIMITES DE CONFIANCE DE 95%

DURATION	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS
DUREE						
5 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0
10 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0
15 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0
30 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0	+/- .0
1 H	11.7	15.0	17.2	20.0	22.0	24.1
	+/- 1.5	+/- 2.6	+/- 3.5	+/- 4.7	+/- 5.6	+/- 6.6
2 H	9.0	10.9	12.1	13.6	14.8	15.9
	+/- .9	+/- 1.4	+/- 1.9	+/- 2.6	+/- 3.1	+/- 3.7
6 H	6.4	8.1	9.2	10.6	11.6	12.6
	+/- .8	+/- 1.3	+/- 1.8	+/- 2.4	+/- 2.9	+/- 3.3
12 H	4.8	6.1	6.9	7.9	8.7	9.5
	+/- .6	+/- 1.0	+/- 1.3	+/- 1.8	+/- 2.1	+/- 2.5
24 H	3.3	4.3	4.9	5.8	6.4	7.0
	+/- .5	+/- .8	+/- 1.0	+/- 1.4	+/- 1.7	+/- 2.0

ATMOSPHERIC ENVIRONMENT SERVICE
 SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
 INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 3 IDF_curve_110JA54.txt 110JA54
 BURNABY MTN BCHPA B.C.

LATITUDE 4917 LONGITUDE 12255 ELEVATION/ALTITUDE 465 M

INTERPOLATION EQUATION / EQUATION D'INTERPOLATION: $R = A * T ** B$
 R = RAINFALL RATE / INTENSITE DE LA PLUIE (MM /HR)
 T = TIME IN HOURS / TEMPS EN HEURES

STATISTICS STATISTIQUES	2 YR ANS	5 YR ANS	10 YR ANS	25 YR ANS	50 YR ANS	100 YR ANS
MEAN OF R MOYENNE DE R	7.0	8.8	10.0	11.5	12.6	13.8
STD. DEV. R ECART-TYPE	3.3	4.2	4.8	5.5	6.0	6.6
STD. ERROR ERREUR STANDARD	.3	.4	.6	.9	1.1	1.3
COEFF. (A) COEFFICIENT (A)	12.0	14.9	16.8	19.2	21.0	22.8
EXPONENT (B) EXPOSANT (B)	-.384	-.376	-.372	-.368	-.366	-.364
MEAN % ERROR % D'ERREUR	4.3	4.2	4.7	5.1	5.4	5.6

APPENDIX N

Westridge Marine Terminal—Hydrogeology Baseline Sampling Program



**Westridge Marine Terminal—
Hydrogeology Baseline Sampling
Program**

Trans Mountain Expansion Project

October 2, 2019

Prepared for:

Trans Mountain Pipeline ULC

Prepared by:

Stantec Consulting Ltd.

Sign-off Sheet

This document entitled Westridge Marine Terminal—Hydrogeology Baseline Sampling Program was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Trans Mountain Pipeline ULC (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Digitally signed by Ryan Shao
Shao
Date: 2019.10.02
13:45:23 -07'00'

Authorized by Ryan Shao
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Reviewed by R. Freymond
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Roger Freymond

Pam Hayward
2019.10.02
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Approved by Pam Hayward
(signature)

Pam Hayward



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Abbreviations

AWWQG MAL	Approved and Working Water Quality Guideline for Marine Aquatic Life
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
CCME MAL	Canadian Council of Ministers of the Environment for Marine Aquatic Life
COD	chemical oxygen demand
DL	detection limit
EMA	<i>Environmental Management Act</i>
EPH	extractible petroleum hydrocarbons
LEPH / HEPH	light extractable petroleum hydrocarbons/heavy extractable petroleum hydrocarbons
mbtoc	metres below top of casing
mg/L	milligrams per litre
NO ₂	nitrite
NO ₃	nitrate
NTU	nephelometric turbidity units
O-PO ₄	orthophosphate
PAH	polycyclic aromatic hydrocarbons



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

QA/QC	quality assurance and quality control
RPD	relative percent difference
TEH	total extractable hydrocarbons
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TSS	total suspended solids
VOC	volatile organic compounds
WQG	water quality guideline



Introduction

1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) intends to upgrade and expand the Westridge Marine Terminal (the Terminal) to increase its crude oil product delivery and export capacity. The Terminal's current wastewater discharge permit (#3678) under the British Columbia *Environmental Management Act* authorizes discharge of effluent from the dyked tank farm into Burrard Inlet through a west and an east outfall. The permitted discharge is required to have ≤ 5 mg/L total extractable hydrocarbons (TEH). This permit requires amendments to support construction-related discharge during the expansion. Trans Mountain retained Stantec Consulting Ltd. (Stantec) to execute a hydrogeology baseline sampling program and review existing hydrogeological data at the Terminal sites (Westridge and Burnaby) and along the pipeline alignment between terminals, to support these permit amendments.

This report presents hydrogeological conditions (physical hydrogeology baseline) and baseline groundwater quality along the tunnel alignment from Burnaby Terminal to Westridge Marine Terminal based on historical data and a 2019 sampling program. In addition, it provides a groundwater seepage to surface location map.

2.0 REVIEW OF EXISTING HYDROGEOLOGICAL DATA

Stantec obtained the following available data documenting hydrogeological baseline for the Project:

Available data documenting hydrogeological baseline conditions:

1. BGC Engineering Inc. (Jan. 2015a), 2014 Westridge Tunnel Investigation Site Data Report—report includes geotechnical borehole logs and completion, water quality during drilling, groundwater quality, packer testing and groundwater level monitoring along the tunnel alignment. This report includes the following appendices:
 - a. Waterline Resources Ltd (Nov 2014); groundwater quality at HMM-BH-03
 - b. Waterline Resources Ltd (Dec 2013); technical memo about groundwater analysis during drilling at HMM-BH-01 and HMM-BH-02
2. BGC Engineering Inc. (Dec. 2015b), Mountain Tunnel Phase II Site Investigation: Westridge Marine Terminal—aquifer test including groundwater level monitoring and quality, three new borehole logs and completions, from chainage 0+000 to 0+200 along proposed tunnel alignment
3. Hatch, Mott and MacDonald, (May 2017), Inflow during Construction—Rates and Impact—Hydrogeological Modelling Report—describes the groundwater flow model along the proposed tunnel alignment, with simulation runs for assessing inflow during construction at different locations along the tunnel

Existing data from boreholes at Burnaby Terminal, along the tunnel alignment and at Westridge Marine Terminal are summarized in Table 2-1 and Table 2-2, and locations are shown in Figure 2-1. Groundwater quantity and quality data are sporadic in 2014 and 2015.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Review of Existing Hydrogeological Data

Table 2-1 Existing Groundwater Level Data between Burnaby Terminal and Westridge Marine Terminal and 2019 Sampling Recommendations

Location	Existing Data		Sampling Recommendation for 2019 Baseline Field Program		
	High water	Low water	High water	Observation Water Well and Tip Elevation	Low water
Westridge Marine Terminal					
HMM-PW-01	Collected in 2015	Collected in 2015	Proposed to be collected in 2019	HMM-PW-01 Standpipe	
HMM-BH-04		Collected in 2015	Proposed to be collected in 2019	HMM-BH-04 Shallow HMM-BH-04 Deep	
HMM-MW-01		Collected in 2015	Proposed to be collected in 2019	HMM-MW-01 Shallow HMM-MW-01 Deep	
Along Tunnel Alignment					
HMM-BH-01					
HMM-BH-05		Collected in 2014–2015	Proposed to be collected in 2019	HMM-BH-05 VWP 15 HMM-BH-05 VWP -5	
HMM-BH-02		Collected in 2015	Proposed to be collected in 2019	HMM-BH-02 VWP 218 HMM-BH-02 VWP 63.4	
Burnaby Terminal					
HMM-BH-03	Collected in 2015	Collected in 2014–2015	Proposed to be collected in 2019	HMM-BH-03 VWP 140 HMM-BH-03 VWP 119 HMM-BH-03 VWP 89 HMM-BH-03 Standpipe	
HMM-BH-06	Collected in 2015	Collected in 2015	Proposed to be collected in 2019	HMM-BH-06 Standpipe	



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

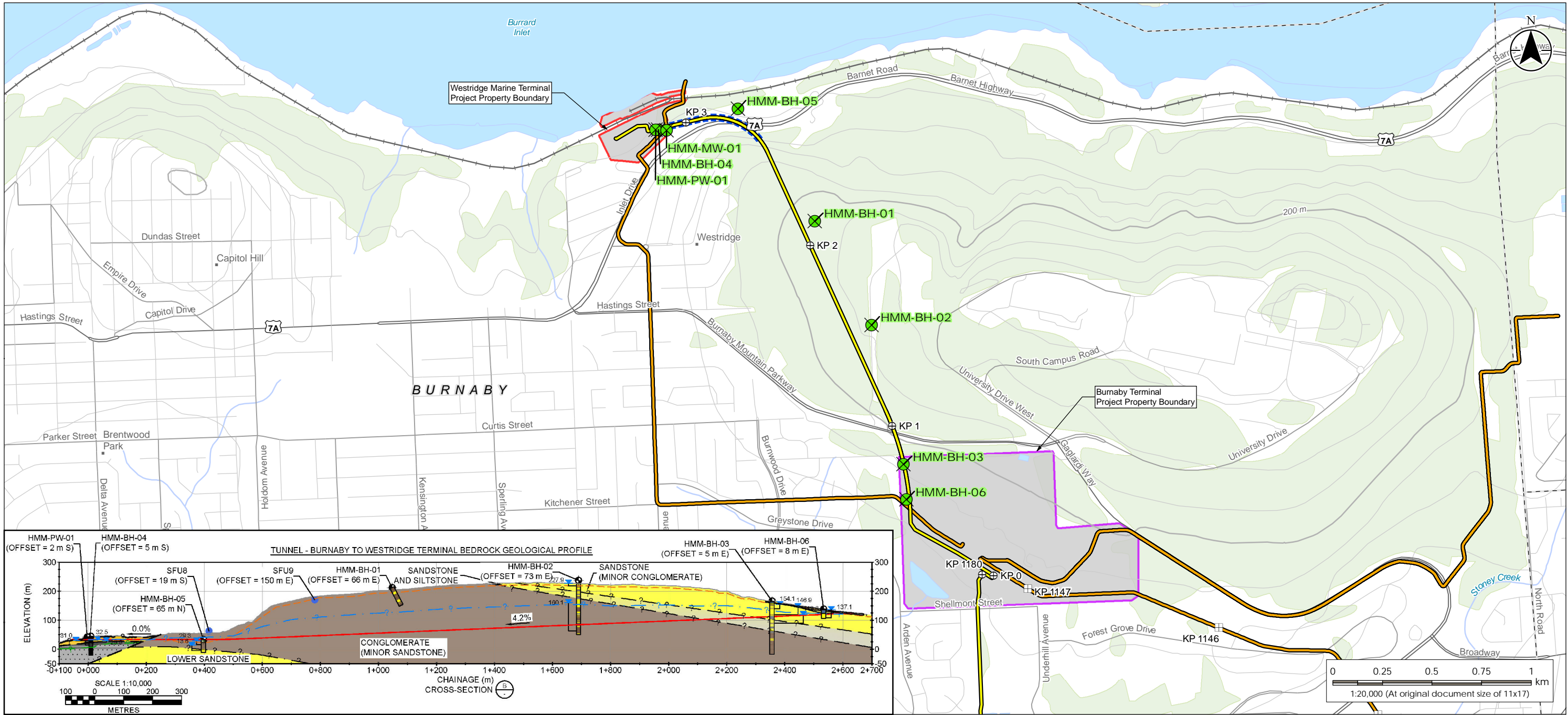
Review of Existing Hydrogeological Data

Table 2-2 Existing Groundwater Quality Data between Burnaby Terminal and Westridge Marine Terminal and 2019 Sampling Recommendations

Location	Existing Data			Sampling Recommendation for 2019 Baseline Field Program		
	Drilling	High water	Low water	High water	Sampling Water Well	Low water
Westridge Marine Terminal						
HMM-PW-01			Collected in 2015	Proposed to be collected in 2019	HMM-PW-01 Standpipe	
HMM-BH-04				Proposed to be collected in 2019 ¹	HMM-BH-04 Shallow HMM-BH-04 Deep	
HMM-MW-01				Proposed to be collected in 2019 ¹	HMM-MW-01 Shallow HMM-MW-01 Deep	
Along Tunnel Alignment						
HMM-BH-01	Collected in 2014 ²			N/A		N/A
HMM-BH-05				N/A		N/A
HMM-BH-02	Collected in 2014 ²			N/A		N/A
Burnaby Terminal						
HMM-BH-03	Collected in 2014 ²		Collected in 2014	Proposed to be collected in 2019	HMM-BH-03 Standpipe	
HMM-BH-06				Proposed to be collected in 2019	HMM-BH-06 Standpipe	
NOTES: ¹ Two levels ² Recirculated drilling water samples collected during drilling were deemed representative of the drilling fluids with possible mixing with groundwater instead of baseline groundwater condition (Waterline, 2014). These samples were not used in this study to assess the baseline groundwater condition along the tunnel alignment.						



\\CD1183-03\Workgroup\123\12312347\Figures\phase_3_memo\Appendix LV\fig_123512431_2_1_groundwater_sampling_locations_overview.mxd
Revised: 2019-07-31 By: cmlalshp



- Highway
- Major Road
- Local Street
- Railway
- Topographic Contour (m)
- Watercourse
- Waterbody
- Wooded Area
- Burnaby Terminal Project Property Boundary
- Westridge Marine Terminal Project Property Boundary
- Municipal Boundary
- Existing Trans Mountain Pipeline Kilometre Post
- Existing Trans Mountain Pipeline Centreline
- Proposed TMEP Pipeline Kilometre Post
- Proposed TMEP Pipeline Centreline
- Phase I and II Site Investigation
- Borehole
- Seepage Mapping (Approx. Location)



Location Information
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by TDINNEEN on 20190726
PM Review LHARRISON PENDING

Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project

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Calgary, AB, T2P 5J2

Figure No. 2-1
Rev. 1
Page No. 1 of 1
Doc No. 01-13283-TW-WT00-EV-RPT-0007

Title
Groundwater Quality Sampling Locations
Plan and Profile View

Notes

- Coordinate System: NAD 1983 BC Environment Albers
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project, Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
- This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

3.0 FIELD PROGRAM METHODS

This hydrogeological baseline study was completed on May 28 and 29, 2019 by two Stantec employees. The field scope of work included the following tasks:

- Collecting one set of manual water level measurements at accessible sampling wells—seven sampling wells, at five locations—corresponding to three one-level sampling wells and two two-level sampling wells—HMM-BH-03, HMM-BH-04 (nested wells [2]), HMM-BH-06, HMM-PW-01, HMM-MW-01 (nested wells [2]).
- Downloading data from level-loggers and baro-loggers from five sampling wells at three locations (HMM-PW-01, HMM-MW-01 (nested wells [2]), HMM-BH-04 (nested wells [2]) (if loggers are present and in good working order).
- Collecting one set of vibrating wire piezometer readings at three locations: HMM-BH-02 (nested wells [2]), HMM-BH-03 (nested wells [3]) and HMM-BH-05 (nested wells [2]) and downloading data (if loggers are present and in good working order).
- Collecting groundwater samples: purging and sampling at HMM-PW-01, HMM-MW-01 (nested wells [2]), HMM-BH-03, HMM-BH-04 (nested wells [2]), HMM-BH-06—including field parameter measurements.
- Submitting groundwater samples from HMM-PW-01 (1), HMM-MW-01 (2), HMM-BH-03 (1), HMM-BH-04 (2), HMM-BH-06 (1) for laboratory analysis of the following parameters:
 - Routine parameters: conductivity, total dissolved solids (TDS), pH, true colour, hardness, turbidity
 - Nutrients (NO₂, NO₃, total Kjeldahl nitrogen [TKN], O-PO₄)
 - Metals (total and dissolved)
 - Total organic carbon (TOC)
 - Chemical oxygen demand (COD)
 - Volatile organic compound (VOC)
 - Hydrocarbons: EPH (C10-19; C19-32), F2-F4, LEPH/HEPH
 - Polycyclic aromatic hydrocarbons (PAH)
 - Methane
 - Phenols (4AAP)
- Preparing a groundwater seepage at-surface map (including flow measurement if applicable) along the tunnel alignment section north of Burnaby Mountain.

3.1 GROUNDWATER SAMPLING

Groundwater sampling at the Westridge Marine Terminal was completed on May 28, 2019. Static water levels were measured in each well prior to sampling, and well construction details were measured (Table 3-1). If present, data from pressure transducers were downloaded, along with the baro-logger installed in the HMM-BH-04 well monument. Pressure transducers were installed in HMM-PW-01, HMM-BH-04S, HMM-BH-04D, and HMM-MW-01D.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Field Program Methods

Table 3-1 Westridge Marine Terminal Groundwater Monitoring Well Details

Well ID	Northing	Easting	Static Water Level (mbtoc ¹)	Depth to Bottom (mbtoc ¹)	Well Stick-up ² (m)	Well Diameter (inch)
HMM-PW-01	5459537	503453	11.29	27.54	0.77	4
HMM-MW-01S	5459533	503508	12.17	13.58	0.71	2
HMM-MW-01D	5459533	503508	15.59	20.56	0.71	2
HMM-BH-04S	5459536	503466	12.19	18.60	0.53	2
HMM-BH-04D	5459536	503466	18.96	25.98	0.53	2
NOTES: ¹ mbtoc: metres below top of casing ² Measured from ground surface						

Five wells were sampled at three locations: HMM-PW-01 (single well), HMM-BH-04 (two nested wells), HMM-MW-01 (two nested wells), shown in Figure 3-1. For nested wells, one well is designated as “shallow” (denoted with a “S” suffix) and one well is designated as “deep” (denoted with a “D” suffix).

To collect representative groundwater samples, each monitoring well was purged prior to sampling using a Grundfos 2” submersible pump and 120-volt control box. During purging, in situ water quality parameters (temperature, pH, conductivity, TDS, and oxidation-reduction potential [ORP]) were monitored using a YSI 556 Multiparameter Instrument, and depth to water and qualitative readings of water colour, odour, and turbidity were noted. These measurements were collected every one-third of a well volume, with purging deemed complete with a stabilization of these measurements. A minimum of three purge volumes and reduced turbidity levels were targeted but was not always achieved at each monitoring well due to large well volumes or the screen parent material (too porous). A stabilization of in situ water quality parameters is considered a more reliable determination of a sufficiently purged well.

In addition to the monitoring wells at the Westridge Marine Terminal, groundwater in monitoring wells at the Burnaby Terminal were to be measured and sampled (Figure 3-2). Groundwater at HMM-BH-06 was monitored and sampled by SNC Lavalin on May 22–23, 2019 as it was slated to be decommissioned that week. A search for HMM-BH-03 was performed but was unsuccessful: the location of the monitoring well is currently being used as a storage site for construction material, and the well is likely buried and/or destroyed.





- Project Property Boundary
- Watercourse
- Existing Building/Facility
- Existing Road/Rail
- Existing Watercourse
- Existing Culvert
- Proposed TMEP Pipeline Kilometre Post
- Proposed TMEP Pipeline Centreline
- Borehole
- Seepage Mapping (Approx. Location)

Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Source: CH2MHILL SKT-WT00-GA01001 Rev B, 2016/10/26; CH2MHILL SKT-WT00-CE01001 Rev B, 2016/11/16; CH2MHILL SKT-WT00-GA01084 Rev 0, 2017/02/10; DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Kinder Morgan Canada Inc.; ESRI World Imagery
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Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by GHUYNH 20190618
Discipline Review MFRIEND 20190618

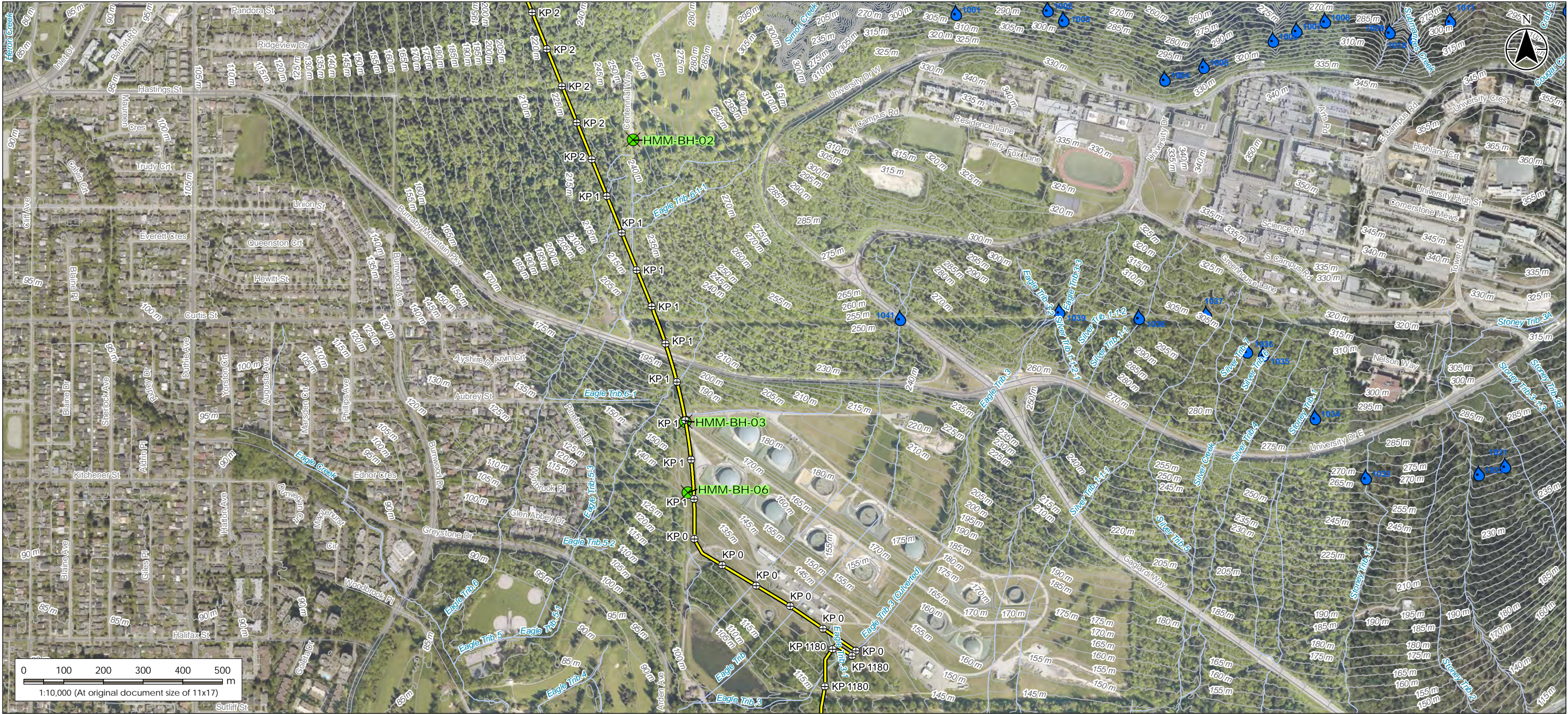
Client/Project
Trans Mountain Pipeline ULC
Trans Mountain Expansion Project

Project Contact
Bronwyn Pountney
403-514-6726
Suite 2700, 300 5th Avenue SW,
Calgary, AB, T2P 5J2

Figure No.
3-1

Doc No.
01-13283-TW-WT00-EV-RPT-0007

Title
Groundwater Quality Sampling Locations
near Westridge Terminal



Notes

1. Coordinate System: NAD 1983 BC Environment Albers
2. Data Source: CH2MHILL SKT-WT00-GA01001 Rev B, 2016/10/26; CH2MHILL SKT-WT00-CE01001 Rev B, 2016/11/16; CH2MHILL SKT-WT00-GA01084 Rev 0, 2017/02/10; DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Kinder Morgan Canada Inc.; ESRI World Imagery
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- Watercourse
- Proposed TMEP Pipeline Kilometre Post
- Proposed TMEP Pipeline Centreline
- Seepage Location
- Borehole



Project Location NTS: 092G07 BCGS: 92G.026 UTM: 10U 503386 5459495	Project Number 123512431 Prepared by GHUYNH 20190618 Discipline Review MRIEND 20190618
Client/Project Trans Mountain Pipeline ULC Trans Mountain Expansion Project	Project Contact Bronwyn Pountney 403-514-6726 Suite 2700, 300 5th Avenue SW, Calgary, AB, T2P 5J2

Figure No. 3-2	Doc No. 01-13283-TW-WT00-EV-RPT-0007
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Groundwater Quality Sampling Locations near Burnaby Terminal

3.1.1 Sample Collection and Analysis

Field methods were conducted in accordance with the BC Field Sampling Manual (BC Ministry of Environment 2013). Groundwater was analyzed for in situ temperature, pH, dissolved oxygen, specific conductivity, and turbidity. Samples were submitted to the ALS Environmental laboratory for analysis of:

- Routine parameters: conductivity, TDS, pH, true colour, hardness, turbidity
- Nutrients (NO₂, NO₃, TKN, O-PO₄)
- Metals (total and dissolved)
- TOC
- COD
- VOC
- Hydrocarbons: EPH (C10-19; C19-32), F2-F4, LEPH/HEPH
- PAHs
- Methane
- Phenols (4AAP)

Samples were collected from the monitoring wells listed in Table 3-1, with a duplicate sample collected at HMM-PW-01 to meet the quality assurance and quality control (QA/QC) objectives as outlined in the *BC Field Sampling Manual* (BC Ministry of Environment 2013).

Nitrile gloves were worn during sample collection, with samples collected using laboratory supplied bottles. Samples were filtered and preserved where required and were stored with chilling packs in laboratory supplied coolers. Samples were delivered to the laboratory on the same day as collected and were submitted with a chain-of-custody form.

3.2 VIBRATING WIRE PIEZOMETERS

On May 29, 2019 an attempt was made to locate vibrating wire piezometers at HMM-BH-02, HMM-BH-03 and HMM-BH-05 along the tunnel alignment (Figure 2-1). The field crew was unable to locate the wells using a visual search or metal detector. HMM-BH-03 is believed to be buried and/or destroyed due to on-site construction activities. Recent paving of Centennial Way may have covered HMM-BH-02, while no evidence exists of the presence of HMM-BH-05.

3.3 GROUNDWATER SEEPAGE ASSESSMENT

On May 29, 2019 a groundwater seepage assessment was completed along a portion of the tunnel alignment. The assessment was completed from the Westridge Marine Terminal to a location approximately 100 m east of Barnet Highway (Figure 3-1). Two Stantec staff members walked the alignment route and mapped locations of surface water and shallow groundwater. Shallow groundwater was noted by the presence of hydrophilic vegetation or visibly wet soil. Surface water was present as small streams that cross over the tunnel alignment. These streams are assumed to originate as a groundwater seep upgradient of the alignment. An estimate of flow rate was performed at each seep using a small graduated container and a stopwatch.



Results

4.0 RESULTS

One sampling trip was completed in spring of 2019 to gather additional data for the groundwater baseline information and verify if conditions were similar to those observed during the 2014–2015 sporadic sampling events.

4.1 GROUNDWATER QUALITY

4.1.1 Groundwater Quality—Field Parameters

Table 4-1 provides field-measured groundwater quality results for the 2014–2015 and 2019 sampling trips.

Table 4-1 Groundwater Field Parameters

Parameter	Date	HMM-PW-01	HMM-MW-01-S	HMM-MW-01-D	HMM-BH-01	HMM-BH-02	HMM-BH-03	HMM-BH-04-S	HMM-BH-04-D	HMM-BH-06
Temperature (°C)	2015/10/07	13.7								
	2015/10/08	14.7								
	2019/05/23									15.3
	2019/05/28	11.35	11.5	14.7				11.18	13.45	
Conductivity (µS/cm)	2015/10/07	180								
	2015/10/08	190								
	2019/05/23									143
	2019/05/28	214	147	198				205	196	
pH (pH units)	2015/10/07	8.36								
	2015/10/08	8.44								
	2019/05/23									10.01
	2019/05/28	7.89	8.17	8.29				7.87	8.14	

Field measurements were available in 2015 only at HMM-PW-01, at Westridge; all other field data were measured during the 2019 sampling visit.

Temperatures were warmer in 2015 compared to 2019, at HMM-PW-01. Conductivity values at HMM-PW-01 suggest groundwater was slightly more mineralized in 2019 compared to 2015, although the difference is not considered significant. The pH values indicate that groundwater at HMM-PW-01 was slightly less basic during the 2019 sampling event compared to 2015.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

The 2019 field data indicate the following trends:

- Groundwater temperature values between 11.2°C and 15.3°C, with no specific spatial distribution
- Conductivity values between 143 and 214 µS/cm, with no specific spatial distribution
- pH between 7.89 (HMM-PW-01) and 10.01 (HMM-BH-06) – pH value of HMM-BH-06 obtained from laboratory analysis is 9.04. The field measurement is not considered reliable.

Results suggest that water is more alkaline at Burnaby Terminal, but it is questionable since only one measurement was made; as the well (HMM-BH-06) has been decommissioned, it is not possible to validate that data.

4.1.2 Groundwater Quality – Laboratory Results

Full laboratory results with screening against guidelines and QA/QC results are provided in Appendix A; results were compared to British Columbia Approved Water Quality Guidelines and British Columbia Working Water Quality Guidelines for marine aquatic life (collectively referred to as BC AWWQG) and the Canadian Council of Ministers of the Environment (CCME) water quality guidelines for marine aquatic life. Laboratory certificates are found in Appendix B. Table 4-2 summarizes the initial groundwater quality results for parameters that exceed WQGs in one or more samples or are relevant to identification of samples containing elevated sediment levels. Applicable water quality guidelines are included in the table. Elevated total metal concentrations were mainly observed in samples from HMM-MW-01D, HMM-BH-04S (both collected in 2019), and HMM-BH-03 (collected in 2014), which were characterized by high turbidity levels (165 to 3740 NTU).



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

Table 4-2 Summary Table of Initial Groundwater Quality Results

Analyte	Units	BC Approved Water Quality Guideline	BC Working Water Quality Guideline	CCME		HMM-PW-01	HMM-PW-01	HMM-PW-01	HMM-MW-01-S	HMM-MW-01-D	HMM-BH-03	HMM-BH-04-S	HMM-BH-04-D	HMM-BH-06
		MAL	MAL	MAL		(BGC)	(BGC)	(Stantec)	(Stantec)	(Stantec)	(Waterline)	(Stantec)	(Stantec)	(SNC Lavalin)
Date Sample Collected						10/7/2015	10/8/2015	5/28/2019	5/28/2019	5/28/2019	10/11/2014	5/28/2019	5/28/2019	5/23/2019
Turbidity	NTU	-	-	-		1.25	0.54	1.93	11.70	165	3,740	177	8.52	2.73
Aluminum (Al)-Total	mg/L	-	-	-		0.1480	0.0586	0.0917	0.0778	10.0000	45.7000	9.2500	0.6370	0.0492
Aluminum (Al)-Dissolved	mg/L	-	-	-		0.0109	0.0097	0.0023	0.0081	0.0024	0.4010	0.0023	0.0039	0.0037
Arsenic (As)-Total	mg/L	0.0125	-	0.0125		0.0095	0.0098	0.0128	0.0130	0.0202	0.0115	0.0067	0.0115	0.0018
Arsenic (As)-Dissolved	mg/L	-	-	-		0.0093	0.0095	0.0107	0.0127	0.0159	0.0014	0.0052	0.0113	0.0018
Cadmium (Cd)-Total	mg/L	-	0.00012	0.00012		<0.000005	<0.000005	<0.000005	0.000010	0.000461	0.001430	0.000076	0.000010	0.000007
Cadmium (Cd)-Dissolved	mg/L	-	-	-		0.000010	<0.000005	<0.000005	0.000010	<0.000005	0.000026	<0.000005	<0.000005	<0.000005
Chromium (Cr)-Total	mg/L	-	-	-		0.00094	0.00066	0.00083	0.00590	0.03300	0.11000	0.01640	0.00149	0.00027
Chromium (Cr)-Dissolved	mg/L	-	-	-		0.00043	0.00029	0.00032	0.00110	0.00030	0.00120	<0.00010	<0.00010	0.00018
Copper (Cu)-Total	mg/L	0.002	-	-		<0.0005	<0.0005	<0.0005	<0.0005	0.02070	0.15200	0.02150	0.00204	0.00072
Copper (Cu)-Dissolved	mg/L	-	-	-		0.0014	<0.0005	<0.0002	<0.0002	<0.0002	0.0021	<0.0002	<0.0002	0.0002
Iron (Fe)-Total	mg/L	-	-	-		0.043	<0.03	0.436	0.091	12.700	0.027	10.700	0.661	0.058
Iron (Fe)-Dissolved	mg/L	-	-	-		<0.03	<0.03	<0.01	0.01	<0.01	0.53	<0.01	<0.01	<0.01
Lead (Pb)-Total	mg/L	0.002	-	-		0.00052	0.00029	0.00009	<0.00005	0.00335	0.02720	0.00238	0.00021	0.00009
Lead (Pb)-Dissolved	mg/L	-	-	-		0.00039	0.00024	<0.00005	<0.00005	<0.00005	0.00026	<0.00005	<0.00005	<0.000050
Manganese (Mn)-Total	mg/L	-	0.1	-		0.0221	0.0220	0.8110	0.0287	0.2680	1.5000	0.2440	0.0375	0.0101
Manganese (Mn)-Dissolved	mg/L	-	-	-		0.0219	0.0211	0.0045	0.0252	0.0207	0.3500	0.0194	0.0191	0.0069
Nickel (Ni)-Total	mg/L	-	0.0083	-		0.00078	0.00061	0.00089	0.00387	0.02450	0.07390	0.01750	0.00164	0.00059
Nickel (Ni)-Dissolved	mg/L	-	-	-		0.00083	0.00057	<0.00050	0.00113	0.00229	0.01800	<0.00050	<0.00050	0.00051
Zinc (Zn)-Total	mg/L	0.01	-	-		0.0073	0.0068	<0.0030	<0.0030	0.0428	0.3110	0.0277	<0.0030	<0.0030
Zinc (Zn)-Dissolved	mg/L	-	-	-		0.0093	0.0060	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	-	-	-		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0024	<0.0010	<0.0010	<0.0010
EPH C19-C32	mg/L	-	-	-		<0.25	<0.25	<0.25	<0.25	<0.25	0.31	<0.25	<0.25	<0.25



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

4.1.2.1 HMM-PW-01

Key findings for groundwater quality at HMM-PW-01 are as follows:

- Water quality remained generally similar since 2015 for most parameters.
- Nitrogen components (nitrate and TKN), showed higher values in 2019. No guideline value applies to TKN while the nitrate concentration is two orders of magnitude lower than the BC AWWQG value. Given that the 2019 sample was collected in spring compared to the 2015 samples collected in summer, it is possible that the elevated nitrogen components are associated with greater contribution of surface runoff.
- Arsenic, iron, and manganese showed higher total metal values in 2019 compared to 2015.
- Total arsenic concentration was slightly higher (2.4%) than BC AWWQG and CCME guidelines in 2019.
- The 2019 sample had a relatively high concentration of total manganese but low concentration of dissolved manganese. The total manganese value is considered an outlier, given that this one value was notably higher than for the other samples collected, including those affected by elevated turbidity.
- Most dissolved metal concentrations were lower in 2019 compared to average 2015 concentration values except for arsenic, calcium, magnesium and silicon.
- Dissolved arsenic concentration was higher in 2019 by one order of magnitude.
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.

4.1.2.2 HMM-MW-01 S

Key findings and trends of groundwater quality at HMM-MW-01 S are as follows:

- Water quality data are available only in 2019; no temporal comparison is available.
- Total arsenic concentrations are slightly higher (4.0%) than the BC AWWQG and CCME guidelines for marine aquatic life; dissolved and total arsenic concentrations being about the same, suggesting that dissolved arsenic is the main form present.
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.

4.1.2.3 HMM-MW-01 D

Key findings and trends of groundwater quality at HMM-MW-01 D are as follows:

- Total concentrations for the following parameters were above the BC AWWQG and CCME guidelines for marine aquatic life: arsenic, cadmium, copper, lead, manganese, nickel and zinc.
- Dissolved arsenic concentration was above the BC AWWQG for marine aquatic life for total arsenic.
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.
- Review of field notes confirmed the presence of sediment in this sample. Elevated total metal concentrations were attributed to high turbidity (165 NTU). As a result, this sample is not considered representative of baseline condition and should be excluded from the baseline assessment.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

4.1.2.4 HMM-BH-03

Key findings and trends of groundwater quality at HMM-BH-03 are as follows:

- Total concentrations for the following parameters were above the BC AWWQG and CCME guidelines for marine aquatic life: cadmium, copper, lead, manganese, nickel and zinc.
- Dissolved concentrations of copper, manganese, nickel were above the BC AWWQG for marine aquatic life for total concentration of these parameters.
- Elevated total metal concentrations were attributed to very high turbidity (3740 NTU). Review of sampling records indicated that the sample from HMM-BH-03 was collected after insufficient quantity of water (2.2 well volumes) was removed, resulting in sampling of disturbed groundwater. As a result, this sample is not considered representative of baseline condition and should be excluded from the baseline assessment.

4.1.2.5 HMM-BH-04 S

Key findings and trends of groundwater quality at HMM-BH-04 S are as follows:

- Total concentrations for the following were above the BC AWWQG and CCME guidelines for marine aquatic life: copper, lead, manganese, nickel, and zinc.
- Measured concentrations of dissolved metals were low.
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.
- Review of field notes confirmed the presence of sediment in this sample. Elevated total metals concentrations relative to dissolved were attributed to high turbidity (177 NTU). As a result, this sample is not considered representative of baseline condition and should be excluded from the baseline assessment.

4.1.2.6 HMM-BH-04 D

Key findings and trends of groundwater quality at HMM-BH-04 D are as follows:

- Total concentration for copper was slightly above (2.0%) the BC AWWQG and CCME guidelines for marine aquatic life.
- Concentrations of dissolved copper was low.
- Elevated total metals concentrations relative to dissolved were attributed to relatively high turbidity (8.52 NTU).
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.

4.1.2.7 HMM-BH-06

Key findings and trends of groundwater quality at HMM-BH-06 are as follows:

- Total and dissolved barium concentrations were low.
- A small discrepancy in results was observed as the dissolved barium concentration was found to be higher than the total barium concentration.
- Volatile compounds, hydrocarbons and PAH were below relevant detection limits.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

4.1.3 Water Quality QA/QC Results

Field QA/QC of the groundwater samples collected from the Westridge Marine Terminal Hydrogeology Baseline Sampling Program was performed through collection of quality control samples (QC Samples), which provided data to identify and quantify potential sources of systematic and random error associated with sample collection and analysis. QC samples typically include field and trip blanks, duplicate or replicate samples, and in-house reference samples.

One field duplicate sample (Sample ID: DUPLICATE) was collected by Stantec from monitoring well HMM-PW-01 at the same time and using the same sampling procedures for the regular sample (Sample ID: HMM-PW-01). The duplicate sample was forwarded to ALS Environmental for analysis along with the regular samples on May 23, 2019, omitting collection time and location data. The purpose of collecting a duplicate is to obtain the precision for each analyte analyzed within these samples and to permit identification of analytical and sampling uncertainty.

The results of analysis of both regular samples and the duplicate are presented in Appendix A. The precision of the analysis is evaluated by calculating the relative percent difference (RPD) of the reported concentration of the same analyte from sample HMM-PW-01 and its field duplicate using the equation presented below:

$$RPD = \frac{2 \times (A - B)}{(A + B)} \times 100\%$$

In this equation, A is the concentration of an analyte from a regular sample; B is the concentration of the same analyte from the duplicate sample. According to the *BC Field Sampling Manual* (2013), an RPD below 20% is considered acceptable when both values are at least five times the detection limit (DL).

Sample HMM-PW-01 and its duplicate were analyzed for 169 parameters, in which 35 parameters are found to be at least five times the detection limit for both samples. The RPD values for 30 (86%) of these parameters are below 20%. Table 4-4 presents the five parameters having RPD values equal or above 20% and more than five times the DL.

Table 4-3 Analytes with RPD Value between Sample and Duplicate Equal or Above 20%

Parameter	Detection Limit	Units	HMM-PW-01	Duplicate	RPD
Total Kjeldahl nitrogen	0.050	mg/L	0.333	0.433	26.1%
Aluminum (Al)—total	0.0030	mg/L	0.0917	0.0717	24.5%
Barium (Ba)—total	0.00010	mg/L	0.0123	0.00884	32.7%
Iron (Fe)—total	0.010	mg/L	0.436	0.356	20.2%
Manganese (Mn)—total	0.00010	mg/L	0.811	0.422	63.1%

As shown in Table 4-3 higher RPD values (e.g. >20%) generally occur with total metal parameters. Sites with high total suspended solid (TSS) and turbidity can result in variable TSS between the sample and field duplicate and hence higher RPD in total metal parameters.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

Laboratory QC was conducted by ALS Environmental. The samples exceeded the recommended hold time (0.25 hours) for the “pH by Meter” parameter. No additional hold time exceedance was reported by the laboratory.

4.1.4 Discussion on Groundwater Quality Results

Groundwater quality sampling events completed in 2014 and 2015 focused on low water conditions (dry season) as Table 2-2 illustrates. The 2019 sampling event was planned to coincide with high water conditions (wet season) to assess seasonal variations. The main objective of the groundwater quality sampling program was to establish baseline conditions to allow for the design of effective treatment of inflow water during construction.

Three samples (from HMM-MW-01-D, HMM-BH-04-S, and HMM-BH-03) are characterized by very high turbidity values. Review of sampling records indicated that sample from HMM-BH-03 was collected after an insufficient quantity of water (2.2 well volumes) was removed from the borehole, resulting in sampling of disturbed groundwater. Field notes also confirmed the presence of sediments in samples from HMM-MW-01-D and HMM-BH-04-S. Particulates in these samples contributed to the high total metal concentrations observed in the analysis results. These three samples were not considered representative of the groundwater baseline condition along the tunnel alignment and were therefore screened out from the baseline assessment. Table 4-4 presents a summary of groundwater quality data after screening for sediment presence. Parameters exceeding applicable water quality standards are highlighted in the table.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

Table 4-4 Summary of Groundwater Quality Results and Exceedances

Analyte	Units	BC Approved Water Quality Guideline	BC Working Water Quality Guideline	CCME		HMM-PW-01	HMM-PW-01	HMM-PW-01	HMM-MW-01-S	HMM-BH-04-D	HMM-BH-06
		MAL	MAL	MAL		(BGC)	(BGC)	(Stantec)	(Stantec)	(Stantec)	(SNC Lavalin)
Date Sample Collected						10/7/2015	10/8/2015	5/28/2019	5/28/2019	5/28/2019	5/23/2019
Turbidity	NTU	-	-	-		1.25	0.54	1.93	11.70	8.52	2.73
Arsenic (As)-Total	mg/L	0.0125	-	0.0125		0.0095	0.0098	0.0128	0.0130	0.0115	0.0018
Arsenic (As)-Dissolved	mg/L	-	-	-		0.0093	0.0095	0.0107	0.0127	0.0113	0.0018
Copper (Cu)-Total	mg/L	0.002	-	-		<0.0005	<0.0005	<0.0005	<0.0005	0.00204	0.00072
Copper (Cu)-Dissolved	mg/L	-	-	-		0.0014	<0.0005	<0.0002	<0.0002	<0.0002	0.0002
Manganese (Mn)-Total	mg/L	-	0.1	-		0.0221	0.0220	0.8110	0.0287	0.0375	0.0101
Manganese (Mn)-Dissolved	mg/L	-	-	-		0.0219	0.0211	0.0045	0.0252	0.0191	0.0069
NOTE: Values highlighted in orange indicate concentrations exceeded BC Approved Water Quality Guideline or BC Working Water Quality Guideline											



Results

4.2 WATER QUANTITY

Groundwater inflow during construction was estimated using a numerical groundwater flow model (Hatch, Mott, MacDonald 2017) as a screening tool. Bedrock hydraulic conductivity and potentiometric head are model sensitive components. One of the 2019 sampling trip objectives was to measure groundwater levels to verify trends since 2015 at as many available locations as possible, then validate potentiometric head data used for calibrating the flow model. Hydraulic conductivity values were determined using multiple approaches: packer testing of different bedrock intervals, step-drawdown tests, a constant rate aquifer test, and a recovery test.

4.2.1 Groundwater Levels

Groundwater level data were acquired from pressure transducers and dataloggers at Westridge Marine Terminal¹, while manual measurements of groundwater level were performed at both Westridge and Burnaby terminals. The data are compiled in Figure 4-1. Individually, water levels fluctuated by 0.84 m to 1.86 m between June 2016 and May 2019, at those water wells where pressure transducers and level-loggers have been recovered (period of uninterrupted record). The values are consistent with seasonal fluctuations.

¹ Groundwater level data are not appended to the current report because of file size but are available upon request.



Results

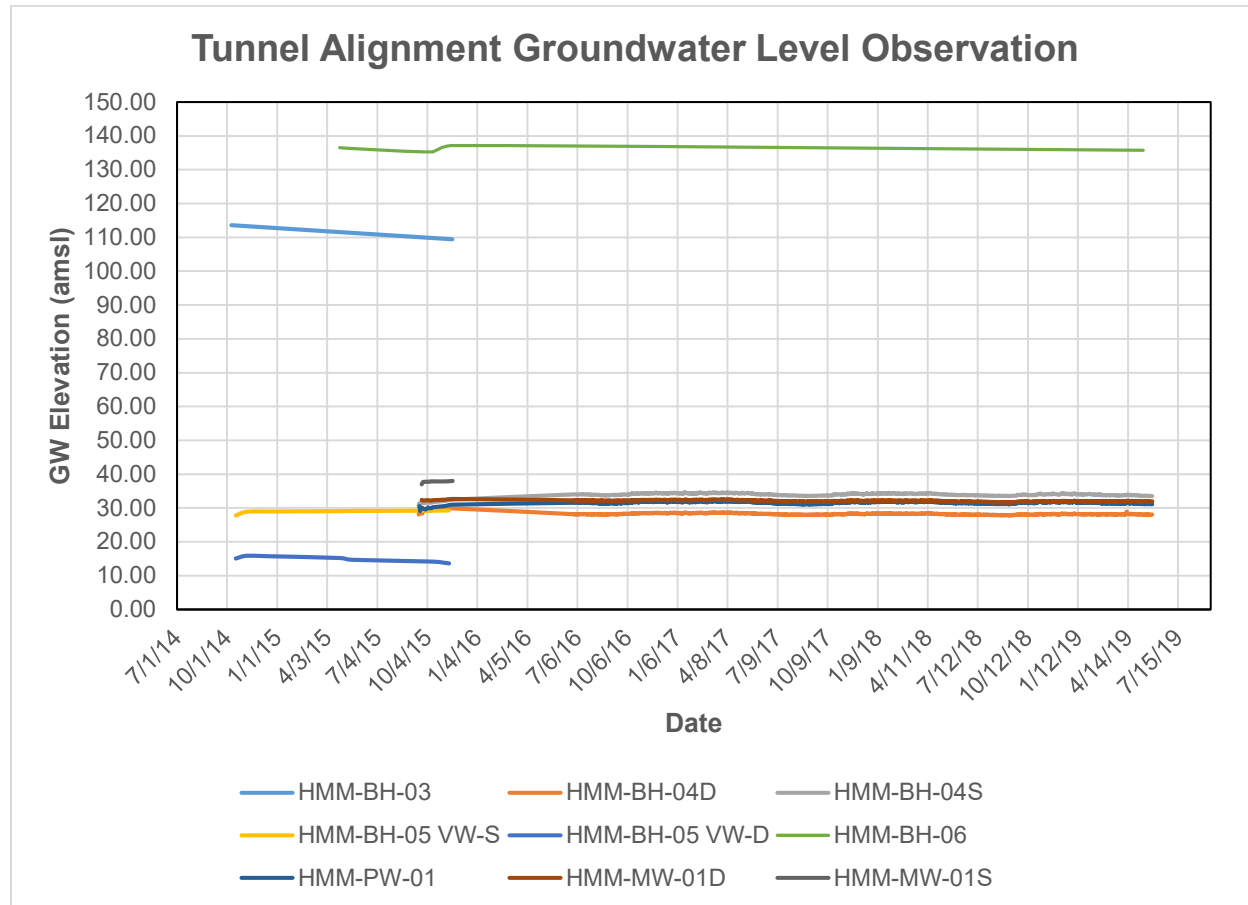


Figure 4-1 Groundwater Elevation along the Tunnel Alignment (2014–2019)

The data show that groundwater levels have remained relatively stable since 2014. As such, the numerical groundwater flow model predictions should still be valid.

4.2.2 Groundwater Inflow

The main objective of the groundwater flow model was to predict groundwater inflows through time so a properly sized water treatment plant could be designed.

Because geology (hydraulic conductivity), vertical depth, and horizontal hydraulic gradient are expected to vary during tunnel construction, simulation runs used time series to simulate those anticipated changes and estimate inflows as tunneling progresses. As a general result, greater inflows are expected when the tunneling will occur at relatively shallow depth: higher hydraulic conductivities are expected at shallow depth (e.g., weathered upper bedrock, unconsolidated and porous aquifer). However, because the hydraulic conductivity was measured in the low range for this type of rock, modelled inflow values were also correspondingly low. Table 4-5 illustrates predicted inflows along the tunnel alignment.



WESTRIDGE MARINE TERMINAL—HYDROGEOLOGY BASELINE SAMPLING PROGRAM

Results

Table 4-5 Predicted Tunnel Inflows during Tunneling

Approximate Days Elapsed since Start of Tunneling in Open Mode	Tunnel Reference Point Chainage (m)	Predicted Average Seepage Rate during this Interval (L/s)	Predicted Cumulative Inflow by the End of this Interval (m ³)
0 to 5	210–270	0.3	130
5 to 10	270–330	0.4	290
10 to 15	330–395	1.0	710
15 to 20	395–460	0.8	1,060
20 to 30	460–590	0.5	1,520
30 to 40	590–710	0.007	1,530
40 to 165	710–2,270	0.015	1,690
165 to 170	2,270–2,330	0.03	1,700
170 to 176	2,330–2,410	1.1	2,270
176 to 180	2,410–2,440	1.5	2,740
180 to 185	2,440–2,520	1.2	3,270
185 to 190	2,520–2,600	0.9	3,700
190 to 193	2,600–end	0.7	3,830
SOURCE: excerpt from Hatch, Mott, MacDonald 2017			

Table 4-5 assumes that tunneling will be performed from the Westridge Marine Terminal toward the Burnaby Terminal, using the tunnel invert slope to convey inflows to the water treatment plant planned at Westridge Marine Terminal. Changes in hydraulic conductivity, potentiometric head, and horizontal hydraulic gradient are expressed by the different values of seepage rate (third column). Seepage rate is predicted to vary between 0.007 and 1.5 L/s over 193 days of tunneling. Cumulative inflow is estimated in the last column; it assumes that seepage will occur continuously during tunneling, while the construction plan is to seal tunnel walls as tunneling progresses. Assuming geological conditions encountered during tunneling are the same as encountered in the boreholes, cumulative inflow is predicted to be a little less than 4,000 m³ over 193 days.

This value of 4,000 m³ is small; it is probably resulted from very little bedrock fracturing was encountered during drilling. It is possible that geological conditions vary between the boreholes and more water will need to be managed if significant water bearing fractures are encountered during tunneling. In addition, the boreholes were drilled vertically and therefore would not be useful to assess vertical fracturing, if present. Inflows will be proactively managed by grouting the tunnel walls as tunneling progresses leaving less than 10 m of bare walls at any given time.



Results

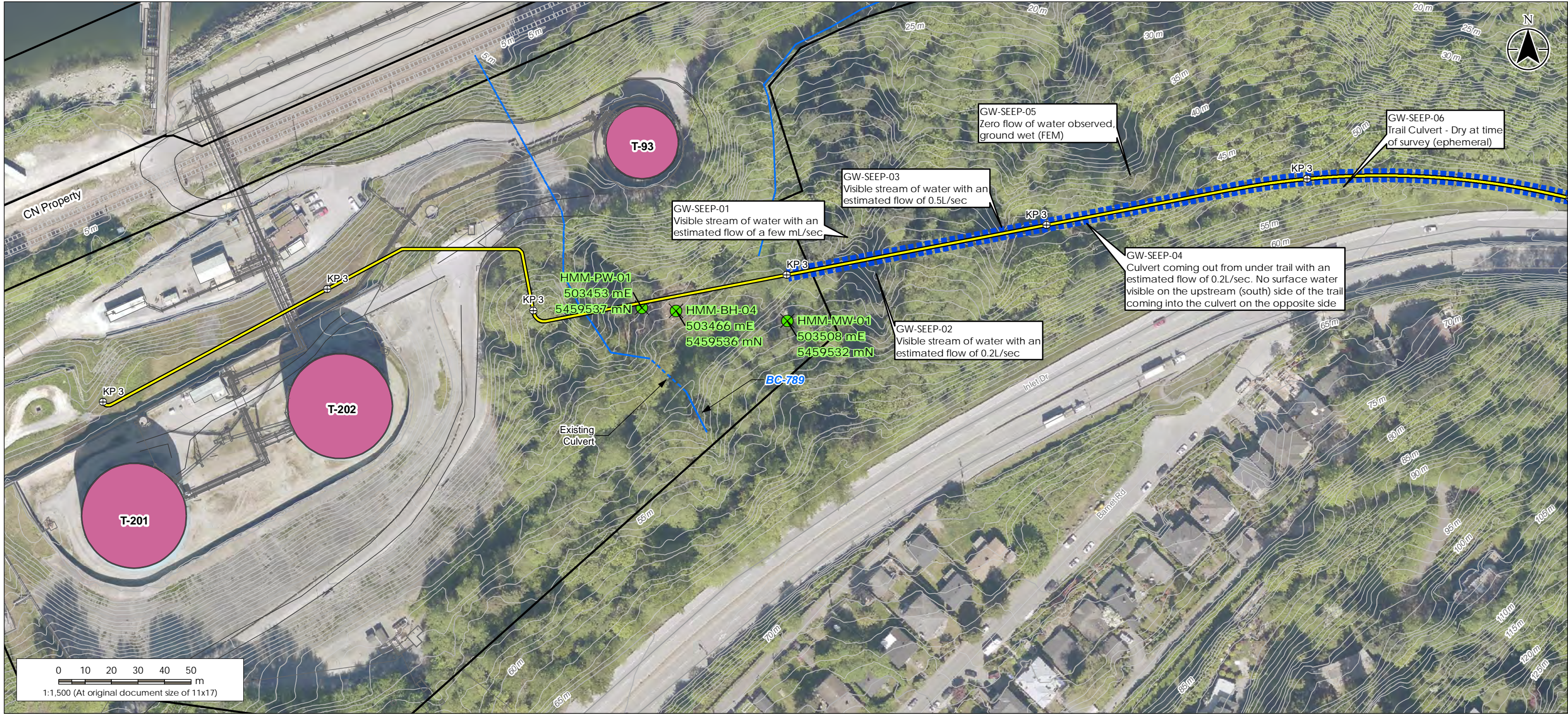
4.2.3 Water Seepage – Springs

Potential effects on currently visible groundwater seepage at surface would be limited to the east-north-east-oriented portion of the tunnel, near Westridge Marine Terminal (chainage 0+000 to 0+600). Surface water was present as small streams that cross over that portion of the tunnel alignment (Figure 4-2 and Figure 4-3). These streams are assumed to originate as a groundwater seep upgradient of the alignment.

An estimate of flow rate was performed at each seep; rates varied from barely measurable traces up to 0.5 L/s, with some streams showing dry conditions at times. It is possible that the flow in these streams could be temporarily impacted during tunnel construction; however, no post construction impacts are likely once the tunnel walls have been grouted and sealed.



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- Project Property Boundary
- Topographic Contour (m)
- Existing Building/Facility
- Existing Road/Rail
- Existing Watercourse
- Existing Culvert
- Permit #3678 Discharge Area
- Proposed TMEP Pipeline Kilometre Post
- Proposed TMEP Pipeline Centreline
- Borehole
- Seepage Mapping (Approx. Location)

Notes

- Coordinate System: NAD 1983 UTM Zone 10N
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project, Trans Mountain Pipeline ULC.; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
- This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or

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Project Location
NTS: 092G07
BCGS: 92G.026
UTM: 10U 503386 5459495

Project Number 123512431
Prepared by GHUYNH 20190626
Discipline Review ALAFOREST 20190626

Client/Project
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Figure No.	Rev.	Page No.	Doc No.
4-2	1	1 of 1	01-13283-TW-WT00-EV-RPT-0007

Seepage Survey Mapbook - Sheet 1



5.0 CONCLUSION AND RECOMMENDATIONS

A 2019 spring sampling event was conducted to augment the groundwater baseline dataset along the Burnaby-Westridge tunnel collected in 2014 and 2015. The 2019 sampling event was limited to five water wells (HMM-PW-01, HMM-MW-01-S, HMM-MW-01-D, HMM-MW-04-S, HMM-MW-04-D) at Westridge Marine Terminal, and one water well (HMM-BH-06, now decommissioned) at Burnaby Terminal.

Groundwater was sampled at both terminals, and then compared to the BC Approved Water Quality Guidelines for marine aquatic life, BC Working Water Quality Guidelines for marine aquatic life, and Canadian Council of Ministers of the Environment water quality guidelines for marine aquatic life. The general groundwater quality key findings are as follows:

- Groundwater quality is deemed relatively constant along the tunnel alignment.
- As shown in Table 4-4, the water quality results for undisturbed groundwater samples collected in the area between the Westridge Marine Terminal and Burnaby Terminal indicate average total concentrations of metal species were below applicable WQGs.
- Maximum total concentrations were marginally above applicable BC AWWQGs for total arsenic and total copper; also, the maximum dissolved arsenic concentration was higher than applicable WQG for total arsenic.
- The total manganese maximum concentration of 0.811 mg/L was eight times the BC WQG (0.1 mg/L). This value is considered an outlier, given that this one value was notably higher than the other samples collected, including those affected by elevated turbidity. The maximum dissolved manganese concentration in that sample was 0.0045 mg/L.
- Arsenic and copper concentrations appear to be naturally elevated in groundwater, with some samples marginally exceeding their WQGs. The maximum total arsenic concentration was 4% higher than the WQG, and the sample contained 97% dissolved arsenic. The maximum total copper concentration was 2% higher than the WQG and the sample contained non-detectable dissolved copper. No toxicity concerns for these concentrations of metals are identified if groundwater is discharged to the marine environment.
- No volatile organic compounds, hydrocarbons or PAH compounds were detected.

Seepage rates during tunneling will vary between 0.007 L/s and 1.5 L/s, with higher rates at both ends of the tunnel alignment, where the tunnel will intercept weathered shallow bedrock and overburden. Cumulative inflow is estimated at approximately 4,000 m³ over 193 days of construction; this value is considered conservative because it does not consider ongoing tunnel wall grouting during tunneling operations. However, it is possible that geological conditions vary between the boreholes and more water will need to be managed if significant water bearing fractures are encountered during tunneling.

Surface seepage of groundwater along the first section of the tunnel alignment to streams, near the Westridge Marine Terminal, may be temporarily affected by tunnel construction, but should revert to pre-construction conditions after the tunnel walls have been grouted and sealed.

It is recommended that the future water treatment plant include treatment for suspended solids.



References

6.0 REFERENCES

- BGC Engineering Inc. 2015a. Trans Mountain Pipeline ULC, TMEP Westridge Tunnel Investigation, 2014 Westridge Tunnel Investigation Site Data Report. Jan 2015. Available at: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3201161>. Accessed September 2019.
- BGC Engineering Inc. 2015b. Trans Mountain Pipeline ULC, Trans Mountain Expansion Project, Burnaby Mountain Tunnel Phase II Site Investigation: Westridge Marine Terminal. Dec 2015. Available at: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3201035>. Accessed September 2019.
- British Columbia Ministry of Environment. 2013. British Columbia Field Sampling Manual. 2013 Edition. Water, Air and Climate Change Branch. Available at: https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/bc_field_sampling_manual_complete.pdf. Accessed April 2018.
- British Columbia Ministry of Environment and Climate Change Strategy. 2018. Approved and Working Water Quality Guidelines for Freshwater Quality. <https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines>. Accessed April 2018.
- Canadian Council of Ministers of the Environment. 2018. Water Quality Guidelines for Protection of Aquatic Life. https://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html. Accessed April 2019.
- Hatch, Mott and MacDonald. 2017. Inflow during Construction – Rates and Impact – Hydrogeological Modelling Report, Burnaby Mountain Tunnel. May 2017. Available at: <https://apps.neb-one.gc.ca/REGDOCS/File/Download/3280566>. Accessed September 2019.
- SNC Lavalin. 2018. 2017 Groundwater Monitoring and Sampling Investigation, Westridge Marine Terminal, 7065 Bayview Drive, Burnaby, BC. Jan 2018.
- Waterline Resources Ltd. 2014. TMEP – Burnaby Terminal HMM-BH-03 Groundwater Sampling. Nov 2014.
- Waterline Resources Ltd. 2013. TMEP – BGC Water Sampling Results from Drilling of HMM-BH-01 and HMM-BH-02. Dec 2014.

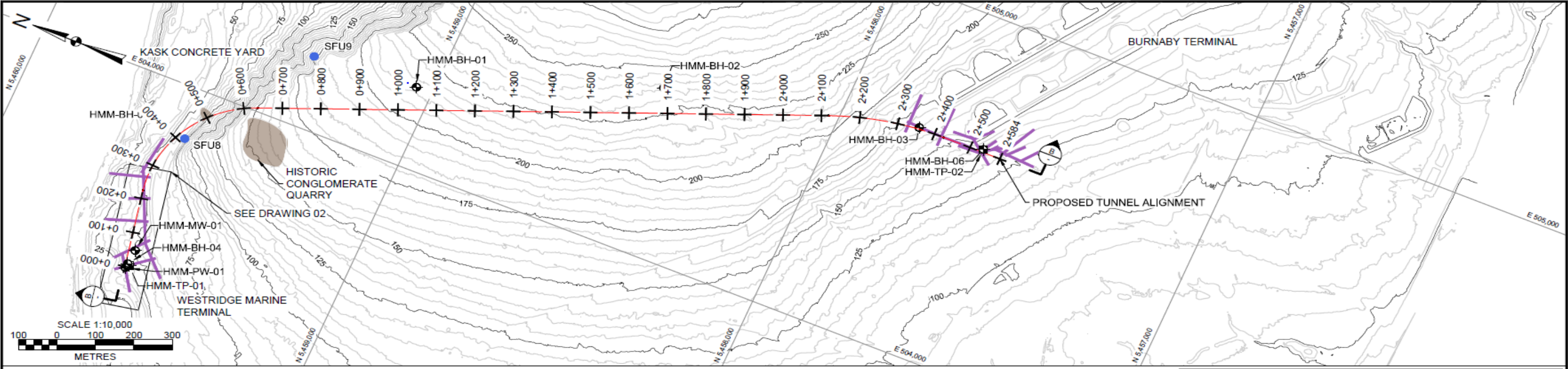


APPENDIX A

Water Quality Results

Hole ID	Easting (m)	Northing (m)	Ground Elevation (masl)	Top of Casing Elevation	Trend	Dip	Start Date	End Date	Final depth (mbgs)	Borehole Diameter (mm)	Effective Screen Length	Top of Screen	Bottom of Screen	Top of Filter Pack	Bottom of Filter Pack	Screened Unit	Monitoring Type	Field Remark
HMM-BH-01	504235	5459042	224.00		185	60	23-Nov-14	28-Nov-14	70.1	96							Unknown, no data	No record
HMM-BH-02	504498	5458507	237.00		0	90	21-Nov-14	25-Nov-14	186.4	96							Vibrating wire	Unable to locate well onsite
HMM-BH-03	504629	5457797	165.00		0	90	11-Sep-14	18-Sep-14	181.9	96							Vibrating wire, standpipe	Unable to locate well onsite
HMM-BH-04D	503466	5459536	43.49	44.27	0	90	7-Sep-15	17-Sep-15	64.6	152	3.05	17.35	20.40	16.20	21.00	Silt	Standpipe	Sampled
HMM-BH-04S	503466	5459536	43.49	44.26	0	90	7-Sep-15	17-Sep-15	64.6	152	3.05	9.85	12.90	9.00	14.20	Sandy silt to silt	Standpipe	Sampled
HMM-BH-05	503871	5459625	33.00		0	90	3-Oct-14	5-Oct-14	44.5	96							Vibrating wire	Unable to locate well onsite
HMM-BH-06	504636	5457619	138.00		0	90	22-Apr-15	25-Apr-15	31.5	96							Standpipe	Sampled by SNC Lavalin
HMM-PW-01	503453	5459537	41.45	42.37	0	90	18-Sep-15	20-Sep-15	27.5	152	15.20	4.80	20.00	3.80	27.30	Sand and silt some clay	Standpipe	Sampled
HMM-MW-01D	503508	5459532	50.27	50.91	0	90	21-Sep-15	23-Sep-15	42.7	152	3.05	22.45	25.50	21.40	26.00	Silt some clay	Standpipe	Sampled
HMM-MW-01S	503508	5459532	50.27	50.90	0	90	21-Sep-15	23-Sep-15	42.7	152	3.05	14.90	17.95	14.10	18.40	Sandy silt	Standpipe	Sampled

Coordinates datum is UTM Zone 10, NAD83.
masl: meters above sea level.
mbgs: meters below ground surface.



Analyte	Units	BC AWWQG	CCME	HMM-PW-01	HMM-PW-01	HMM-PW-01
		MAL	MAL	(BGC)	(BGC)	(Stantec)
Date sample collected				10/7/2015	10/8/2015	5/28/2019
Description						
Lab File No.				L1684969-1	L1685565-1	L2280800-1
Physical Tests						
Conductivity (Lab)	uS/cm	-	-	210	219	-
Conductivity (Field)	uS/cm	-	-	180	190	214
pH (Lab)	pH	7.0-8.7	7.0-8.7	8.51	-	8.24
pH (Field)	pH	-	-	8.36	8.44	7.89
Temperature (Field)	°C	-	-	13.7	14.7	11.4
Total Suspended Solids	mg/L	-	-	<3	<3	-
Total Dissolved Solids	mg/L	-	-	124	140	142
True Colour	CU	15	15	<5	<5	<5.0
Hardness (as CaCO3)	mg/L	-	-	74.1	75	84.7
Turbidity	NTU	-	-	1.25	0.54	1.93
Anions and Nutrients						
Acidity (as CaCO3)	mg/L	-	-	-	<1	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	84.4	77.8	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1	6.6	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1	<1	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	84.4	84.4	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	0.0294	0.0361	-
Bromide (Br)	mg/L	-	-	<0.05	<0.05	-
Chloride (Cl)	mg/L	-	-	5.54	5.55	-
Fluoride (F)	mg/L	1.5	-	0.086	0.092	-
Nitrate (as N)	mg/L	3.7	-	<0.005	<0.005	0.0279
Nitrite (as N)	mg/L	-	-	<0.001	<0.001	0.0015
Total Kjeldahl Nitrogen	mg/L	-	-	0.096	0.071	0.333
Total Nitrogen	mg/L	-	-	0.063	0.054	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.075	0.0709	0.065
Phosphorus (P)-Total	mg/L	-	-	0.0718	0.0728	-
Sulfate (SO4)	mg/L	-	-	17.3	18.3	-
Sulphide as S	mg/L	-	-	<0.02	<0.02	-
Total Metals						
Aluminum (Al)-Total	mg/L	-	-	0.148	0.0586	0.0917
Antimony (Sb)-Total	mg/L	-	-	0.00049	0.00048	0.00025
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.00949	0.00976	0.0128
Barium (Ba)-Total	mg/L	-	-	0.0152	0.0154	0.0123
Beryllium (Be)-Total	mg/L	0.1	-	<0.0001	<0.0001	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.00005	<0.00005	<0.000050
Boron (B)-Total	mg/L	1.2	-	0.036	0.029	0.032
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	<0.000005	<0.000005	<0.0000050
Calcium (Ca)-Total	mg/L	-	-	19.7	20.2	22.6
Cesium (Cs)-Total	mg/L	-	-	-	-	<0.000010
Chromium (Cr)-Total	mg/L	-	-	0.00094	0.00066	0.00083
Cobalt (Co)-Total	mg/L	-	-	<0.0001	<0.0001	0.00016
Copper (Cu)-Total	mg/L	0.002	-	<0.0005	<0.0005	<0.00050
Iron (Fe)-Total	mg/L	-	-	0.043	<0.03	0.436
Lead (Pb)-Total	mg/L	0.002	-	0.00052	0.000294	0.000089
Lithium (Li)-Total	mg/L	-	-	<0.001	<0.001	<0.0010
Magnesium (Mg)-Total	mg/L	-	-	6.42	6.26	7.90
Manganese (Mn)-Total	mg/L	0.1	-	0.0221	0.022	0.811
Mercury (Hg)-Total	mg/L	0.00001	-	<0.000005	<0.000005	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00291	0.00331	0.00218
Nickel (Ni)-Total	mg/L	0.0083	-	0.00078	0.00061	0.00089
Phosphorus (P)-Total	mg/L	-	-	<0.3	<0.3	0.121
Potassium (K)-Total	mg/L	-	-	3.9	3.93	3.66
Rubidium (Rb)-Total	mg/L	-	-	-	-	0.00067
Selenium (Se)-Total	mg/L	0.002	-	0.000176	0.000222	<0.000050
Silicon (Si)-Total	mg/L	-	-	6.51	5.96	7.37
Silver (Ag)-Total	mg/L	0.0015	-	<0.00001	<0.00001	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-PW-01	HMM-PW-01	HMM-PW-01
		MAL	MAL	(BGC)	(BGC)	(Stantec)
Methane	mg/L	-	-	<0.005	<0.005	<0.0050
Volatile Organic Compounds						
Benzene	mg/L	0.11	0.11	<0.0005	<0.0005	<0.00050
Toluene	mg/L	-	-	0.0343	0.0182	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.0005	<0.0005	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.0005	<0.0005	<0.00050
ortho-Xylene	mg/L	-	-	<0.0005	<0.0005	<0.00050
Total Xylenes	mg/L	-	-	<0.00075	<0.00075	<0.00075
Styrene	mg/L	-	-	<0.0005	<0.0005	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.0005	<0.0005	<0.00050
Bromodichloromethane	mg/L	-	-	<0.001	<0.001	<0.0010
Bromoform	mg/L	-	-	<0.001	<0.001	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.0005	<0.0005	<0.00050
Chlorobenzene	mg/L	-	-	<0.001	<0.001	<0.0010
Dibromochloromethane	mg/L	-	-	<0.001	<0.001	<0.0010
Chloroethane	mg/L	-	-	<0.001	<0.001	<0.0010
Chloroform	mg/L	-	-	<0.001	<0.001	<0.0010
Chloromethane	mg/L	-	-	<0.005	<0.005	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.0007	<0.0007	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.001	<0.001	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.001	<0.001	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.001	<0.001	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.001	<0.001	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.001	<0.001	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.001	<0.001	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.001	<0.001	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014	<0.0010
Dichloromethane	mg/L	-	-	<0.005	<0.005	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.001	<0.001	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.001	<0.001	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.001	<0.001	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.001	<0.001	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.001	<0.001	<0.00020
Tetrachloroethylene	mg/L	-	-	<0.001	<0.001	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.001	<0.001	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.001	<0.001	<0.00050
Trichloroethylene	mg/L	-	-	<0.001	<0.001	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.001	<0.001	<0.0010
Vinyl Chloride	mg/L	-	-	<0.001	<0.001	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	-	-	83.9
1,4-Difluorobenzene (SS)	%	-	-	-	-	96.6
Hydrocarbons						
EPH10-19	mg/L	-	-	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25
LEPH	mg/L	-	-	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25
F2 (C10-C16)	mg/L	-	-	<0.3	<0.3	<0.30
F3 (C16-C34)	mg/L	-	-	<0.3	<0.3	<0.30
F4 (C34-C50)	mg/L	-	-	<0.3	<0.3	<0.30
2-Bromobenzotrifluoride	%	-	-	-	-	93.5
2-Bromobenzotrifluoride, F2-F4	%	-	-	-	-	95.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	mg/L	0.006	-	<0.00005	<0.00005	<0.000010
Acenaphthylene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Acridine	mg/L	-	-	<0.00005	<0.00005	<0.000010
Anthracene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.00001	<0.00001	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	<0.00005	<0.00005	-
Benzo(b&j)fluoranthene	mg/L	-	-	-	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-PW-01	HMM-PW-01	HMM-PW-01
		MAL	MAL	(BGC)	(BGC)	(Stantec)
Benzo(b+j+k)fluoranthene	mg/L	-	-	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Chrysene	mg/L	0.0001	-	<0.00005	<0.00005	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.00005	<0.00005	<0.0000050
Fluoranthene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Fluorene	mg/L	0.012	-	<0.00005	<0.00005	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.00005	<0.00005	<0.000010
1-Methylnaphthalene	mg/L	-	-	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.00005	<0.00005	<0.000050
Phenanthrene	mg/L	-	-	<0.00005	<0.00005	<0.000020
Pyrene	mg/L	-	-	<0.00005	<0.00005	<0.000010
Quinoline	mg/L	-	-	<0.00005	<0.00005	<0.000050
Acridine d9	%	-	-	-	-	129.2
Chrysene d12	%	-	-	-	-	109.7
Naphthalene d8	%	-	-	-	-	93.8
Phenanthrene d10	%	-	-	-	-	113.2

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-S
		MAL	MAL	(Stantec)
Date sample collected				5/28/2019
Description				
Lab File No.				L2280800-2
Physical Tests				
Conductivity (Lab)	uS/cm	-	-	205
Conductivity (Field)	uS/cm	-	-	147
pH (Lab)	pH	7.0-8.7	7.0-8.7	8.21
pH (Field)	pH	-	-	8.17
Temperature (Field)	°C	-	-	11.56
Total Suspended Solids	mg/L	-	-	-
Total Dissolved Solids	mg/L	-	-	150
True Colour	CU	15	15	<5.0
Hardness (as CaCO3)	mg/L	-	-	79.7
Turbidity	NTU	-	-	11.70
Anions and Nutrients				
Acidity (as CaCO3)	mg/L	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	-
Bromide (Br)	mg/L	-	-	-
Chloride (Cl)	mg/L	-	-	-
Fluoride (F)	mg/L	1.5	-	-
Nitrate (as N)	mg/L	3.7	-	<0.0050
Nitrite (as N)	mg/L	-	-	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	0.063
Total Nitrogen	mg/L	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.063
Phosphorus (P)-Total	mg/L	-	-	-
Sulfate (SO4)	mg/L	-	-	-
Sulphide as S	mg/L	-	-	-
Total Metals				
Aluminum (Al)-Total	mg/L	-	-	0.078
Antimony (Sb)-Total	mg/L	-	-	0.00052
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.01300
Barium (Ba)-Total	mg/L	-	-	0.0233
Beryllium (Be)-Total	mg/L	0.1	-	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.000050
Boron (B)-Total	mg/L	1.2	-	0.016
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	0.0000099
Calcium (Ca)-Total	mg/L	-	-	22.8
Cesium (Cs)-Total	mg/L	-	-	<0.000010
Chromium (Cr)-Total	mg/L	-	-	0.00590
Cobalt (Co)-Total	mg/L	-	-	0.00015
Copper (Cu)-Total	mg/L	0.002	-	<0.00050
Iron (Fe)-Total	mg/L	-	-	0.091
Lead (Pb)-Total	mg/L	0.002	-	<0.000050
Lithium (Li)-Total	mg/L	-	-	<0.0010
Magnesium (Mg)-Total	mg/L	-	-	7.24
Manganese (Mn)-Total	mg/L	0.1	-	0.0287
Mercury (Hg)-Total	mg/L	0.00001	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00225
Nickel (Ni)-Total	mg/L	0.0083	-	0.00387
Phosphorus (P)-Total	mg/L	-	-	0.114
Potassium (K)-Total	mg/L	-	-	3.7
Rubidium (Rb)-Total	mg/L	-	-	0.0
Selenium (Se)-Total	mg/L	0.002	-	0.000262
Silicon (Si)-Total	mg/L	-	-	6.24
Silver (Ag)-Total	mg/L	0.0015	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-S
		MAL	MAL	(Stantec)
Sodium (Na)-Total	mg/L	-	-	7.8
Strontium (Sr)-Total	mg/L	-	-	0.0778
Sulfur (S)-Total	mg/L	-	-	4.6900
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	0.000011
Thorium (Th)-Total	mg/L	-	-	<0.00010
Tin (Sn)-Total	mg/L	-	-	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.0028
Tungsten (W)-Total	mg/L	-	-	0.00021
Uranium (U)-Total	mg/L	-	-	0.000554
Vanadium (V)-Total	mg/L	0.05	-	0.00286
Zinc (Zn)-Total	mg/L	0.01	-	<0.0030
Zirconium (Zr)-Total	mg/L	-	-	<0.000060
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	-	0.0081
Antimony (Sb)-Dissolved	mg/L	-	-	0.00045
Arsenic (As)-Dissolved	mg/L	-	-	0.01270
Barium (Ba)-Dissolved	mg/L	-	-	0.0243
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	-	-	0.014
Cadmium (Cd)-Dissolved	mg/L	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	20.0
Cesium (Cs)-Dissolved	mg/L	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	-	-	0.00110
Cobalt (Co)-Dissolved	mg/L	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	-	-	<0.00020
Iron (Fe)-Dissolved	mg/L	-	-	0.01
Lead (Pb)-Dissolved	mg/L	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	-	7.25
Manganese (Mn)-Dissolved	mg/L	-	-	0.0252
Mercury (Hg)-Dissolved	mg/L	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00187
Nickel (Ni)-Dissolved	mg/L	-	-	0.00113
Phosphorus (P)- Dissolved	mg/L	-	-	0.061
Potassium (K)-Dissolved	mg/L	-	-	3.50
Rubidium (Rb)-Dissolved	mg/L	-	-	0.00
Selenium (Se)-Dissolved	mg/L	-	-	0.000340
Silicon (Si)-Dissolved	mg/L	-	-	5.95
Silver (Ag)-Dissolved	mg/L	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	7.7
Strontium (Sr)-Dissolved	mg/L	-	-	0.075
Sulfur (S)-Dissolved	mg/L	-	-	4.990
Tellurium (Te)-Dissolved	mg/L	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010
Thorium (Th)-Dissolved	mg/L	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030
Tungsten (W)-Dissolved	mg/L	-	-	0.00015
Uranium (U)-Dissolved	mg/L	-	-	0.000484
Vanadium (V)-Dissolved	mg/L	-	-	0.00271
Zinc (Zn)-Dissolved	mg/L	-	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	-	-	<0.000060
Organic / Inorganic Carbon (Water)				
Total Organic Carbon	mg/L	-	-	<0.50
Aggregate Organics (Water)				
COD	mg/L	-	-	<20
Phenols (4AAP)	mg/L	-	-	<0.0010
Dissolved Gases (Water)				

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-S
		MAL	MAL	(Stantec)
Methane	mg/L	-	-	-
Volatile Organic Compounds				
Benzene	mg/L	0.11	0.11	<0.00050
Toluene	mg/L	-	-	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.00050
ortho-Xylene	mg/L	-	-	<0.00050
Xylenes	mg/L	-	-	<0.00075
Styrene	mg/L	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.00050
Chlorobenzene	mg/L	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	-	-	<0.0010
Chloromethane	mg/L	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0010
Dichloromethane	mg/L	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.00020
Tetrachloroethylene	mg/L	-	-	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.00050
Trichloroethylene	mg/L	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	86.5
1,4-Difluorobenzene (SS)	%	-	-	97.2
Hydrocarbons				
EPH10-19	mg/L	-	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	-	-	<0.25
HEPH	mg/L	-	-	<0.25
F2 (C10-C16)	mg/L	-	-	<0.30
F3 (C16-C34)	mg/L	-	-	<0.30
F4 (C34-C50)	mg/L	-	-	<0.30
2-Bromobenzotrifluoride	%	-	-	99.7
2-Bromobenzotrifluoride, F2-F4	%	-	-	99.5
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.006	-	<0.000010
Acenaphthylene	mg/L	-	-	<0.000010
Acridine	mg/L	-	-	<0.000010
Anthracene	mg/L	-	-	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	-
Benzo(b&j)fluoranthene	mg/L	-	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-S
		MAL	MAL	(Stantec)
Benzo(b+j+k)fluoranthene	mg/L	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.000010
Chrysene	mg/L	0.0001	-	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.0000050
Fluoranthene	mg/L	-	-	<0.000010
Fluorene	mg/L	0.012	-	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000010
1-Methylnaphthalene	mg/L	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.000050
Phenanthrene	mg/L	-	-	<0.000020
Pyrene	mg/L	-	-	<0.000010
Quinoline	mg/L	-	-	<0.000050
Acridine d9	%	-	-	118.7
Chrysene d12	%	-	-	114.4
Naphthalene d8	%	-	-	98.8
Phenanthrene d10	%	-	-	115.3

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-D
		MAL	MAL	(Stantec)
Date sample collected				5/28/2019
Description				High turbidity sample
Lab File No.				L2280800-3
Physical Tests				
Conductivity (Lab)	uS/cm	-	-	201
Conductivity (Field)	uS/cm	-	-	198
pH (Lab)	pH	7.0-8.7	7.0-8.7	8.25
pH (Field)	pH	-	-	8.29
Temperature (Field)	°C	-	-	14.72
Total Suspended Solids	mg/L	-	-	-
Total Dissolved Solids	mg/L	-	-	173
True Colour	CU	15	15	<5.0
Hardness (as CaCO3)	mg/L	-	-	80.4
Turbidity	NTU	-	-	165.00
Anions and Nutrients				
Acidity (as CaCO3)	mg/L	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	-
Bromide (Br)	mg/L	-	-	-
Chloride (Cl)	mg/L	-	-	-
Fluoride (F)	mg/L	1.5	-	-
Nitrate (as N)	mg/L	3.7	-	<0.0050
Nitrite (as N)	mg/L	-	-	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	0.190
Total Nitrogen	mg/L	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.028
Phosphorus (P)-Total	mg/L	-	-	-
Sulfate (SO4)	mg/L	-	-	-
Sulphide as S	mg/L	-	-	-
Total Metals				
Aluminum (Al)-Total	mg/L	-	-	10.000
Antimony (Sb)-Total	mg/L	-	-	0.00099
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.02020
Barium (Ba)-Total	mg/L	-	-	0.0728
Beryllium (Be)-Total	mg/L	0.1	-	0.00028
Bismuth (Bi)-Total	mg/L	-	-	0.000081
Boron (B)-Total	mg/L	1.2	-	0.018
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	0.000461
Calcium (Ca)-Total	mg/L	-	-	28.0
Cesium (Cs)-Total	mg/L	-	-	0.0
Chromium (Cr)-Total	mg/L	-	-	0.03300
Cobalt (Co)-Total	mg/L	-	-	0.00703
Copper (Cu)-Total	mg/L	0.002	-	0.0207
Iron (Fe)-Total	mg/L	-	-	12.700
Lead (Pb)-Total	mg/L	0.002	-	0.00335
Lithium (Li)-Total	mg/L	-	-	0.0058
Magnesium (Mg)-Total	mg/L	-	-	13.40
Manganese (Mn)-Total	mg/L	0.1	-	0.2680
Mercury (Hg)-Total	mg/L	0.00001	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00439
Nickel (Ni)-Total	mg/L	0.0083	-	0.02450
Phosphorus (P)-Total	mg/L	-	-	0.354
Potassium (K)-Total	mg/L	-	-	3.6
Rubidium (Rb)-Total	mg/L	-	-	0.0
Selenium (Se)-Total	mg/L	0.002	-	0.000357
Silicon (Si)-Total	mg/L	-	-	26.60

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-D
		MAL	MAL	(Stantec)
Silver (Ag)-Total	mg/L	0.0015	-	0.00005
Sodium (Na)-Total	mg/L	-	-	8.4
Strontium (Sr)-Total	mg/L	-	-	0.1230
Sulfur (S)-Total	mg/L	-	-	4.3400
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	0.000129
Thorium (Th)-Total	mg/L	-	-	0.00153
Tin (Sn)-Total	mg/L	-	-	0.0003
Titanium (Ti)-Total	mg/L	-	-	0.403
Tungsten (W)-Total	mg/L	-	-	<0.00010
Uranium (U)-Total	mg/L	-	-	0.000688
Vanadium (V)-Total	mg/L	0.05	-	0.02770
Zinc (Zn)-Total	mg/L	0.01	-	0.0428
Zirconium (Zr)-Total	mg/L	-	-	0.0005
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	-	0.0024
Antimony (Sb)-Dissolved	mg/L	-	-	0.00097
Arsenic (As)-Dissolved	mg/L	-	-	0.01590
Barium (Ba)-Dissolved	mg/L	-	-	0.0047
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	-	-	0.015
Cadmium (Cd)-Dissolved	mg/L	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	20.6
Cesium (Cs)-Dissolved	mg/L	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	-	-	0.00030
Cobalt (Co)-Dissolved	mg/L	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	-	-	<0.00020
Iron (Fe)-Dissolved	mg/L	-	-	<0.010
Lead (Pb)-Dissolved	mg/L	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	-	7.04
Manganese (Mn)-Dissolved	mg/L	-	-	0.0207
Mercury (Hg)-Dissolved	mg/L	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00307
Nickel (Ni)-Dissolved	mg/L	-	-	0.00229
Phosphorus (P)- Dissolved	mg/L	-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	-	2.05
Rubidium (Rb)-Dissolved	mg/L	-	-	0.00
Selenium (Se)-Dissolved	mg/L	-	-	0.000149
Silicon (Si)-Dissolved	mg/L	-	-	7.92
Silver (Ag)-Dissolved	mg/L	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	6.9
Strontium (Sr)-Dissolved	mg/L	-	-	0.084
Sulfur (S)-Dissolved	mg/L	-	-	4.170
Tellurium (Te)-Dissolved	mg/L	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010
Thorium (Th)-Dissolved	mg/L	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030
Tungsten (W)-Dissolved	mg/L	-	-	<0.00010
Uranium (U)-Dissolved	mg/L	-	-	0.000204
Vanadium (V)-Dissolved	mg/L	-	-	0.00349
Zinc (Zn)-Dissolved	mg/L	-	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	-	-	<0.000060
Organic / Inorganic Carbon (Water)				
Total Organic Carbon	mg/L	-	-	4.04
Aggregate Organics (Water)				
COD	mg/L	-	-	<20
Phenols (4AAP)	mg/L	-	-	<0.0010

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-D
		MAL	MAL	(Stantec)
Dissolved Gases (Water)				
Methane	mg/L	-	-	-
Volatile Organic Compounds				
Benzene	mg/L	0.11	0.11	<0.00050
Toluene	mg/L	-	-	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.00050
ortho-Xylene	mg/L	-	-	<0.00050
Xylenes	mg/L	-	-	<0.00075
Styrene	mg/L	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.00050
Chlorobenzene	mg/L	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	-	-	<0.0010
Chloromethane	mg/L	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0010
Dichloromethane	mg/L	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.00020
Tetrachloroethylene	mg/L	-	-	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.00050
Trichloroethylene	mg/L	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	95.3
1,4-Difluorobenzene (SS)	%	-	-	100.5
Hydrocarbons				
EPH10-19	mg/L	-	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	-	-	<0.25
HEPH	mg/L	-	-	<0.25
F2 (C10-C16)	mg/L	-	-	<0.30
F3 (C16-C34)	mg/L	-	-	<0.30
F4 (C34-C50)	mg/L	-	-	<0.30
2-Bromobenzotrifluoride	%	-	-	97.4
2-Bromobenzotrifluoride, F2-F4	%	-	-	96.5
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.006	-	<0.000010
Acenaphthylene	mg/L	-	-	<0.000010
Acridine	mg/L	-	-	<0.000010
Anthracene	mg/L	-	-	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	-

Analyte	Units	BC AWWQG	CCME	HMM-MW-01-D
		MAL	MAL	(Stantec)
Benzo(b&j)fluoranthene	mg/L	-	-	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.000010
Chrysene	mg/L	0.0001	-	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.0000050
Fluoranthene	mg/L	-	-	<0.000010
Fluorene	mg/L	0.012	-	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000010
1-Methylnaphthalene	mg/L	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.000050
Phenanthrene	mg/L	-	-	<0.000020
Pyrene	mg/L	-	-	<0.000010
Quinoline	mg/L	-	-	<0.000050
Acridine d9	%	-	-	104.5
Chrysene d12	%	-	-	105.2
Naphthalene d8	%	-	-	87.6
Phenanthrene d10	%	-	-	96.2

Legend:
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"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-01 WS01	HMM-BH-01 WS02	HMM-BH-01 WS03
		MAL	MAL	(BGC)	(BGC)	(BGC)
Date sample collected				11/25/2014	11/26/2014	11/27/2014
Description				Sample of recirculated drilling water, not representative of baseline groundwater condition		
Lab File No.						
General Chemistry						
Total Dissolved Solids - Calculated	mg/L	-	-	19	67	91
Hardness (CaCO3) - Calculated	mg/L	-	-	12.2	23.4	25.3
pH	-	7.0-8.7	7.0-8.7	7.06	8.66	7.45
Conductivity (EC)	uS/cm	-	-	38	81	158
Turbidity	NTU	-	-	2.2	9600	960
Alkalinity, pH 4.5 (as CaCO3)	mg/L	-	-	12	71	69
Alkalinity, p (as CaCO3)	mg/L	-	-	<1	3	<1
Sulphate (SO4)	mg/L	-	-	1.7	1.9	7.1
Chloride (Cl)	mg/L	-	-	3.14	3.31	6.66
Fluoride (F)	mg/L	1.5	-	0.04	0.09	0.18
Bicarbonate (HCO3)	mg/L	-	-	12	65	69
Carbonate (CO3)	mg/L	-	-	<1	6	<1
Hydroxide (OH)	mg/L	-	-	<1	<1	<1
Nitrate+Nitrite-N	mg/L	-	-	0.13	0.09	0.55
Nitrate-N	mg/L	3.7	-	0.133	0.087	0.548
Nitrite-N	mg/L	-	-	<0.005	<0.005	0.006
Total Phenols	mg/L	-	-	< 0.002	0.002	0.006
Phosphorus Dissolved	mg/L	-	-	0.013	0.112	0.016
Phosphorus Total	mg/L	-	-	0.013	3.42	0.36
Total Metals						
Aluminum (Al)	mg/L	-	-	0.088	180	38.6
Antimony (Sb)	mg/L	-	-	<0.0005	<0.0005	0.0007
Arsenic (As)	mg/L	0.0125	0.0125	0.0007	0.0202	0.0028
Barium (Ba)	mg/L	-	-	0.017	1.19	0.422
Beryllium (Be)	mg/L	-	-	<0.00005	0.0029	0.00084
Boron (B)	mg/L	1.2	-	<0.0005	0.065	0.107
Cadmium (Cd)	mg/L	0.00012	0.00012	0.00009	0.00078	0.0001
Calcium (Ca)	mg/L	-	-	4.54	78.1	23.9
Chromium (Cr)	mg/L	-	-	<0.0005	0.259	0.0316
Cobalt (Co)	mg/L	-	-	0.00011	0.0969	0.0095
Copper (Cu)	mg/L	0.002	-	0.0124	0.808	0.111
Iron (Fe)	mg/L	-	-	0.162	280	41.9
Lead (Pb)	mg/L	0.002	-	0.00075	0.0487	0.00936
Lithium (Li)	mg/L	-	-	<0.0005	0.104	0.0158
Magnesium (Mg)	mg/L	-	-	0.209	96.5	13.3
Manganese (Mn)	mg/L	0.1	-	0.013	4.44	0.724
Mercury (Hg)	mg/L	0.00001	-	<0.00001	0.00006	<0.00001
Molybdenum (Mo)	mg/L	-	-	0.0004	0.0444	0.0845
Nickel (Ni)	mg/L	0.0083	-	0.0005	0.11	0.0168
Selenium (Se)	mg/L	0.002	-	<0.0005	<0.0005	0.0045
Silver (Ag)	mg/L	0.0015	-	0.00003	0.00468	0.00176
Sodium (Na)	mg/L	-	-	1.99	18.7	25
Thallium (Tl)	mg/L	-	-	<0.00002	0.00076	0.00013
Titanium (Ti)	mg/L	-	-	0.002	3.39	0.494
Uranium (U)	mg/L	-	-	0.00002	0.00392	0.00069
Vanadium (V)	mg/L	0.05	-	<0.001	0.444	0.088
Zinc (Zn)	mg/L	0.01	-	0.024	0.752	0.094
Dissolved Metals						
Aluminum (Al)	mg/L	-	-	0.016	0.287	0.335
Antimony (Sb)	mg/L	-	-	<0.0005	0.0013	0.002
Arsenic (As)	mg/L	-	-	0.0009	0.0024	0.0008
Barium (Ba)	mg/L	-	-	0.0179	0.0078	0.0083
Beryllium (Be)	mg/L	-	-	<0.00001	0.00002	0.00002
Boron (B)	mg/L	-	-	0.003	0.019	0.105

Analyte	Units	BC AWWQG	CCME	HMM-BH-01 WS01	HMM-BH-01 WS02	HMM-BH-01 WS03
		MAL	MAL	(BGC)	(BGC)	(BGC)
Cadmium (Cd)	mg/L	-	-	0.00009	0.00003	0.00011
Calcium (Ca)	mg/L	-	-	4.56	8	8.12
Chromium (Cr)	mg/L	-	-	<0.0005	<0.0005	0.0005
Cobalt (Co)	mg/L	-	-	0.00006	<0.00005	<0.00005
Copper (Cu)	mg/L	-	-	0.005	0.0022	0.0035
Iron (Fe)	mg/L	-	-	0.024	0.05	0.108
Lead (Pb)	mg/L	-	-	0.00024	0.00013	0.0001
Lithium (Li)	mg/L	-	-	<0.0005	0.0044	0.0033
Magnesium (Mg)	mg/L	-	-	0.195	0.816	1.22
Manganese (Mn)	mg/L	-	-	0.009	0.009	0.024
Mercury (Hg)	mg/L	-	-	<0.00001	<0.00001	<0.00001
Molybdenum (Mo)	mg/L	-	-	0.00035	0.02	0.0968
Nickel (Ni)	mg/L	-	-	0.0003	0.0002	0.0006
Potassium (K)	mg/L	-	-	0.25	4.35	6.43
Selenium (Se)	mg/L	-	-	<0.0005	<0.0005	0.0027
Silver (Ag)	mg/L	-	-	0.00005	0.00013	0.00005
Sodium (Na)	mg/L	-	-	2.0	6.0	18.9
Thallium (Tl)	mg/L	-	-	0.00004	0.00004	0.00004
Titanium (Ti)	mg/L	-	-	<0.0005	0.0464	0.0215
Uranium (U)	mg/L	-	-	<0.00001	0.00007	0.00005
Vanadium (V)	mg/L	-	-	<0.0005	0.007	0.0014
Zinc (Zn)	mg/L	-	-	0.02	<0.002	0.003
Hydrocarbons						
Methyl tert-butyl ether (MTBE)	µg/L	-	-	<1	<1	1
Benzene	µg/L	-	-	<0.5	<0.5	<0.5
Toluene	µg/L	-	-	<0.5	<0.5	3.5
Ethylbenzene	µg/L	-	-	<0.5	<0.5	<0.5
m&p-Xylene	µg/L	-	-	<0.5	<0.5	2.2
o-Xylene	µg/L	-	-	<0.5	<0.5	0.7
Styrene	µg/L	-	-	<0.5	<0.5	1.2
VPH	µg/L	-	-	<100	<100	<100
VH	µg/L	-	-	<100	<100	<100
EPH C10-C19	µg/L	-	-	140	180	1240
EPH C19-C32	µg/L	-	-	3110	520	800
Total Xylenes	µg/L	-	-	<1	<1	3

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"-" - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-02 WS01	HMM-BH-02 WS02	HMM-BH-02 WS03
		MAL	MAL	(BGC)	(BGC)	(BGC)
Date Collected				11/22/2014	11/23/2014	11/25/2014
Description				Sample of recirculated drilling water, not representative of baseline groundwater condition		
Lab File No.						
General Chemistry						
Total Dissolved Solids - Calculated	mg/L	-	-	69	101	104
Hardness (CaCO3) - Calculated	mg/L	-	-	13.2	25.3	31.6
pH	-	7.0-8.7	7.0-8.7	8.49	8.68	8.68
Conductivity (EC)	uS/cm	-	-	89	100	108
Turbidity	NTU	-	-	27000	21000	50000
Alkalinity, pH 4.5 (as CaCO3)	mg/L	-	-	65	119	115
Alkalinity, p (as CaCO3)	mg/L	-	-	2	3	3
Sulphate (SO4)	mg/L	-	-	3.3	2	3.3
Chloride (Cl)	mg/L	-	-	5.26	4.62	4.95
Fluoride (F)	mg/L	1.5	-	0.2	0.17	0.18
Bicarbonate (HCO3)	mg/L	-	-	61	112	108
Carbonate (CO3)	mg/L	-	-	4	7	7
Hydroxide (OH)	mg/L	-	-	<1	<1	<1
Nitrate+Nitrite-N	mg/L	-	-	0.07	0.11	0.42
Nitrate-N	mg/L	3.7	-	0.07	0.111	0.406
Nitrite-N	mg/L	-	-	<0.005	<0.005	0.01
Total Phenols	mg/L	-	-	< 0.002	0.002	0.004
Phosphorus Dissolved	mg/L	-	-	0.072	0.013	0.014
Phosphorus Total	mg/L	-	-	2.59	8.69	13.7
Total Metals						
Aluminum (Al)	mg/L	-	-	139.000	667	614.0
Antimony (Sb)	mg/L	-	-	<0.0005	<0.0005	<0.0005
Arsenic (As)	mg/L	0.0125	0.0125	0.0197	0.0847	0.0344
Barium (Ba)	mg/L	-	-	0.590	7.82	4.250
Beryllium (Be)	mg/L	-	-	0.00192	0.0105	0.00980
Boron (B)	mg/L	1.2	-	0.032	0.154	0.153
Cadmium (Cd)	mg/L	0.00012	0.00012	0.00052	0.00233	0.0018
Calcium (Ca)	mg/L	-	-	53.40	287.0	294.0
Chromium (Cr)	mg/L	-	-	0.394	0.960	0.4720
Cobalt (Co)	mg/L	-	-	0.11400	0.4600	0.3390
Copper (Cu)	mg/L	0.002	-	1.7900	6.430	3.360
Iron (Fe)	mg/L	-	-	274.000	1190	1020.0
Lead (Pb)	mg/L	0.002	-	0.04590	0.2180	0.19100
Lithium (Li)	mg/L	-	-	0.0733	0.378	0.3140
Magnesium (Mg)	mg/L	-	-	86.700	358.0	291.0
Manganese (Mn)	mg/L	0.1	-	3.760	17.50	15.400
Mercury (Hg)	mg/L	0.00001	-	0.00005	0.00003	<0.00001
Molybdenum (Mo)	mg/L	-	-	0.0835	0.1250	0.0289
Nickel (Ni)	mg/L	0.0083	-	0.3250	1.15	0.6270
Selenium (Se)	mg/L	0.002	-	<0.0005	<0.0005	<0.0005
Silver (Ag)	mg/L	0.0015	-	0.55900	0.59200	0.41000
Sodium (Na)	mg/L	-	-	14.40	38.6	27
Thallium (Tl)	mg/L	-	-	0.00051	0.00358	0.00224
Titanium (Ti)	mg/L	-	-	3.310	4.43	3.680
Uranium (U)	mg/L	-	-	0.00344	0.01460	0.01250
Vanadium (V)	mg/L	0.05	-	0.357	1.710	1.670
Zinc (Zn)	mg/L	0.01	-	0.619	1.740	1.330
Dissolved Metals						
Aluminum (Al)	mg/L	-	-	0.292	0	0.2
Antimony (Sb)	mg/L	-	-	0.0047	0.0019	0.0018
Arsenic (As)	mg/L	-	-	0.0036	0.0029	0.0020
Barium (Ba)	mg/L	-	-	0.004	0.01	0.007
Beryllium (Be)	mg/L	-	-	0.00002	0.0000	0.00005
Boron (B)	mg/L	-	-	0.043	0.072	0.077

Analyte	Units	BC AWWQG	CCME	HMM-BH-02 WS01	HMM-BH-02 WS02	HMM-BH-02 WS03
		MAL	MAL	(BGC)	(BGC)	(BGC)
Cadmium (Cd)	mg/L	-	-	0.00010	0.00004	0.0001
Calcium (Ca)	mg/L	-	-	4.15	8.6	11.0
Chromium (Cr)	mg/L	-	-	<0.0005	<0.0005	<0.0005
Cobalt (Co)	mg/L	-	-	0.00010	<0.00005	<0.00005
Copper (Cu)	mg/L	-	-	0.0020	0.002	0.002
Iron (Fe)	mg/L	-	-	0.092	0	0.0
Lead (Pb)	mg/L	-	-	0.00023	0.0001	0.00013
Lithium (Li)	mg/L	-	-	0.001	0.001	0.0015
Magnesium (Mg)	mg/L	-	-	0.679	1.0	1.0
Manganese (Mn)	mg/L	-	-	0.007	0.01	0.009
Mercury (Hg)	mg/L	-	-	0.00001	0.00001	<0.00001
Molybdenum (Mo)	mg/L	-	-	0.0712	0.0215	0.0428
Nickel (Ni)	mg/L	-	-	0.0006	0.00	0.0002
Potassium (K)	mg/L	-	-	2.6	3.51	3.7600
Selenium (Se)	mg/L	-	-	<0.0005	<0.0005	<0.0005
Silver (Ag)	mg/L	-	-	0.00	0.0	0
Sodium (Na)	mg/L	-	-	13.6	9.80000	9.94000
Thallium (Tl)	mg/L	-	-	0.000	0.00	0.000
Titanium (Ti)	mg/L	-	-	0.05560	0.03390	0.02910
Uranium (U)	mg/L	-	-	0.00006	0.000	0.000
Vanadium (V)	mg/L	-	-	0.004	0.014	0.007
Zinc (Zn)	mg/L	-	-	<0.002	<0.002	<0.002
Hydrocarbons						
Methyl tert-butyl ether (MTBE)	µg/L	-	-	<1	<1	<1
Benzene	µg/L	-	-	<0.5	<0.5	<0.5
Toluene	µg/L	-	-	<0.5	16.7	2.5
Ethylbenzene	µg/L	-	-	<0.5	<0.5	<0.5
m&p-Xylene	µg/L	-	-	<0.5	<0.5	<0.5
o-Xylene	µg/L	-	-	<0.5	<0.5	<0.5
Styrene	µg/L	-	-	<0.5	<0.5	<0.5
VPH	µg/L	-	-	<100	<100	<100
VH	µg/L	-	-	<100	<100	<100
EPH C10-C19	µg/L	-	-	<100	100	<100
EPH C19-C32	µg/L	-	-	130	130	140
Total Xylenes	µg/L	-	-	<1	<1	<1

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"-" - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-03 WS02	HMM-BH-03 WS03	HMM-BH-03 WS04	HMM-BH-03 WS05	HMM-BH-03 WS06	HMM-BH-03 WS07	HMM-BH-03 WS08
		MAL	MAL	(BGC)	(BGC)	(BGC)	(BGC)	(BGC)	(BGC)	(Waterline)
Date Collected				9/12/2014	9/13/2014	9/15/2014	9/15/2014	9/17/2014	9/18/2014	10/11/2014
Description				Sample of recirculated drilling water, not representative of baseline groundwater condition						High turbidity sample
Lab File No.										
General Chemistry										
Total Dissolved Solids - Calculated	mg/L	-	-	62	77	80	78	28	20	394
Hardness (CaCO3) - Calculated	mg/L	-	-	29.3	24.6	22.2	26.5	12.7	6.2	224.0
Dissolved Hardness (CaCO3)	mg/L	7.0-8.7	7.0-8.7	-	-	-	-	-	-	85.8
pH	-	-	-	7.72	8.06	8.17	7.95	7.34	6.94	7.99
Conductivity (EC)	uS/cm	-	-	106	118	122	124	53	37	555
Turbidity	NTU	-	-	8.6	543	921	-	-	-	3740
Alkalinity, pH 4.5 (as CaCO3)	mg/L	-	-	53	72	70	58	23	13	129
Alkalinity, p (as CaCO3)	mg/L	-	-	<1	<1	<1	<1	<1	<1	<0.50
True Colour	Col. Unit	-	-	-	-	-	-	-	-	70
Sulphate (SO4)	mg/L	-	-	3.5	1.9	3.2	15.5	0.8	0.8	136.0
Sulphide (S2-)		-	-	-	-	-	-	-	-	<0.0050
Chloride (Cl)	mg/L	-	-	3.52	3.15	5.93	3.35	2.5	3.82	8.00
Fluoride (F)	mg/L	1.5		0.11	0.24	0.27	0.29	<0.02	<0.02	0.34
Bicarbonate (HCO3)	mg/L	-	-	53	72	70	58	23	13	158
Carbonate (CO3)	mg/L	-	-	<1	<1	<1	<1	<1	<1	<0.50
Hydroxide (OH)	mg/L	-	-	-	-	-	-	-	-	<0.50
Nitrate+Nitrite-N	mg/L	3.7	-	0.04	0.06	0.05	0.02	0.05	0.06	0.34
Nitrate-N	mg/L	-	-	0.038	0.046	0.046	<0.005	0.053	0.058	<0.20
Nitrite-N	mg/L	-	-	<0.005	0.018	<0.005	0.02	<0.005	<0.005	0.307
Total Phenols	mg/L	-	-	0.003	<0.002	0.003	0.003	< 0.002	< 0.002	0.0055
Phosphorus Dissolved	mg/L	-	-	0.04	0.027	0.027	0.041	0.042	-	0.0614
Phosphorus Total	mg/L	-	-	0.246	0.84	0.933	7.86	0.114	0.092	1.210
Total Metals										
Aluminum (Al)	mg/L	-	-	218	928	1490	482	5.21	4.25	45.70
Antimony (Sb)	mg/L	-	-	0.0007	<0.005	<0.005	<0.0005	<0.0005	<0.0005	0.00081
Arsenic (As)	mg/L	0.0125	0.0125	0.0331	0.058	0.103	0.109	0.0012	0.0009	0.0115
Barium (Ba)	mg/L	-	-	1.48	6.13	8.45	4.41	0.0571	0.0357	0.3480
Beryllium (Be)	mg/L	-	-	0.00385	0.0183	0.03	0.00902	0.00008	0.00005	0.00200
Bismuth (Bi)	mg/L	-	-	-	-	-	-	-	-	<0.0010
Boron (B)	mg/L	1.2	-	0.185	0.432	1.58	0.167	0.008	0.006	0.116
Cadmium (Cd)	mg/L	0.00012	0.00012	0.0013	0.0055	0.0076	0.00211	0.00003	0.00005	0.00143
Calcium (Ca)	mg/L	-	-	94.8	256	473	195	6.74	16.1	54.6
Chromium (Cr)	mg/L	-	-	0.231	1.05	2.15	0.397	0.0135	0.0167	0.1100
Cobalt (Co)	mg/L	-	-	0.12	0.542	0.921	0.359	0.00296	0.0024	0.0325
Copper (Cu)	mg/L	0.002	-	1.67	2.99	4.19	1.48	0.0297	0.0266	0.1520
Iron (Fe)	mg/L	-	-	277	1380	2460	745	9.81	13.8	67.8
Lead (Pb)	mg/L	0.002	-	0.087	0.273	0.568	0.19	0.00177	0.00249	0.02720
Lithium (Li)	mg/L	-	-	0.171	0.634	1.14	0.27	0.0031	0.0019	0.0218
Magnesium (Mg)	mg/L	-	-	106	566	865	241	2.23	1.22	21.30
Manganese (Mn)	mg/L	0.1	-	4.69	22.9	35.6	10.3	0.144	0.226	1.500
Mercury (Hg)	mg/L	0.00001	-	<0.00001	0.00005	<0.00001	0.002	<0.00001	<0.00001	<0.00020
Molybdenum (Mo)	mg/L	-	-	0.0325	0.057	0.107	0.0193	0.0057	0.0067	0.0340
Nickel (Ni)	mg/L	0.0083	-	0.381	1.06	1.27	0.423	0.0078	0.0041	0.0739
Potassium (K)	mg/L	-	-	-	-	-	-	-	-	6.1700
Selenium (Se)	mg/L	0.002	-	0.006	0.026	0.056	0.0288	<0.0005	<0.0005	0.00078
Silicon (Si)	mg/L	-	-	-	-	-	-	-	-	54.3
Silver (Ag)	mg/L	0.0015	-	0.00163	0.003	0.0068	0.00155	<0.00002	<0.00002	0.000114
Sodium (Na)	mg/L	-	-	21.8	72.6	85.7	28.8	6.42	51.8	87.5
Strontium (Sr)	mg/L	-	-	-	-	-	-	-	-	0.4
Sulfur (S)	mg/L	-	-	-	-	-	-	-	-	41.9
Thallium (Tl)	mg/L	-	-	0.0007	0.0041	0.0074	0.0026	<0.00002	<0.00002	0.00082
Tin (Sn)	mg/L	-	-	-	-	-	-	-	-	0.02
Titanium (Ti)	mg/L	-	-	2.53	26.5	10.8	0.707	0.218	0.158	0.753
Uranium (U)	mg/L	-	-	0.00523	0.0215	0.0455	0.00965	0.00013	0.00012	0.00635

[illegible]

Analyte	Units	BC AWWQG	CCME	HMM-BH-03 WS02	HMM-BH-03 WS03	HMM-BH-03 WS04	HMM-BH-03 WS05	HMM-BH-03 WS06	HMM-BH-03 WS07	HMM-BH-03 WS08
		MAL	MAL	(BGC)	(BGC)	(BGC)	(BGC)	(BGC)	(BGC)	(Waterline)
Calculated Methane	mg/L	-	-	-	-	-	-	-	-	0.004
Hydrogen Sulphide	mg/L	-	-	-	-	-	-	-	-	<0.0050

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-S
		MAL	MAL	(Stantec)
Date sample collected				5/28/2019
Description				High turbidity sample
Lab File No.				L2280800-4
Physical Tests				
Conductivity (Lab)	uS/cm	-	-	205
Conductivity (Field)	uS/cm	-	-	205
pH (Lab)	pH	7.0-8.7	7.0-8.7	8.24
pH (Field)	pH	-	-	7.87
Temperature (Field)	°C	-	-	11.18
Total Suspended Solids	mg/L	-	-	-
Total Dissolved Solids	mg/L	-	-	170
True Colour	CU	15	15	<5.0
Hardness (as CaCO3)	mg/L	-	-	82.3
Turbidity	NTU	-	-	177.00
Anions and Nutrients				
Acidity (as CaCO3)	mg/L	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	-
Bromide (Br)	mg/L	-	-	-
Chloride (Cl)	mg/L	-	-	-
Fluoride (F)	mg/L	1.5	-	-
Nitrate (as N)	mg/L	3.7	-	<0.0050
Nitrite (as N)	mg/L	-	-	0.0018
Total Kjeldahl Nitrogen	mg/L	-	-	0.052
Total Nitrogen	mg/L	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.053
Phosphorus (P)-Total	mg/L	-	-	-
Sulfate (SO4)	mg/L	-	-	-
Sulphide as S	mg/L	-	-	-
Total Metals				
Aluminum (Al)-Total	mg/L	-	-	9.250
Antimony (Sb)-Total	mg/L	-	-	0.00022
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.00672
Barium (Ba)-Total	mg/L	-	-	0.0589
Beryllium (Be)-Total	mg/L	0.1	-	0.00017
Bismuth (Bi)-Total	mg/L	-	-	0.000058
Boron (B)-Total	mg/L	1.2	-	0.032
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	0.000076
Calcium (Ca)-Total	mg/L	-	-	27.8
Cesium (Cs)-Total	mg/L	-	-	0.000487
Chromium (Cr)-Total	mg/L	-	-	0.01640
Cobalt (Co)-Total	mg/L	-	-	0.00537
Copper (Cu)-Total	mg/L	0.002	-	0.0215
Iron (Fe)-Total	mg/L	-	-	10.700
Lead (Pb)-Total	mg/L	0.002	-	0.00238
Lithium (Li)-Total	mg/L	-	-	0.0052
Magnesium (Mg)-Total	mg/L	-	-	11.90
Manganese (Mn)-Total	mg/L	0.1	-	0.2440
Mercury (Hg)-Total	mg/L	0.00001	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00267
Nickel (Ni)-Total	mg/L	0.0083	-	0.01750
Phosphorus (P)-Total	mg/L	-	-	0.376
Potassium (K)-Total	mg/L	-	-	3.7
Rubidium (Rb)-Total	mg/L	-	-	0.0
Selenium (Se)-Total	mg/L	0.002	-	0.000129
Silicon (Si)-Total	mg/L	-	-	24.70

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-S
		MAL	MAL	(Stantec)
Silver (Ag)-Total	mg/L	0.0015	-	0.000108
Sodium (Na)-Total	mg/L	-	-	9.7
Strontium (Sr)-Total	mg/L	-	-	0.1240
Sulfur (S)-Total	mg/L	-	-	4.4200
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	0.000043
Thorium (Th)-Total	mg/L	-	-	0.00092
Tin (Sn)-Total	mg/L	-	-	0.0002
Titanium (Ti)-Total	mg/L	-	-	0.484
Tungsten (W)-Total	mg/L	-	-	<0.00010
Uranium (U)-Total	mg/L	-	-	0.000298
Vanadium (V)-Total	mg/L	0.05	-	0.02250
Zinc (Zn)-Total	mg/L	0.01	-	0.0277
Zirconium (Zr)-Total	mg/L	-	-	0.0009
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	-	0.0023
Antimony (Sb)-Dissolved	mg/L	-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	-	-	0.00520
Barium (Ba)-Dissolved	mg/L	-	-	0.0036
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	-	-	0.028
Cadmium (Cd)-Dissolved	mg/L	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	22.6
Cesium (Cs)-Dissolved	mg/L	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	-	-	<0.00010
Cobalt (Co)-Dissolved	mg/L	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	-	-	<0.00020
Iron (Fe)-Dissolved	mg/L	-	-	<0.010
Lead (Pb)-Dissolved	mg/L	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	-	6.28
Manganese (Mn)-Dissolved	mg/L	-	-	0.0194
Mercury (Hg)-Dissolved	mg/L	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00236
Nickel (Ni)-Dissolved	mg/L	-	-	<0.00050
Phosphorus (P)- Dissolved	mg/L	-	-	0.062
Potassium (K)-Dissolved	mg/L	-	-	2.41
Rubidium (Rb)-Dissolved	mg/L	-	-	0.00
Selenium (Se)-Dissolved	mg/L	-	-	<0.000050
Silicon (Si)-Dissolved	mg/L	-	-	8.35
Silver (Ag)-Dissolved	mg/L	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	8.4
Strontium (Sr)-Dissolved	mg/L	-	-	0.093
Sulfur (S)-Dissolved	mg/L	-	-	4.080
Tellurium (Te)-Dissolved	mg/L	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010
Thorium (Th)-Dissolved	mg/L	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030
Tungsten (W)-Dissolved	mg/L	-	-	0.00014
Uranium (U)-Dissolved	mg/L	-	-	0.000095
Vanadium (V)-Dissolved	mg/L	-	-	<0.00050
Zinc (Zn)-Dissolved	mg/L	-	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	-	-	<0.000060
Organic / Inorganic Carbon (Water)				
Total Organic Carbon	mg/L	-	-	0.68
Aggregate Organics (Water)				
COD	mg/L	-	-	<20
Phenols (4AAP)	mg/L	-	-	<0.0010

Analyte	Units	BC	CCME	HMM-BH-04-S
		AWWQG		
		MAL	MAL	(Stantec)
Dissolved Gases (Water)				
Methane	mg/L	-	-	-
Volatile Organic Compounds				
Benzene	mg/L	0.11	0.11	<0.00050
Toluene	mg/L	-	-	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.00050
ortho-Xylene	mg/L	-	-	<0.00050
Xylenes	mg/L	-	-	<0.00075
Styrene	mg/L	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.00050
Chlorobenzene	mg/L	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	-	-	<0.0010
Chloromethane	mg/L	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0010
Dichloromethane	mg/L	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.00040
Tetrachloroethylene	mg/L	-	-	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.00050
Trichloroethylene	mg/L	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	99.1
1,4-Difluorobenzene (SS)	%	-	-	93.5
Hydrocarbons				
EPH10-19	mg/L	-	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	-	-	<0.25
HEPH	mg/L	-	-	<0.25
F2 (C10-C16)	mg/L	-	-	<0.30
F3 (C16-C34)	mg/L	-	-	<0.30
F4 (C34-C50)	mg/L	-	-	<0.30
2-Bromobenzotrifluoride	%	-	-	101.1
2-Bromobenzotrifluoride, F2-F4	%	-	-	98.6
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.006	-	<0.000010
Acenaphthylene	mg/L	-	-	<0.000010
Acridine	mg/L	-	-	<0.000010
Anthracene	mg/L	-	-	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	-

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-S
		MAL	MAL	(Stantec)
Benzo(b&j)fluoranthene	mg/L	-	-	<0.000010
Benzo(b+j+k)fluoranthene	mg/L	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.000010
Chrysene	mg/L	0.0001	-	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.0000050
Fluoranthene	mg/L	-	-	<0.000010
Fluorene	mg/L	0.012	-	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000010
1-Methylnaphthalene	mg/L	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.000050
Phenanthrene	mg/L	-	-	<0.000020
Pyrene	mg/L	-	-	<0.000010
Quinoline	mg/L	-	-	<0.000050
Acridine d9	%	-	-	86.1
Chrysene d12	%	-	-	98
Naphthalene d8	%	-	-	88.7
Phenanthrene d10	%	-	-	97.8

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-D
		MAL	MAL	(Stantec)
Date sample collected				5/28/2019
Description				
Lab File No.				L2280800-5
Physical Tests				
Conductivity (Lab)	uS/cm	-	-	199
Conductivity (Field)	uS/cm	-	-	196
pH (Lab)	pH	7.0-8.7	7.0-8.7	8.24
pH (Field)	pH	-	-	8.14
Temperature (Field)	°C	-	-	13.45
Total Suspended Solids	mg/L	-	-	-
Total Dissolved Solids	mg/L	-	-	134
True Colour	CU	15	15	<5.0
Hardness (as CaCO3)	mg/L	-	-	74.7
Turbidity	NTU	-	-	8.52
Anions and Nutrients				
Acidity (as CaCO3)	mg/L	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	-
Bromide (Br)	mg/L	-	-	-
Chloride (Cl)	mg/L	-	-	-
Fluoride (F)	mg/L	1.5	-	-
Nitrate (as N)	mg/L	3.7	-	<0.0050
Nitrite (as N)	mg/L	-	-	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	0.086
Total Nitrogen	mg/L	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	0.076
Phosphorus (P)-Total	mg/L	-	-	-
Sulfate (SO4)	mg/L	-	-	-
Sulphide as S	mg/L	-	-	-
Total Metals				
Aluminum (Al)-Total	mg/L	-	-	0.637
Antimony (Sb)-Total	mg/L	-	-	0.00012
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.01150
Barium (Ba)-Total	mg/L	-	-	0.0116
Beryllium (Be)-Total	mg/L	0.1	-	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.000050
Boron (B)-Total	mg/L	1.2	-	0.031
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	0.0000104
Calcium (Ca)-Total	mg/L	-	-	21.1
Cesium (Cs)-Total	mg/L	-	-	0.00003
Chromium (Cr)-Total	mg/L	-	-	0.00149
Cobalt (Co)-Total	mg/L	-	-	0.00041
Copper (Cu)-Total	mg/L	0.002	-	0.00204
Iron (Fe)-Total	mg/L	-	-	0.661
Lead (Pb)-Total	mg/L	0.002	-	0.00021
Lithium (Li)-Total	mg/L	-	-	<0.0010
Magnesium (Mg)-Total	mg/L	-	-	6.68
Manganese (Mn)-Total	mg/L	0.1	-	0.0375
Mercury (Hg)-Total	mg/L	0.00001	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00208
Nickel (Ni)-Total	mg/L	0.0083	-	0.00164
Phosphorus (P)-Total	mg/L	-	-	0.142
Potassium (K)-Total	mg/L	-	-	4.0
Rubidium (Rb)-Total	mg/L	-	-	0.0
Selenium (Se)-Total	mg/L	0.002	-	<0.000050
Silicon (Si)-Total	mg/L	-	-	7.58
Silver (Ag)-Total	mg/L	0.0015	-	0.000013

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-D
		MAL	MAL	(Stantec)
Sodium (Na)-Total	mg/L	-	-	9.1
Strontium (Sr)-Total	mg/L	-	-	0.0870
Sulfur (S)-Total	mg/L	-	-	3.8800
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	<0.000010
Thorium (Th)-Total	mg/L	-	-	<0.00010
Tin (Sn)-Total	mg/L	-	-	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.0317
Tungsten (W)-Total	mg/L	-	-	0.00034
Uranium (U)-Total	mg/L	-	-	0.000214
Vanadium (V)-Total	mg/L	0.05	-	0.00173
Zinc (Zn)-Total	mg/L	0.01	-	<0.0030
Zirconium (Zr)-Total	mg/L	-	-	0.0003
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	-	0.0039
Antimony (Sb)-Dissolved	mg/L	-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	-	-	0.01130
Barium (Ba)-Dissolved	mg/L	-	-	0.0068
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	-	-	0.028
Cadmium (Cd)-Dissolved	mg/L	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	19.5
Cesium (Cs)-Dissolved	mg/L	-	-	<0.000010
Chromium (Cr)-Dissolved	mg/L	-	-	<0.00010
Cobalt (Co)-Dissolved	mg/L	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	-	-	<0.00020
Iron (Fe)-Dissolved	mg/L	-	-	<0.010
Lead (Pb)-Dissolved	mg/L	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	<0.0010
Magnesium (Mg)-Dissolved	mg/L	-	-	6.29
Manganese (Mn)-Dissolved	mg/L	-	-	0.0191
Mercury (Hg)-Dissolved	mg/L	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00203
Nickel (Ni)-Dissolved	mg/L	-	-	<0.00050
Phosphorus (P)- Dissolved	mg/L	-	-	0.094
Potassium (K)-Dissolved	mg/L	-	-	3.84
Rubidium (Rb)-Dissolved	mg/L	-	-	0.000590
Selenium (Se)-Dissolved	mg/L	-	-	<0.000050
Silicon (Si)-Dissolved	mg/L	-	-	6.82
Silver (Ag)-Dissolved	mg/L	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	8.9
Strontium (Sr)-Dissolved	mg/L	-	-	0.090
Sulfur (S)-Dissolved	mg/L	-	-	4.070
Tellurium (Te)-Dissolved	mg/L	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010
Thorium (Th)-Dissolved	mg/L	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030
Tungsten (W)-Dissolved	mg/L	-	-	0.00034
Uranium (U)-Dissolved	mg/L	-	-	0.000183
Vanadium (V)-Dissolved	mg/L	-	-	<0.00050
Zinc (Zn)-Dissolved	mg/L	-	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	-	-	<0.000060
Organic / Inorganic Carbon (Water)				
Total Organic Carbon	mg/L	-	-	<0.50
Aggregate Organics (Water)				
COD	mg/L	-	-	<20
Phenols (4AAP)	mg/L	-	-	<0.0010
Dissolved Gases (Water)				

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-D
		MAL	MAL	(Stantec)
Methane	mg/L	-	-	
Volatile Organic Compounds				
Benzene	mg/L	0.11	0.11	<0.00050
Toluene	mg/L	-	-	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.00050
ortho-Xylene	mg/L	-	-	<0.00050
Xylenes	mg/L	-	-	<0.00075
Styrene	mg/L	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.00050
Chlorobenzene	mg/L	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	-	-	<0.0010
Chloromethane	mg/L	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0010
Dichloromethane	mg/L	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.00020
Tetrachloroethylene	mg/L	-	-	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.00050
Trichloroethylene	mg/L	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	95.7
1,4-Difluorobenzene (SS)	%	-	-	92.6
Hydrocarbons				
EPH10-19	mg/L	-	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	-	-	<0.25
HEPH	mg/L	-	-	<0.25
F2 (C10-C16)	mg/L	-	-	<0.30
F3 (C16-C34)	mg/L	-	-	<0.30
F4 (C34-C50)	mg/L	-	-	<0.30
2-Bromobenzotrifluoride	%	-	-	94.5
2-Bromobenzotrifluoride, F2-F4	%	-	-	94
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.006	-	<0.000010
Acenaphthylene	mg/L	-	-	<0.000010
Acridine	mg/L	-	-	<0.000010
Anthracene	mg/L	-	-	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	-
Benzo(b&j)fluoranthene	mg/L	-	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-BH-04-D
		MAL	MAL	(Stantec)
Benzo(b+j+k)fluoranthene	mg/L	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.000010
Chrysene	mg/L	0.0001	-	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.0000050
Fluoranthene	mg/L	-	-	<0.000010
Fluorene	mg/L	0.012	-	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000010
1-Methylnaphthalene	mg/L	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.000050
Phenanthrene	mg/L	-	-	<0.000020
Pyrene	mg/L	-	-	<0.000010
Quinoline	mg/L	-	-	<0.000050
Acridine d9	%	-	-	106.1
Chrysene d12	%	-	-	109
Naphthalene d8	%	-	-	93.4
Phenanthrene d10	%	-	-	105.1

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

Analyte	Units	BC AWWQG	CCME	HMM-BH-06
		MAL	MAL	(SNC Lavalin)
Date sample collected				5/23/2019
Description				
Lab File No.				L2278227-1
Physical Tests				
Conductivity (Lab)	uS/cm	-	-	154
Conductivity (Field)	uS/cm	-	-	143
pH (Lab)	pH	7.0-8.7	7.0-8.7	9.04
pH (Field)	pH	-	-	10.01
Temperature (Field)	°C	-	-	15.3
Total Suspended Solids	mg/L	-	-	-
Total Dissolved Solids	mg/L	-	-	125
True Colour	CU	15	15	<5.0
Hardness (as CaCO3)	mg/L	-	-	51.2
Turbidity	NTU	-	-	2.73
Anions and Nutrients				
Acidity (as CaCO3)	mg/L	-	-	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	-
Alkalinity, Total (as CaCO3)	mg/L	-	-	-
Ammonia, Total (as N)	mg/L	0.2-1.9	-	-
Bromide (Br)	mg/L	-	-	-
Chloride (Cl)	mg/L	-	-	-
Fluoride (F)	mg/L	1.5	-	-
Nitrate (as N)	mg/L	3.7	-	-
Nitrite (as N)	mg/L	-	-	-
Total Kjeldahl Nitrogen	mg/L	-	-	-
Total Nitrogen	mg/L	-	-	-
Orthophosphate-Dissolved (as P)	mg/L	-	-	-
Phosphorus (P)-Total	mg/L	-	-	-
Sulfate (SO4)	mg/L	-	-	-
Sulphide as S	mg/L	-	-	-
Total Metals				
Aluminum (Al)-Total	mg/L	-	-	0.049
Antimony (Sb)-Total	mg/L	-	-	<0.00010
Arsenic (As)-Total	mg/L	0.0125	0.0125	0.00175
Barium (Ba)-Total	mg/L	-	-	0.1860
Beryllium (Be)-Total	mg/L	0.1	-	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.000050
Boron (B)-Total	mg/L	1.2	-	0.045
Cadmium (Cd)-Total	mg/L	0.00012	0.00012	0.0000066
Calcium (Ca)-Total	mg/L	-	-	18.7
Cesium (Cs)-Total	mg/L	-	-	0.00013
Chromium (Cr)-Total	mg/L	-	-	0.00027
Cobalt (Co)-Total	mg/L	-	-	<0.00010
Copper (Cu)-Total	mg/L	0.002	-	0.00072
Iron (Fe)-Total	mg/L	-	-	0.058
Lead (Pb)-Total	mg/L	0.002	-	0.00009
Lithium (Li)-Total	mg/L	-	-	0.0054
Magnesium (Mg)-Total	mg/L	-	-	0.85
Manganese (Mn)-Total	mg/L	0.1	-	0.0101
Mercury (Hg)-Total	mg/L	0.00001	-	<0.0000050
Molybdenum (Mo)-Total	mg/L	-	-	0.00113
Nickel (Ni)-Total	mg/L	0.0083	-	0.00059
Phosphorus (P)-Total	mg/L	-	-	0.054
Potassium (K)-Total	mg/L	-	-	1.6
Rubidium (Rb)-Total	mg/L	-	-	0.0045
Selenium (Se)-Total	mg/L	0.002	-	0.000095
Silicon (Si)-Total	mg/L	-	-	9.41
Silver (Ag)-Total	mg/L	0.0015	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-BH-06
		MAL	MAL	(SNC Lavalin)
Sodium (Na)-Total	mg/L	-	-	13.3
Strontium (Sr)-Total	mg/L	-	-	0.5480
Sulfur (S)-Total	mg/L	-	-	2.1300
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	<0.000010
Thorium (Th)-Total	mg/L	-	-	<0.00010
Tin (Sn)-Total	mg/L	-	-	0.0001
Titanium (Ti)-Total	mg/L	-	-	0.00138
Tungsten (W)-Total	mg/L	-	-	0.00482
Uranium (U)-Total	mg/L	-	-	0.000069
Vanadium (V)-Total	mg/L	0.05	-	0.00085
Zinc (Zn)-Total	mg/L	0.01	-	<0.0030
Zirconium (Zr)-Total	mg/L	-	-	<0.000060
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	-	0.0037
Antimony (Sb)-Dissolved	mg/L	-	-	<0.00010
Arsenic (As)-Dissolved	mg/L	-	-	0.00176
Barium (Ba)-Dissolved	mg/L	-	-	0.1950
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050
Boron (B)-Dissolved	mg/L	-	-	0.043
Cadmium (Cd)-Dissolved	mg/L	-	-	<0.0000050
Calcium (Ca)-Dissolved	mg/L	-	-	19.1
Cesium (Cs)-Dissolved	mg/L	-	-	0.0
Chromium (Cr)-Dissolved	mg/L	-	-	0.00018
Cobalt (Co)-Dissolved	mg/L	-	-	<0.00010
Copper (Cu)-Dissolved	mg/L	-	-	0.00024
Iron (Fe)-Dissolved	mg/L	-	-	<0.010
Lead (Pb)-Dissolved	mg/L	-	-	<0.000050
Lithium (Li)-Dissolved	mg/L	-	-	0.0065
Magnesium (Mg)-Dissolved	mg/L	-	-	0.84
Manganese (Mn)-Dissolved	mg/L	-	-	0.00688
Mercury (Hg)-Dissolved	mg/L	-	-	<0.0000050
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00115
Nickel (Ni)-Dissolved	mg/L	-	-	0.00051
Phosphorus (P)- Dissolved	mg/L	-	-	<0.050
Potassium (K)-Dissolved	mg/L	-	-	1.90
Rubidium (Rb)-Dissolved	mg/L	-	-	0.01
Selenium (Se)-Dissolved	mg/L	-	-	0.000110
Silicon (Si)-Dissolved	mg/L	-	-	9.17
Silver (Ag)-Dissolved	mg/L	-	-	<0.000010
Sodium (Na)-Dissolved	mg/L	-	-	13.4
Strontium (Sr)-Dissolved	mg/L	-	-	0.612
Sulfur (S)-Dissolved	mg/L	-	-	1.920
Tellurium (Te)-Dissolved	mg/L	-	-	<0.00020
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010
Thorium (Th)-Dissolved	mg/L	-	-	<0.00010
Tin (Sn)-Dissolved	mg/L	-	-	<0.00010
Titanium (Ti)-Dissolved	mg/L	-	-	<0.00030
Tungsten (W)-Dissolved	mg/L	-	-	0.00535
Uranium (U)-Dissolved	mg/L	-	-	0.000069
Vanadium (V)-Dissolved	mg/L	-	-	0.00074
Zinc (Zn)-Dissolved	mg/L	-	-	<0.0010
Zirconium (Zr)-Dissolved	mg/L	-	-	<0.000060
Organic / Inorganic Carbon (Water)				
Total Organic Carbon	mg/L	-	-	0.97
Aggregate Organics (Water)				
COD	mg/L	-	-	<20
Phenols (4AAP)	mg/L	-	-	<0.0010
Dissolved Gases (Water)				

Analyte	Units	BC AWWQG	CCME	HMM-BH-06
		MAL	MAL	(SNC Lavalin)
Methane	mg/L	-	-	-
Volatile Organic Compounds				
Benzene	mg/L	0.11	0.11	<0.00050
Toluene	mg/L	-	-	<0.00045
Ethylbenzene	mg/L	0.25	-	<0.00050
meta- & para-Xylene	mg/L	-	-	<0.00050
ortho-Xylene	mg/L	-	-	<0.00050
Xylenes	mg/L	-	-	<0.00075
Styrene	mg/L	-	-	<0.00050
Methyl t-butyl ether (MTBE)	mg/L	0.44	-	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	-	-	<0.00050
Chlorobenzene	mg/L	-	-	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	-	-	<0.0010
Chloromethane	mg/L	-	-	<0.0050
1,2-Dichlorobenzene	mg/L	-	0.042	<0.00050
1,3-Dichlorobenzene	mg/L	-	-	<0.0010
1,4-Dichlorobenzene	mg/L	-	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	-	-	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0010
Dichloromethane	mg/L	-	-	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.00050
trans-1,3-Dichloropropylene	mg/L	-	-	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.00020
Tetrachloroethylene	mg/L	-	-	<0.0010
1,1,1-Trichloroethane	mg/L	-	-	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.00050
Trichloroethylene	mg/L	-	-	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.00040
4-Bromofluorobenzene (SS)	%	-	-	94.4
1,4-Difluorobenzene (SS)	%	-	-	101.4
Hydrocarbons				
EPH10-19	mg/L	-	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	-	-	<0.25
HEPH	mg/L	-	-	<0.25
F2 (C10-C16)	mg/L	-	-	<0.30
F3 (C16-C34)	mg/L	-	-	<0.30
F4 (C34-C50)	mg/L	-	-	<0.30
2-Bromobenzotrifluoride	%	-	-	93.2
2-Bromobenzotrifluoride, F2-F4	%	-	-	93.3
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	mg/L	0.006	-	<0.000010
Acenaphthylene	mg/L	-	-	<0.000010
Acridine	mg/L	-	-	<0.000010
Anthracene	mg/L	-	-	<0.000010
Benz(a)anthracene	mg/L	-	-	<0.000010
Benzo(a)pyrene	mg/L	0.00001	-	<0.0000050
Benzo(b)fluoranthene	mg/L	-	-	-
Benzo(b&j)fluoranthene	mg/L	-	-	<0.000010

Analyte	Units	BC AWWQG	CCME	HMM-BH-06
		MAL	MAL	(SNC Lavalin)
Benzo(b+j+k)fluoranthene	mg/L	-	-	<0.000015
Benzo(g,h,i)perylene	mg/L	-	-	<0.000010
Benzo(k)fluoranthene	mg/L	-	-	<0.000010
Chrysene	mg/L	0.0001	-	<0.000010
Dibenz(a,h)anthracene	mg/L	-	-	<0.0000050
Fluoranthene	mg/L	-	-	<0.000010
Fluorene	mg/L	0.012	-	<0.000010
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000010
1-Methylnaphthalene	mg/L	-	-	<0.000050
2-Methylnaphthalene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.001	-	<0.000050
Phenanthrene	mg/L	-	-	<0.000020
Pyrene	mg/L	-	-	<0.000010
Quinoline	mg/L	-	-	<0.000050
Acridine d9	%	-	-	127.1
Chrysene d12	%	-	-	115.6
Naphthalene d8	%	-	-	98.1
Phenanthrene d10	%	-	-	114.1

Legend:
BCAWWQG = British Columbia Approved and Working Water Quality Guidelines for Marinewater Aquatic Life;
CCME MAL = Canadian Council of Ministers of the Environment Regulations for Marinewater Aquatic Life
"mg/L" - milligrams per litre
"µS/cm" - microsiemens per centimeter centimeter
"µg/L" - micrograms per litre
"NTU" - nephelometric turbidity units
"CU" - colour units
"- " - guideline not available or parameter not analyzed
EPH = Extractable Petroleum Hydrocarbons; LEPH = Light Extractable Petroleum hydrocarbons;
HEPH = Heavy Extractable Petroleum Hydrocarbons
F2 to F4 = Fractions F2, F3 and F4, extractable hydrocarbons in the range C10 to C50

APPENDIX B

Laboratory Certificates



Kiewit Ledcor TMEP Partnership
ATTN: CORY TORKINGTON
4350 Still Creek Drive
Burnaby BC V5C 6C6

Date Received: 23-MAY-19
Report Date: 03-JUN-19 16:25 (MT)
Version: FINAL

Client Phone: 604-439-8103

Certificate of Analysis

Lab Work Order #: L2278227
Project P.O. #: PMOD Water Quality Testing
Job Reference: BT
C of C Numbers: 17-717263
Legal Site Desc:

Carla Fuginski
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2278227-1 Water 23-MAY-19 12:00 BH-06-190523				
Grouping	Analyte						
WATER							
Physical Tests	Colour, True (CU)	<5.0					
	Conductivity (uS/cm)	154					
	Hardness (as CaCO3) (mg/L)	51.2					
	pH (pH)	9.04					
	Total Dissolved Solids (mg/L)	125					
	Turbidity (NTU)	2.73					
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	0.97					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0492					
	Antimony (Sb)-Total (mg/L)	<0.00010					
	Arsenic (As)-Total (mg/L)	0.00175					
	Barium (Ba)-Total (mg/L)	0.186					
	Beryllium (Be)-Total (mg/L)	<0.00010					
	Bismuth (Bi)-Total (mg/L)	<0.000050					
	Boron (B)-Total (mg/L)	0.045					
	Cadmium (Cd)-Total (mg/L)	0.0000066					
	Calcium (Ca)-Total (mg/L)	18.7					
	Cesium (Cs)-Total (mg/L)	0.000125					
	Chromium (Cr)-Total (mg/L)	0.00027					
	Cobalt (Co)-Total (mg/L)	<0.00010					
	Copper (Cu)-Total (mg/L)	0.00072					
	Iron (Fe)-Total (mg/L)	0.058					
	Lead (Pb)-Total (mg/L)	0.000088					
	Lithium (Li)-Total (mg/L)	0.0054					
	Magnesium (Mg)-Total (mg/L)	0.854					
	Manganese (Mn)-Total (mg/L)	0.0101					
	Mercury (Hg)-Total (mg/L)	<0.0000050					
	Molybdenum (Mo)-Total (mg/L)	0.00113					
	Nickel (Ni)-Total (mg/L)	0.00059					
	Phosphorus (P)-Total (mg/L)	0.054					
	Potassium (K)-Total (mg/L)	1.59					
	Rubidium (Rb)-Total (mg/L)	0.00445					
	Selenium (Se)-Total (mg/L)	0.000095					
	Silicon (Si)-Total (mg/L)	9.41					
	Silver (Ag)-Total (mg/L)	<0.000010					
	Sodium (Na)-Total (mg/L)	13.3					
	Strontium (Sr)-Total (mg/L)	0.548					
	Sulfur (S)-Total (mg/L)	2.13					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2278227-1 Water 23-MAY-19 12:00 BH-06-190523				
Grouping	Analyte					
WATER						
Total Metals	Tellurium (Te)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Thorium (Th)-Total (mg/L)	<0.00010				
	Tin (Sn)-Total (mg/L)	0.00013				
	Titanium (Ti)-Total (mg/L)	0.00138				
	Tungsten (W)-Total (mg/L)	0.00482				
	Uranium (U)-Total (mg/L)	0.000069				
	Vanadium (V)-Total (mg/L)	0.00085				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.000060				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0037				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00176				
	Barium (Ba)-Dissolved (mg/L)	0.195				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.043				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	19.1				
	Cesium (Cs)-Dissolved (mg/L)	0.000157				
	Chromium (Cr)-Dissolved (mg/L)	0.00018				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	0.00024				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0065				
	Magnesium (Mg)-Dissolved (mg/L)	0.835				
	Manganese (Mn)-Dissolved (mg/L)	0.00688				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00115				
	Nickel (Ni)-Dissolved (mg/L)	0.00051				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	1.90				
	Rubidium (Rb)-Dissolved (mg/L)	0.00500				
	Selenium (Se)-Dissolved (mg/L)	0.000110				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID				
		L2278227-1 Water 23-MAY-19 12:00 BH-06-190523				
Grouping	Analyte					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	9.17				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	13.4				
	Strontium (Sr)-Dissolved (mg/L)	0.612				
	Sulfur (S)-Dissolved (mg/L)	1.92				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	0.00535				
	Uranium (U)-Dissolved (mg/L)	0.000069				
	Vanadium (V)-Dissolved (mg/L)	0.00074				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060				
Aggregate Organics	COD (mg/L)	<20				
	Phenols (4AAP) (mg/L)	<0.0010				
Volatile Organic Compounds	Benzene (mg/L)	<0.00050				
	Bromodichloromethane (mg/L)	<0.0010				
	Bromoform (mg/L)	<0.0010				
	Carbon Tetrachloride (mg/L)	<0.00050				
	Chlorobenzene (mg/L)	<0.0010				
	Dibromochloromethane (mg/L)	<0.0010				
	Chloroethane (mg/L)	<0.0010				
	Chloroform (mg/L)	<0.0010				
	Chloromethane (mg/L)	<0.0050				
	1,2-Dichlorobenzene (mg/L)	<0.00050				
	1,3-Dichlorobenzene (mg/L)	<0.0010				
	1,4-Dichlorobenzene (mg/L)	<0.0010				
	1,1-Dichloroethane (mg/L)	<0.0010				
	1,2-Dichloroethane (mg/L)	<0.0010				
	1,1-Dichloroethylene (mg/L)	<0.0010				
	cis-1,2-Dichloroethylene (mg/L)	<0.0010				
	trans-1,2-Dichloroethylene (mg/L)	<0.0010				
	Dichloromethane (mg/L)	<0.0050				
	1,2-Dichloropropane (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2278227-1 Water 23-MAY-19 12:00 BH-06-190523				
Grouping	Analyte					
WATER						
Volatile Organic Compounds	cis-1,3-Dichloropropylene (mg/L)	<0.00050				
	trans-1,3-Dichloropropylene (mg/L)	<0.00050				
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0010				
	Ethylbenzene (mg/L)	<0.00050				
	Methane, dissolved (mg/L)	<0.0050				
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050				
	Styrene (mg/L)	<0.00050				
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010				
	1,1,2,2-Tetrachloroethane (mg/L)	<0.00020				
	Tetrachloroethylene (mg/L)	<0.0010				
	Toluene (mg/L)	<0.00045				
	1,1,1-Trichloroethane (mg/L)	<0.0010				
	1,1,2-Trichloroethane (mg/L)	<0.00050				
	Trichloroethylene (mg/L)	<0.0010				
	Trichlorofluoromethane (mg/L)	<0.0010				
	Vinyl Chloride (mg/L)	<0.00040				
	ortho-Xylene (mg/L)	<0.00050				
	meta- & para-Xylene (mg/L)	<0.00050				
	Xylenes (mg/L)	<0.00075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	94.4				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	101.4				
Hydrocarbons	EPH10-19 (mg/L)	<0.25				
	EPH19-32 (mg/L)	<0.25				
	LEPH (mg/L)	<0.25				
	HEPH (mg/L)	<0.25				
	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride (%)	93.2				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	93.3				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010				
	Acenaphthylene (mg/L)	<0.000010				
	Acridine (mg/L)	<0.000010				
	Anthracene (mg/L)	<0.000010				
	Benz(a)anthracene (mg/L)	<0.000010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2278227-1 Water 23-MAY-19 12:00 BH-06-190523				
Grouping	Analyte					
WATER						
Polycyclic Aromatic Hydrocarbons	Benzo(a)pyrene (mg/L)	<0.0000050				
	Benzo(b&j)fluoranthene (mg/L)	<0.000010				
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015				
	Benzo(g,h,i)perylene (mg/L)	<0.000010				
	Benzo(k)fluoranthene (mg/L)	<0.000010				
	Chrysene (mg/L)	<0.000010				
	Dibenz(a,h)anthracene (mg/L)	<0.0000050				
	Fluoranthene (mg/L)	<0.000010				
	Fluorene (mg/L)	<0.000010				
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010				
	1-Methylnaphthalene (mg/L)	<0.000050				
	2-Methylnaphthalene (mg/L)	<0.000050				
	Naphthalene (mg/L)	<0.000050				
	Phenanthrene (mg/L)	<0.000020				
	Pyrene (mg/L)	<0.000010				
	Quinoline (mg/L)	<0.000050				
	Surrogate: Acridine d9 (%)	127.1				
	Surrogate: Chrysene d12 (%)	115.6				
	Surrogate: Naphthalene d8 (%)	98.1				
	Surrogate: Phenanthrene d10 (%)	114.1				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	trans-1,3-Dichloropropylene	LCS-ND	L2278227-1
Laboratory Control Sample	Strontium (Sr)-Dissolved	MES	L2278227-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2278227-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2278227-1
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2278227-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2278227-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2278227-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2278227-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2278227-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2278227-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2278227-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2278227-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2278227-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
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.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND
This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.			
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			

Reference Information

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

METHANE-DIS-CL Water Methane, dissolved Kampbell & Vandegrift, JC, V3, 1998

Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-WT Water Phenol (4AAP) EPA 9066

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees Celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

VOC-HSMS-VA Water VOCs in water by Headspace GCMS EPA 5021A/8260C

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA Water BTEX/MTBE/Styrene by Headspace GCMS EPA 5021A/8260C

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Water VOC7 and/or VOC Surrogates for Waters EPA 5035A/5021A/8260C

XYLENES-CALC-VA Water Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code Laboratory Location

WT ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

CL ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

Chain of Custody Numbers:

17-717263

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

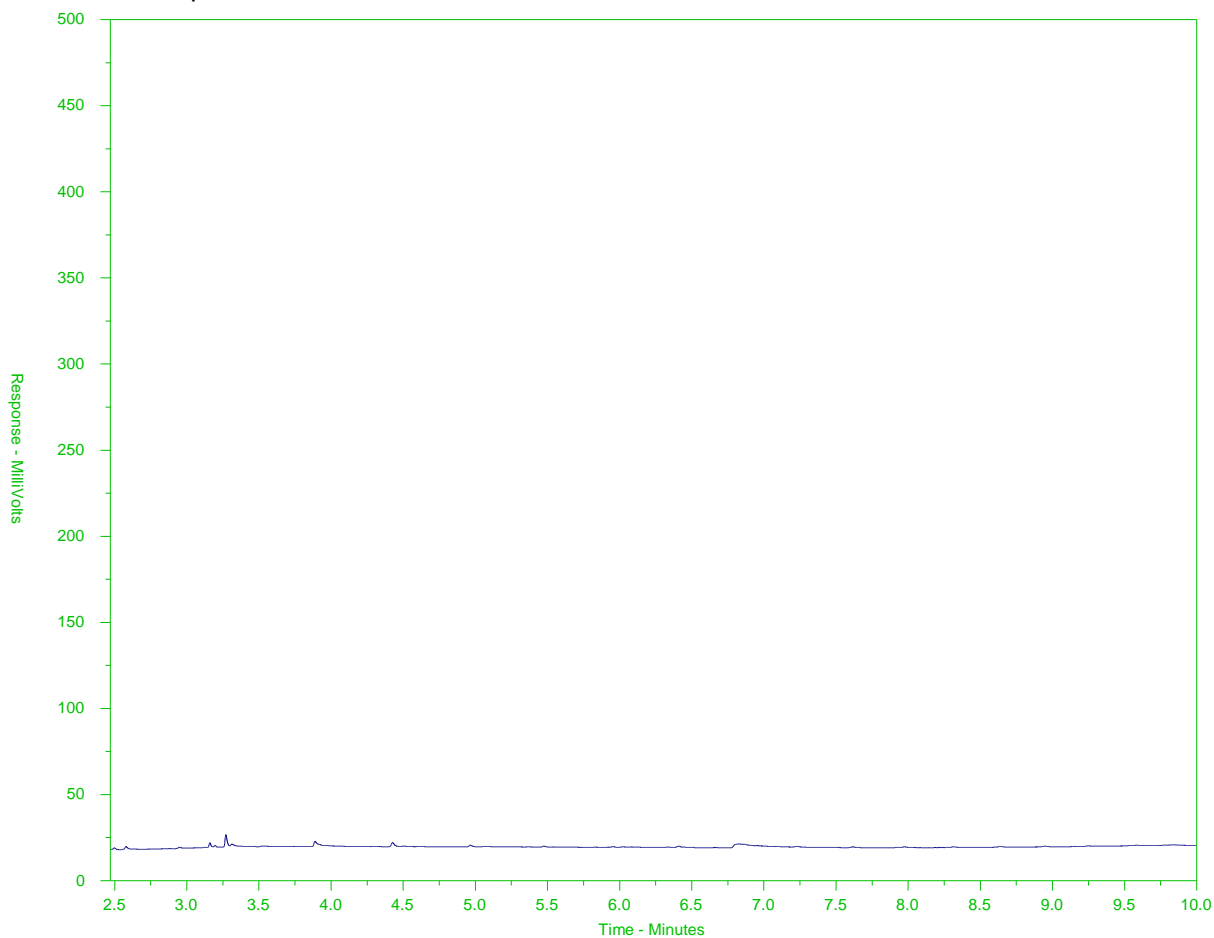
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2278227-1
Client Sample ID: BH-06-190523



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

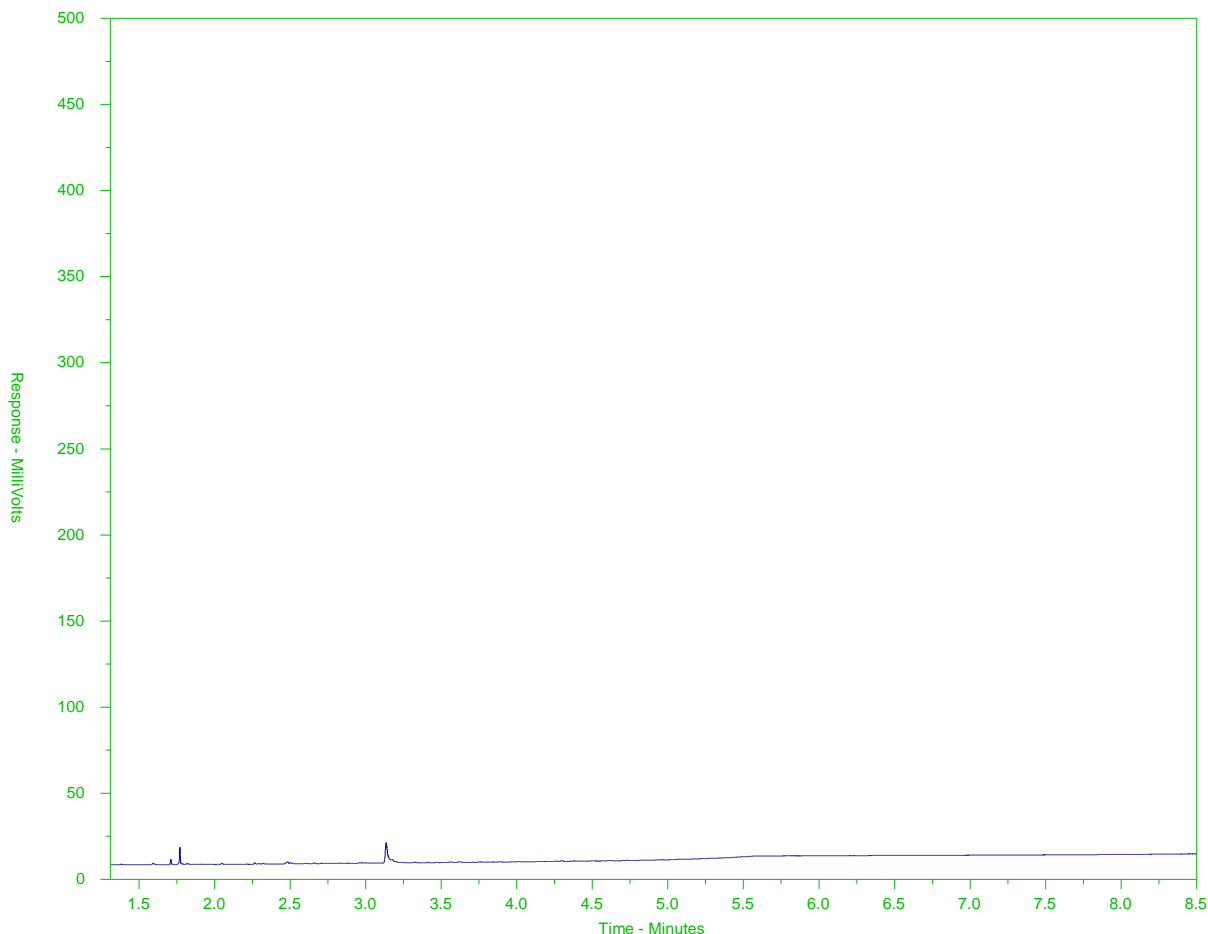
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2278227-C-1
Client Sample ID: BH-06-190523



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



JULY 2017 FRQ



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 28-MAY-19
Report Date: 11-JUN-19 14:54 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2280800
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431 TASK 600.300
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2280800-1 Water 28-MAY-19 11:45 HMM-PW-01	L2280800-2 Water 28-MAY-19 13:20 HMM-MW-01-A	L2280800-3 Water 28-MAY-19 14:45 HMM-MW-01-B	L2280800-4 Water 28-MAY-19 14:40 HMM-BH-04-A	L2280800-5 Water 28-MAY-19 15:15 HMM-BH-04-B
Grouping	Analyte					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	211	205	201	205	199
	Hardness (as CaCO3) (mg/L)	84.7	79.7	80.4	82.3	74.7
	pH (pH)	8.24	8.21	8.25	8.24	8.24
	Total Dissolved Solids (mg/L)	142	150	173	170	134
	Turbidity (NTU)	1.93	11.7	165	177	8.52
Anions and Nutrients	Nitrate (as N) (mg/L)	0.0279	<0.0050	<0.0050	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.0015	<0.0010	<0.0010	0.0018	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.333	0.063	0.190	0.052	0.086
	Orthophosphate-Dissolved (as P) (mg/L)	0.065	0.063	0.0281	0.053	0.076
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.34	<0.50	4.04	0.68	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.0917	0.0778	10.0	9.25	0.637
	Antimony (Sb)-Total (mg/L)	0.00025	0.00052	0.00099	0.00022	0.00012
	Arsenic (As)-Total (mg/L)	0.0128	0.0130	0.0202	0.00672	0.0115
	Barium (Ba)-Total (mg/L)	0.0123	0.0233	0.0728	0.0589	0.0116
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	0.00028	0.00017	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	0.000081	0.000058	<0.000050
	Boron (B)-Total (mg/L)	0.032	0.016	0.018	0.032	0.031
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000099	0.000461	0.0000760	0.0000104
	Calcium (Ca)-Total (mg/L)	22.6	22.8	28.0	27.8	21.1
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	0.000631	0.000487	0.000030
	Chromium (Cr)-Total (mg/L)	0.00083	0.00590	0.0330	0.0164	0.00149
	Cobalt (Co)-Total (mg/L)	0.00016	0.00015	0.00703	0.00537	0.00041
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	0.0207	0.0215	0.00204
	Iron (Fe)-Total (mg/L)	0.436	0.091	12.7	10.7	0.661
	Lead (Pb)-Total (mg/L)	0.000089	<0.000050	0.00335	0.00238	0.000206
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	0.0058	0.0052	<0.0010
	Magnesium (Mg)-Total (mg/L)	7.90	7.24	13.4	11.9	6.68
	Manganese (Mn)-Total (mg/L)	0.811	0.0287	0.268	0.244	0.0375
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00218	0.00225	0.00439	0.00267	0.00208
	Nickel (Ni)-Total (mg/L)	0.00089	0.00387	0.0245	0.0175	0.00164
	Phosphorus (P)-Total (mg/L)	0.121	0.114	0.354	0.376	0.142
	Potassium (K)-Total (mg/L)	3.66	3.68	3.57	3.68	3.97
	Rubidium (Rb)-Total (mg/L)	0.00067	0.00057	0.00770	0.00573	0.00090
	Selenium (Se)-Total (mg/L)	<0.000050	0.000262	0.000357	0.000129	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2280800-6 Water 28-MAY-19 DUPLICATE				
Grouping	Analyte						
WATER							
Physical Tests	Colour, True (CU)	<5.0					
	Conductivity (uS/cm)	212					
	Hardness (as CaCO3) (mg/L)	85.1					
	pH (pH)	8.27					
	Total Dissolved Solids (mg/L)	155					
	Turbidity (NTU)	1.69					
Anions and Nutrients	Nitrate (as N) (mg/L)	0.0247					
	Nitrite (as N) (mg/L)	0.0014					
	Total Kjeldahl Nitrogen (mg/L)	0.433					
	Orthophosphate-Dissolved (as P) (mg/L)	0.068					
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.81					
Total Metals	Aluminum (Al)-Total (mg/L)	0.0717					
	Antimony (Sb)-Total (mg/L)	0.00016					
	Arsenic (As)-Total (mg/L)	0.0116					
	Barium (Ba)-Total (mg/L)	0.00884					
	Beryllium (Be)-Total (mg/L)	<0.00010					
	Bismuth (Bi)-Total (mg/L)	<0.000050					
	Boron (B)-Total (mg/L)	0.033					
	Cadmium (Cd)-Total (mg/L)	<0.0000050					
	Calcium (Ca)-Total (mg/L)	24.2					
	Cesium (Cs)-Total (mg/L)	<0.000010					
	Chromium (Cr)-Total (mg/L)	0.00071					
	Cobalt (Co)-Total (mg/L)	0.00011					
	Copper (Cu)-Total (mg/L)	<0.00050					
	Iron (Fe)-Total (mg/L)	0.356					
	Lead (Pb)-Total (mg/L)	0.000070					
	Lithium (Li)-Total (mg/L)	<0.0010					
	Magnesium (Mg)-Total (mg/L)	8.05					
	Manganese (Mn)-Total (mg/L)	0.422					
	Mercury (Hg)-Total (mg/L)	<0.0000050					
	Molybdenum (Mo)-Total (mg/L)	0.00227					
	Nickel (Ni)-Total (mg/L)	0.00065					
	Phosphorus (P)-Total (mg/L)	0.135					
	Potassium (K)-Total (mg/L)	3.41					
	Rubidium (Rb)-Total (mg/L)	0.00062					
	Selenium (Se)-Total (mg/L)	<0.000050					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2280800-1 Water 28-MAY-19 11:45 HMM-PW-01	L2280800-2 Water 28-MAY-19 13:20 HMM-MW-01-A	L2280800-3 Water 28-MAY-19 14:45 HMM-MW-01-B	L2280800-4 Water 28-MAY-19 14:40 HMM-BH-04-A	L2280800-5 Water 28-MAY-19 15:15 HMM-BH-04-B
Grouping	Analyte					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)	7.37	6.24	26.6	24.7	7.58
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000050	0.000108	0.000013
	Sodium (Na)-Total (mg/L)	9.81	7.82	8.38	9.66	9.08
	Strontium (Sr)-Total (mg/L)	0.0886	0.0778	0.123	0.124	0.0870
	Sulfur (S)-Total (mg/L)	4.56	4.69	4.34	4.42	3.88
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000011	0.000129	0.000043	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	0.00153	0.00092	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00027	0.00018	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00198	0.00280	0.403	0.484	0.0317
	Tungsten (W)-Total (mg/L)	0.00024	0.00021	<0.00010	<0.00010	0.00034
	Uranium (U)-Total (mg/L)	0.000200	0.000554	0.000688	0.000298	0.000214
	Vanadium (V)-Total (mg/L)	<0.00050	0.00286	0.0277	0.0225	0.00173
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0428	0.0277	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.000088	<0.000060	0.000504	0.000920	0.000331
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0023	0.0081	0.0024	0.0023	0.0039
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00045	0.00097	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.0107	0.0127	0.0159	0.00520	0.0113
	Barium (Ba)-Dissolved (mg/L)	0.00431	0.0243	0.00471	0.00361	0.00679
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.030	0.014	0.015	0.028	0.028
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	21.8	20.0	20.6	22.6	19.5
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	0.00032	0.00110	0.00030	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	7.33	7.25	7.04	6.28	6.29
	Manganese (Mn)-Dissolved (mg/L)	0.00451	0.0252	0.0207	0.0194	0.0191
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00236	0.00187	0.00307	0.00236	0.00203

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
Grouping	Analyte					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)	6.84				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	8.97				
	Strontium (Sr)-Total (mg/L)	0.0800				
	Sulfur (S)-Total (mg/L)	4.15				
	Tellurium (Te)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Thorium (Th)-Total (mg/L)	<0.00010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.00177				
	Tungsten (W)-Total (mg/L)	0.00020				
	Uranium (U)-Total (mg/L)	0.000183				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	0.000081				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0024				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.0107				
	Barium (Ba)-Dissolved (mg/L)	0.00428				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.029				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050				
	Calcium (Ca)-Dissolved (mg/L)	21.6				
	Cesium (Cs)-Dissolved (mg/L)	<0.000010				
	Chromium (Cr)-Dissolved (mg/L)	0.00033				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	<0.00020				
	Iron (Fe)-Dissolved (mg/L)	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	<0.0010				
	Magnesium (Mg)-Dissolved (mg/L)	7.58				
	Manganese (Mn)-Dissolved (mg/L)	0.00466				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00236				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2280800-1 Water 28-MAY-19 11:45 HMM-PW-01	L2280800-2 Water 28-MAY-19 13:20 HMM-MW-01-A	L2280800-3 Water 28-MAY-19 14:45 HMM-MW-01-B	L2280800-4 Water 28-MAY-19 14:40 HMM-BH-04-A	L2280800-5 Water 28-MAY-19 15:15 HMM-BH-04-B
Grouping	Analyte					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00113	0.00229	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	0.077	0.061	<0.050	0.062	0.094
	Potassium (K)-Dissolved (mg/L)	3.37	3.50	2.05	2.41	3.84
	Rubidium (Rb)-Dissolved (mg/L)	0.00054	0.00048	0.00051	0.00054	0.00059
	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000340	0.000149	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	6.81	5.95	7.92	8.35	6.82
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	8.77	7.67	6.94	8.44	8.85
	Strontium (Sr)-Dissolved (mg/L)	0.0862	0.0753	0.0841	0.0932	0.0900
	Sulfur (S)-Dissolved (mg/L)	3.95	4.99	4.17	4.08	4.07
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	0.00016	0.00015	<0.00010	0.00014	0.00034
	Uranium (U)-Dissolved (mg/L)	0.000169	0.000484	0.000204	0.000095	0.000183
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00271	0.00349	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060
Aggregate Organics	COD (mg/L)	<20	<20	<20	<20	<20
	Phenols (4AAP) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Volatile Organic Compounds	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichlorobenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2280800-6 Water 28-MAY-19 DUPLICATE				
Grouping	Analyte					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	0.077				
	Potassium (K)-Dissolved (mg/L)	3.39				
	Rubidium (Rb)-Dissolved (mg/L)	0.00053				
	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	6.79				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	8.73				
	Strontium (Sr)-Dissolved (mg/L)	0.0852				
	Sulfur (S)-Dissolved (mg/L)	4.02				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	0.00017				
	Uranium (U)-Dissolved (mg/L)	0.000169				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060				
Aggregate Organics	COD (mg/L)	<20				
	Phenols (4AAP) (mg/L)	<0.0010				
Volatile Organic Compounds	Benzene (mg/L)	<0.00050				
	Bromodichloromethane (mg/L)	<0.0010				
	Bromoform (mg/L)	<0.0010				
	Carbon Tetrachloride (mg/L)	<0.00050				
	Chlorobenzene (mg/L)	<0.0010				
	Dibromochloromethane (mg/L)	<0.0010				
	Chloroethane (mg/L)	<0.0010				
	Chloroform (mg/L)	<0.0010				
	Chloromethane (mg/L)	<0.0050				
	1,2-Dichlorobenzene (mg/L)	<0.00050				
	1,3-Dichlorobenzene (mg/L)	<0.0010				
	1,4-Dichlorobenzene (mg/L)	<0.0010				
	1,1-Dichloroethane (mg/L)	<0.0010				
	1,2-Dichloroethane (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2280800-1	L2280800-2	L2280800-3	L2280800-4	L2280800-5
		Description	Water	Water	Water	Water	Water
		Sampled Date	28-MAY-19	28-MAY-19	28-MAY-19	28-MAY-19	28-MAY-19
		Sampled Time	11:45	13:20	14:45	14:40	15:15
		Client ID	HMM-PW-01	HMM-MW-01-A	HMM-MW-01-B	HMM-BH-04-A	HMM-BH-04-B
Grouping	Analyte						
WATER							
Volatile Organic Compounds	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	cis-1,3-Dichloropropylene (mg/L)	<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	
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Methane, dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	1,1,2,2-Tetrachloroethane (mg/L)	<0.00020	<0.00020	<0.00020	<0.00040 ^{DLCI}	<0.00020	
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Toluene (mg/L)	<0.00045	<0.00045	<0.00045	<0.00045	<0.00045	
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	1,1,2-Trichloroethane (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
	Vinyl Chloride (mg/L)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075	
	Surrogate: 4-Bromofluorobenzene (SS) (%)	83.9	86.5	95.3	99.1	95.7	
	Surrogate: 1,4-Difluorobenzene (SS) (%)	96.6	97.2	100.5	93.5	92.6	
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30	
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30	
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30	
	Surrogate: 2-Bromobenzotrifluoride (%)	93.5	99.7	97.4	101.1	94.5	
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	95.1	99.5	96.5	98.6	94.0	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2280800-6 Water 28-MAY-19 DUPLICATE				
Grouping	Analyte					
WATER						
Volatile Organic Compounds	1,1-Dichloroethylene (mg/L)	<0.0010				
	cis-1,2-Dichloroethylene (mg/L)	<0.0010				
	trans-1,2-Dichloroethylene (mg/L)	<0.0010				
	Dichloromethane (mg/L)	<0.0050				
	1,2-Dichloropropane (mg/L)	<0.0010				
	cis-1,3-Dichloropropylene (mg/L)	<0.00050				
	trans-1,3-Dichloropropylene (mg/L)	<0.00050				
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0010				
	Ethylbenzene (mg/L)	<0.00050				
	Methane, dissolved (mg/L)	<0.0050				
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050				
	Styrene (mg/L)	<0.00050				
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010				
	1,1,2,2-Tetrachloroethane (mg/L)	<0.00020				
	Tetrachloroethylene (mg/L)	<0.0010				
	Toluene (mg/L)	<0.00045				
	1,1,1-Trichloroethane (mg/L)	<0.0010				
	1,1,2-Trichloroethane (mg/L)	<0.00050				
	Trichloroethylene (mg/L)	<0.0010				
	Trichlorofluoromethane (mg/L)	<0.0010				
	Vinyl Chloride (mg/L)	<0.00040				
	ortho-Xylene (mg/L)	<0.00050				
	meta- & para-Xylene (mg/L)	<0.00050				
	Xylenes (mg/L)	<0.00075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	92.1				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	92.4				
Hydrocarbons	EPH10-19 (mg/L)	<0.25				
	EPH19-32 (mg/L)	<0.25				
	LEPH (mg/L)	<0.25				
	HEPH (mg/L)	<0.25				
	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride (%)	93.7				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	94.5				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2280800-1 Water 28-MAY-19 11:45 HMM-PW-01	L2280800-2 Water 28-MAY-19 13:20 HMM-MW-01-A	L2280800-3 Water 28-MAY-19 14:45 HMM-MW-01-B	L2280800-4 Water 28-MAY-19 14:40 HMM-BH-04-A	L2280800-5 Water 28-MAY-19 15:15 HMM-BH-04-B
Grouping	Analyte						
WATER							
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Acenaphthylene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Acridine (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Benz(a)anthracene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(a)pyrene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Benzo(b&j)fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015	<0.000015	<0.000015	<0.000015	<0.000015	
	Benzo(g,h,i)perylene (mg/L)	<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	
	Chrysene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Dibenz(a,h)anthracene (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Fluoranthene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Fluorene (mg/L)	<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	
	1-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	2-Methylnaphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Phenanthrene (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	
	Pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	
	Surrogate: Acridine d9 (%)	129.2	118.7	104.5	86.1	106.1	
	Surrogate: Chrysene d12 (%)	109.7	114.4	105.2	98.0	109.0	
	Surrogate: Naphthalene d8 (%)	93.8	98.8	87.6	88.7	93.4	
	Surrogate: Phenanthrene d10 (%)	113.2	115.3	96.2	97.8	105.1	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID				
		Description				
		Sampled Date				
		Sampled Time				
		Client ID				
Grouping	Analyte					
WATER						
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000010				
	Acenaphthylene (mg/L)	<0.000010				
	Acridine (mg/L)	<0.000010				
	Anthracene (mg/L)	<0.000010				
	Benz(a)anthracene (mg/L)	<0.000010				
	Benzo(a)pyrene (mg/L)	<0.0000050				
	Benzo(b&j)fluoranthene (mg/L)	<0.000010				
	Benzo(b+j+k)fluoranthene (mg/L)	<0.000015				
	Benzo(g,h,i)perylene (mg/L)	<0.000010				
	Benzo(k)fluoranthene (mg/L)	<0.000010				
	Chrysene (mg/L)	<0.000010				
	Dibenz(a,h)anthracene (mg/L)	<0.0000050				
	Fluoranthene (mg/L)	<0.000010				
	Fluorene (mg/L)	<0.000010				
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000010				
	1-Methylnaphthalene (mg/L)	<0.000050				
	2-Methylnaphthalene (mg/L)	<0.000050				
	Naphthalene (mg/L)	<0.000050				
	Phenanthrene (mg/L)	<0.000020				
	Pyrene (mg/L)	<0.000010				
	Quinoline (mg/L)	<0.000050				
	Surrogate: Acridine d9 (%)	95.7				
	Surrogate: Chrysene d12 (%)	94.9				
	Surrogate: Naphthalene d8 (%)	83.0				
	Surrogate: Phenanthrene d10 (%)	92.1				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Total Organic Carbon	MS-B	L2280800-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2280800-1, -2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Total	MS-B	L2280800-1, -2
Matrix Spike	Aluminum (Al)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2280800-1, -2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Iron (Fe)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2280800-1, -2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L2280800-3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2280800-1, -2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2280800-3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLCI	Detection Limit Raised: Chromatographic Interference due to co-elution.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND
This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method.			
Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Reference Information

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHw and HEPHw are measures of Light and Heavy Extractable Petroleum Hydrocarbons in water. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHw = EPH10-19 minus Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene.

HEPHw = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

METHANE-DIS-CL Water Methane, dissolved Campbell & Vandegrift, JC, V3, 1998

Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-WT Water Phenol (4AAP) EPA 9066

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees Celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

Reference Information

VOC-HSMS-VA Water VOCs in water by Headspace GCMS EPA 5021A/8260C

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA Water BTEX/MTBE/Styrene by Headspace GCMS EPA 5021A/8260C

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Water VOC7 and/or VOC Surrogates for Waters EPA 5035A/5021A/8260C

XYLENES-CALC-VA Water Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

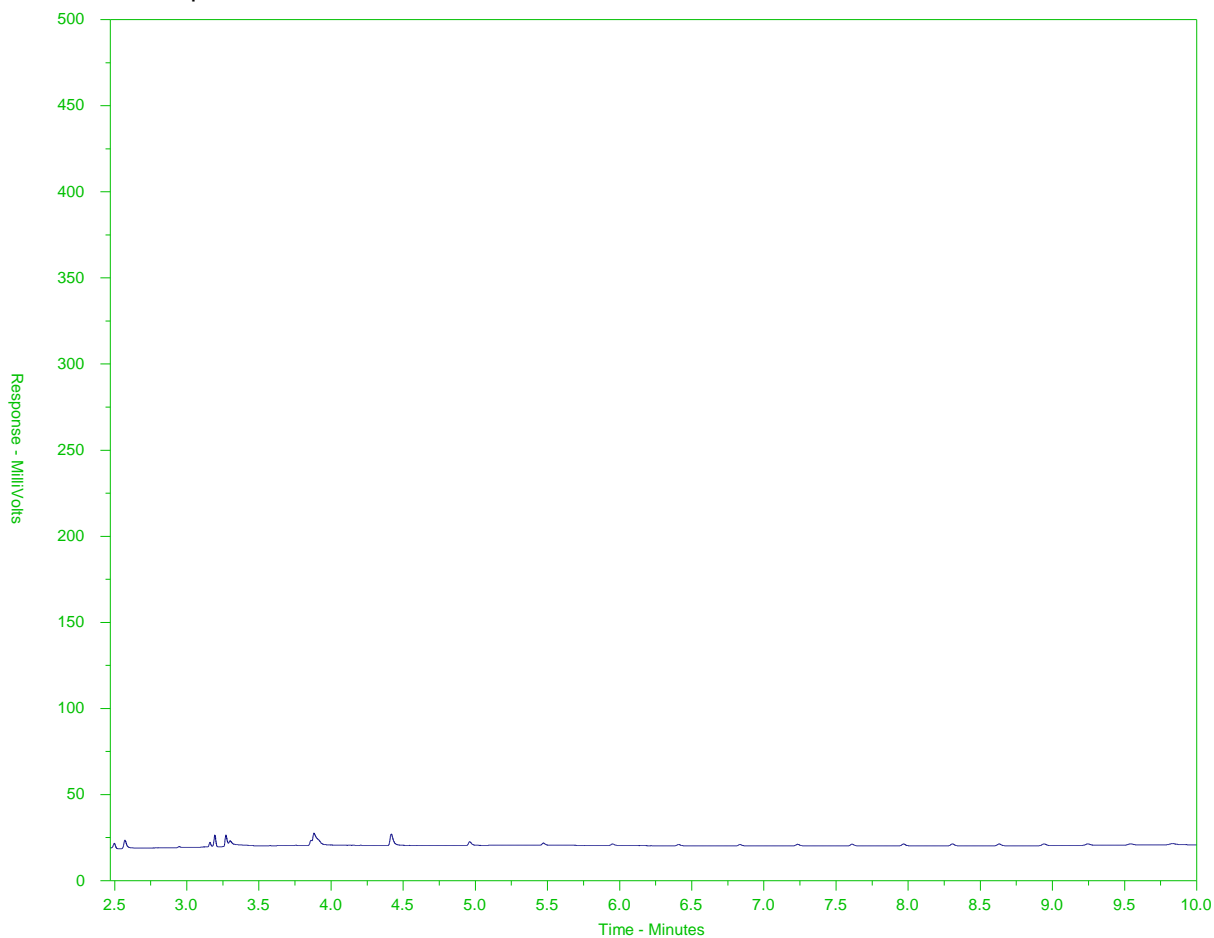
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-1
Client Sample ID: HMM-PW-01



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

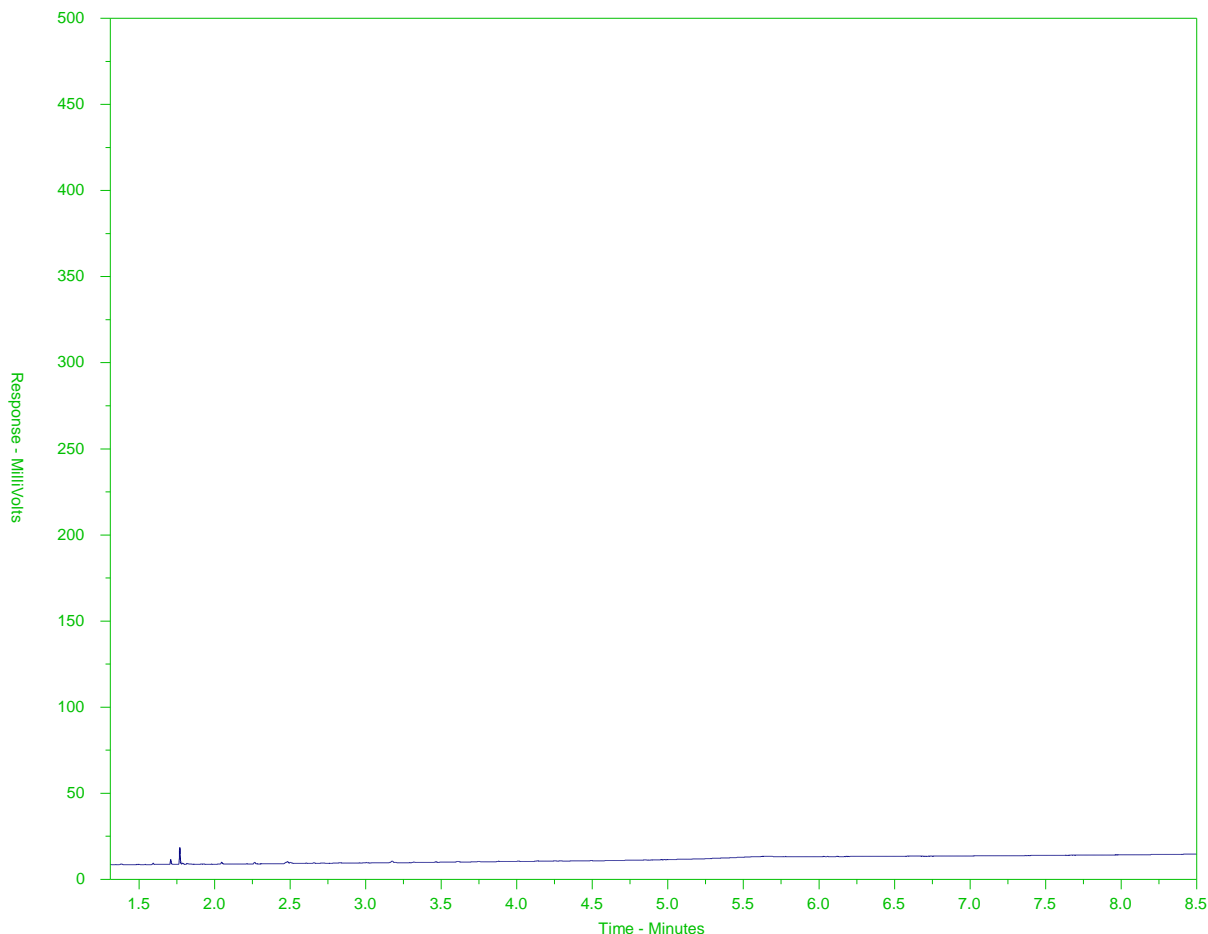
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-1
Client Sample ID: HMM-PW-01



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

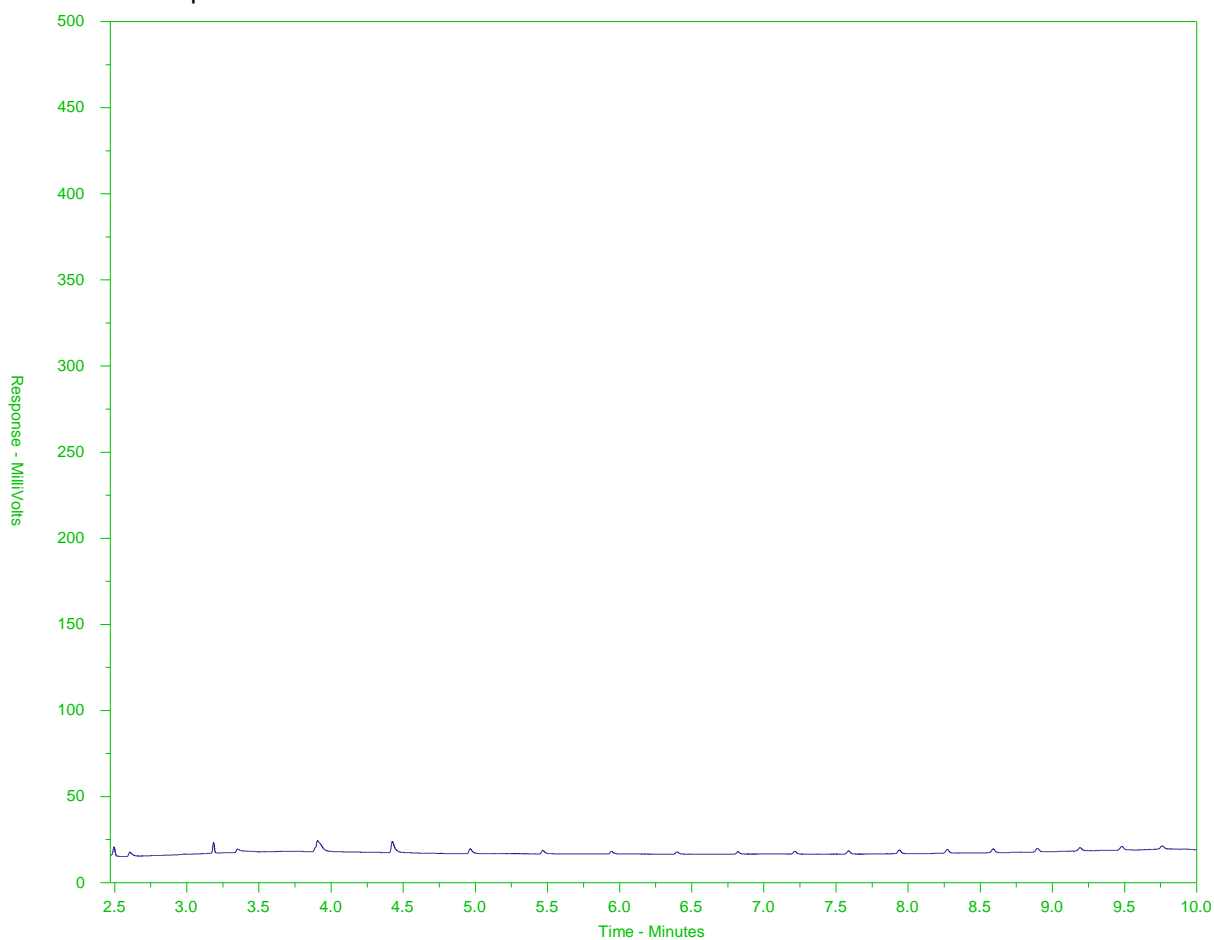
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-2
Client Sample ID: HMM-MW-01-A



← EPH10-19 →		← EPH19-32 →	
nC10		nC19	nC32
174°C		330°C	467°C
346°F		626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

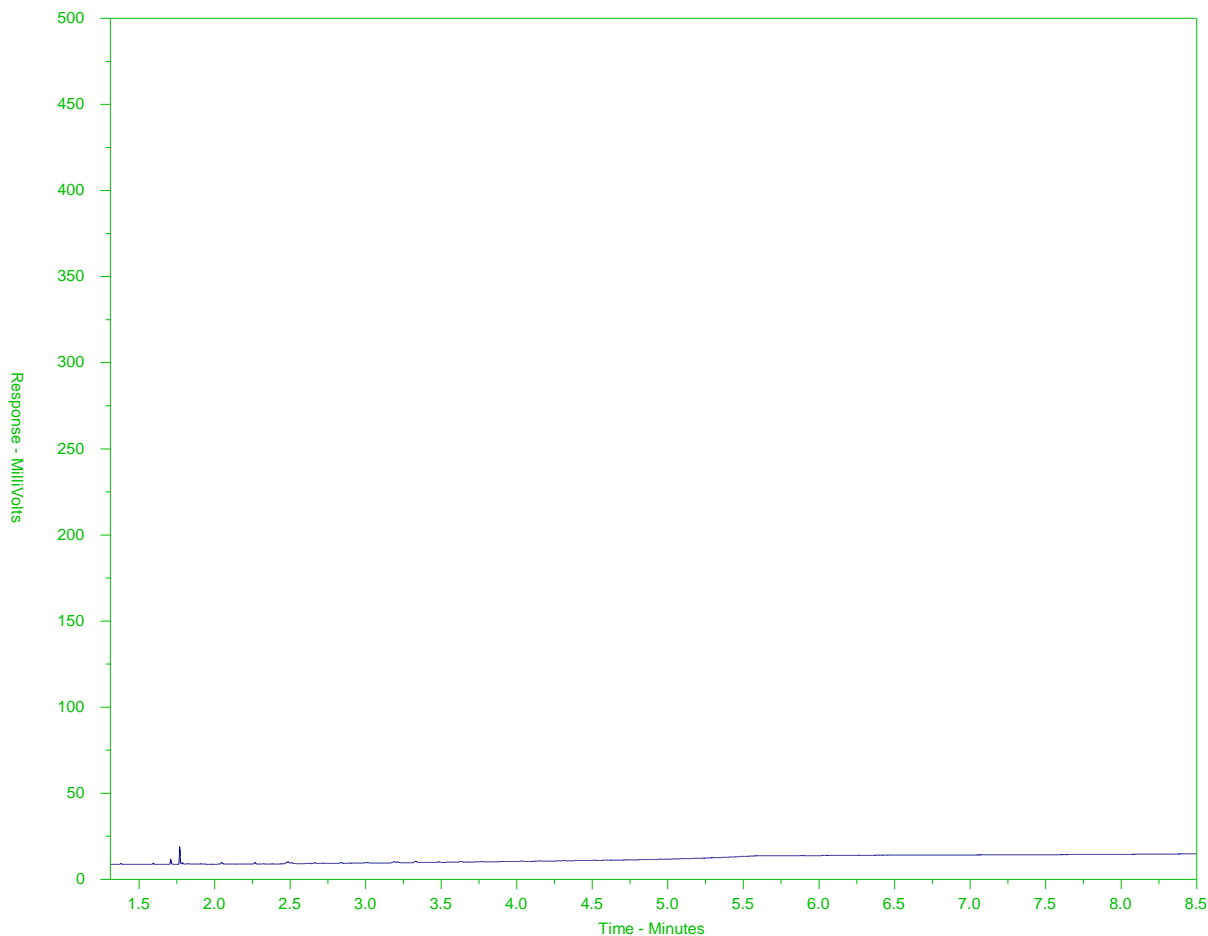
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-2
Client Sample ID: HMM-MW-01-A



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

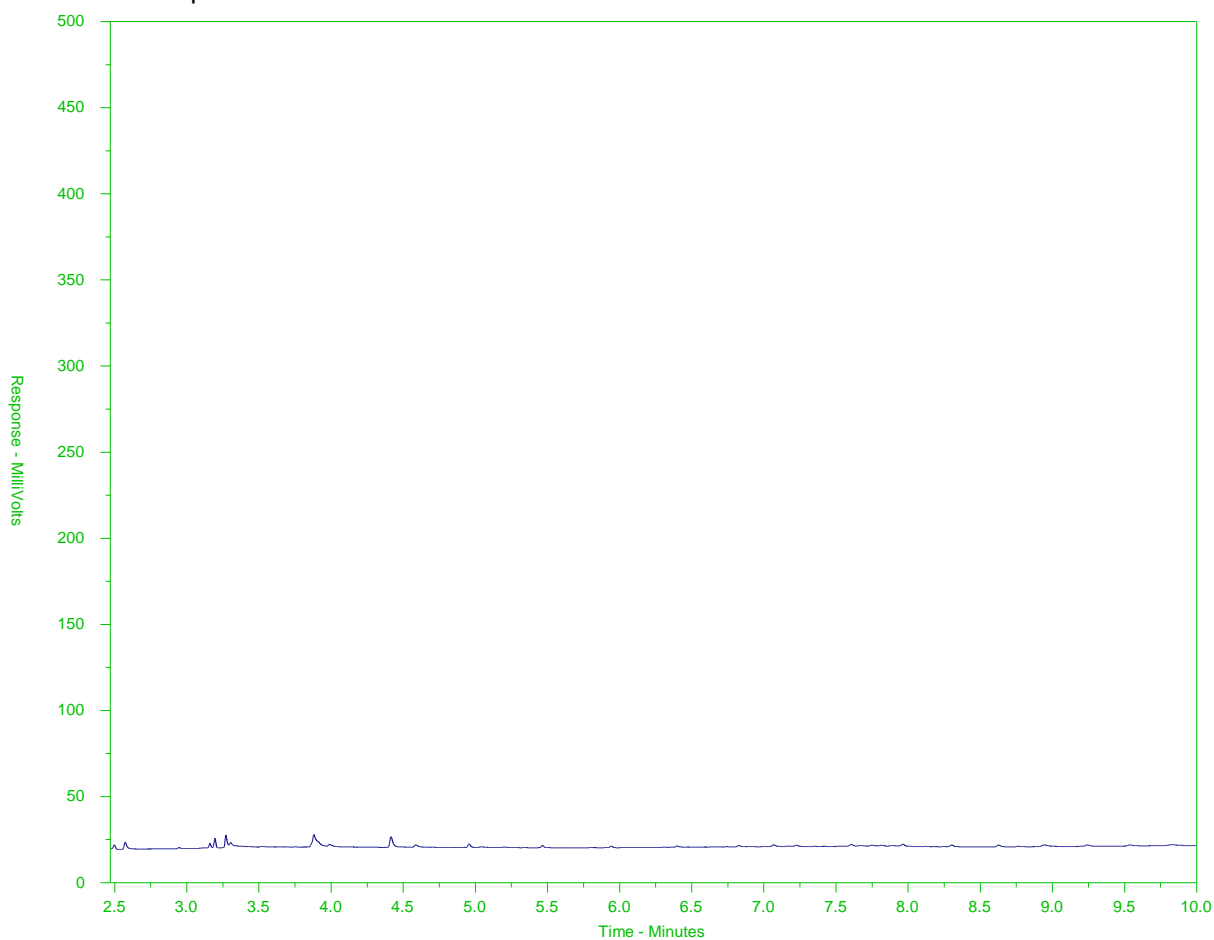
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-3
Client Sample ID: HMM-MW-01-B



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

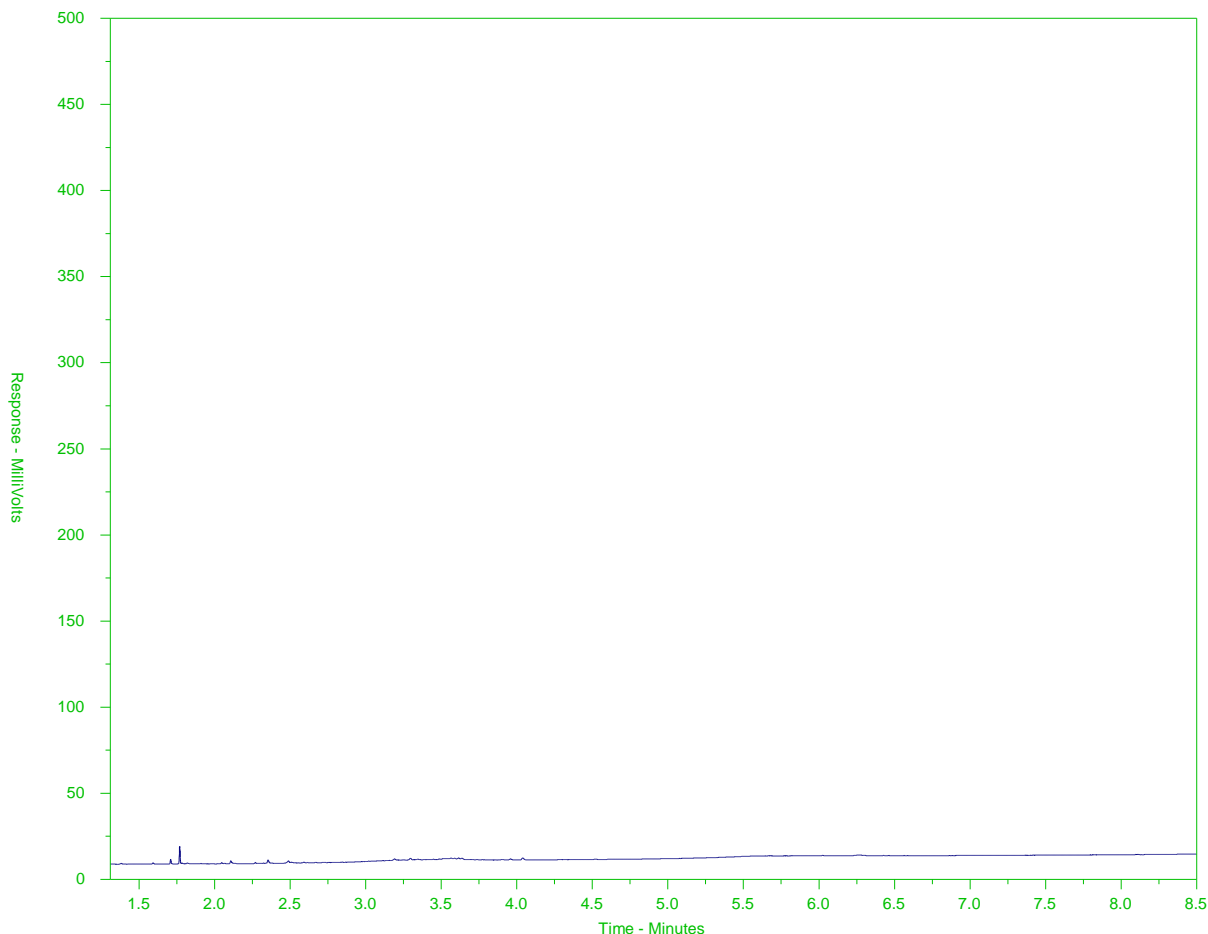
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-3
Client Sample ID: HMM-MW-01-B



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

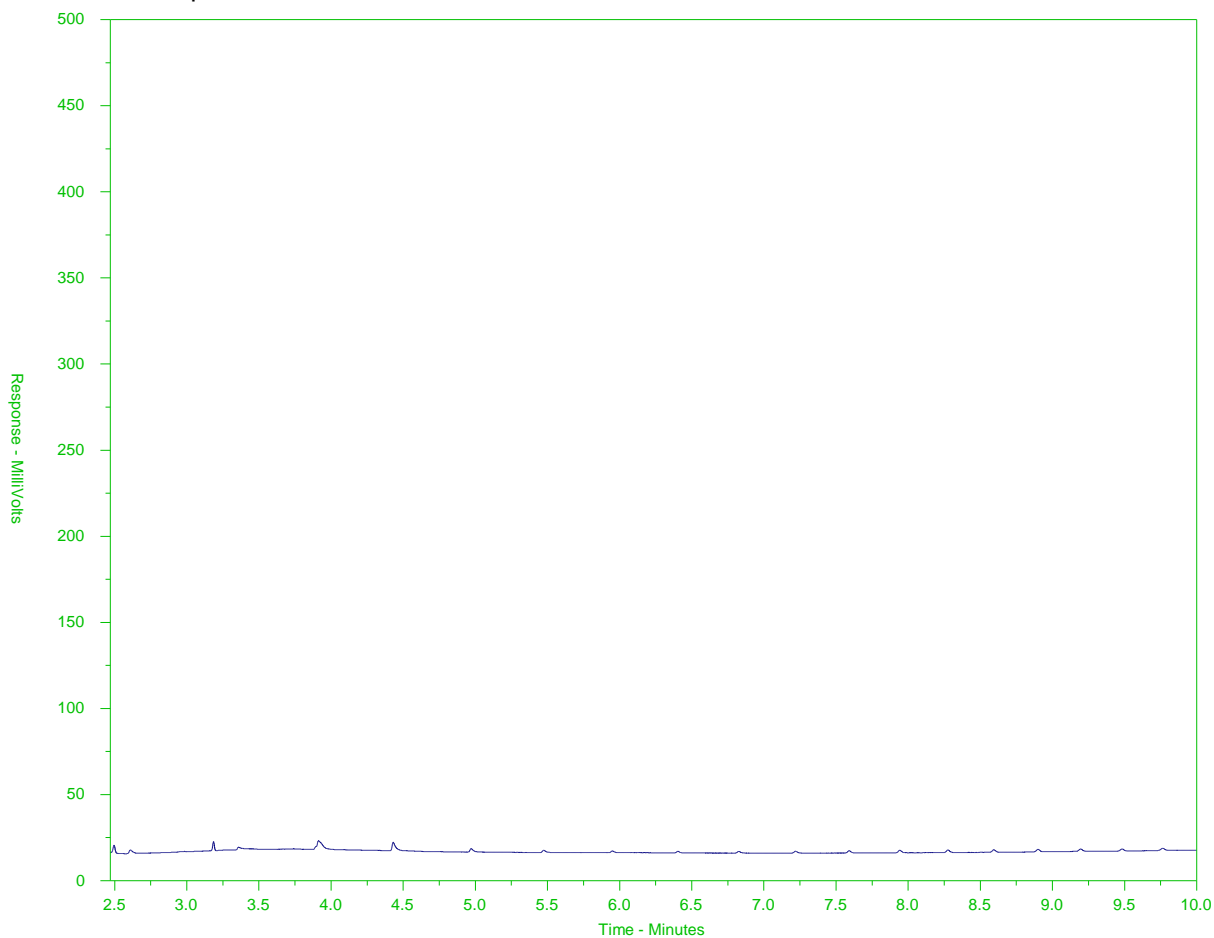
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-4
Client Sample ID: HMM-BH-04-A



← EPH10-19 →		← EPH19-32 →	
nC10		nC19	nC32
174°C		330°C	467°C
346°F		626°F	873°F
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

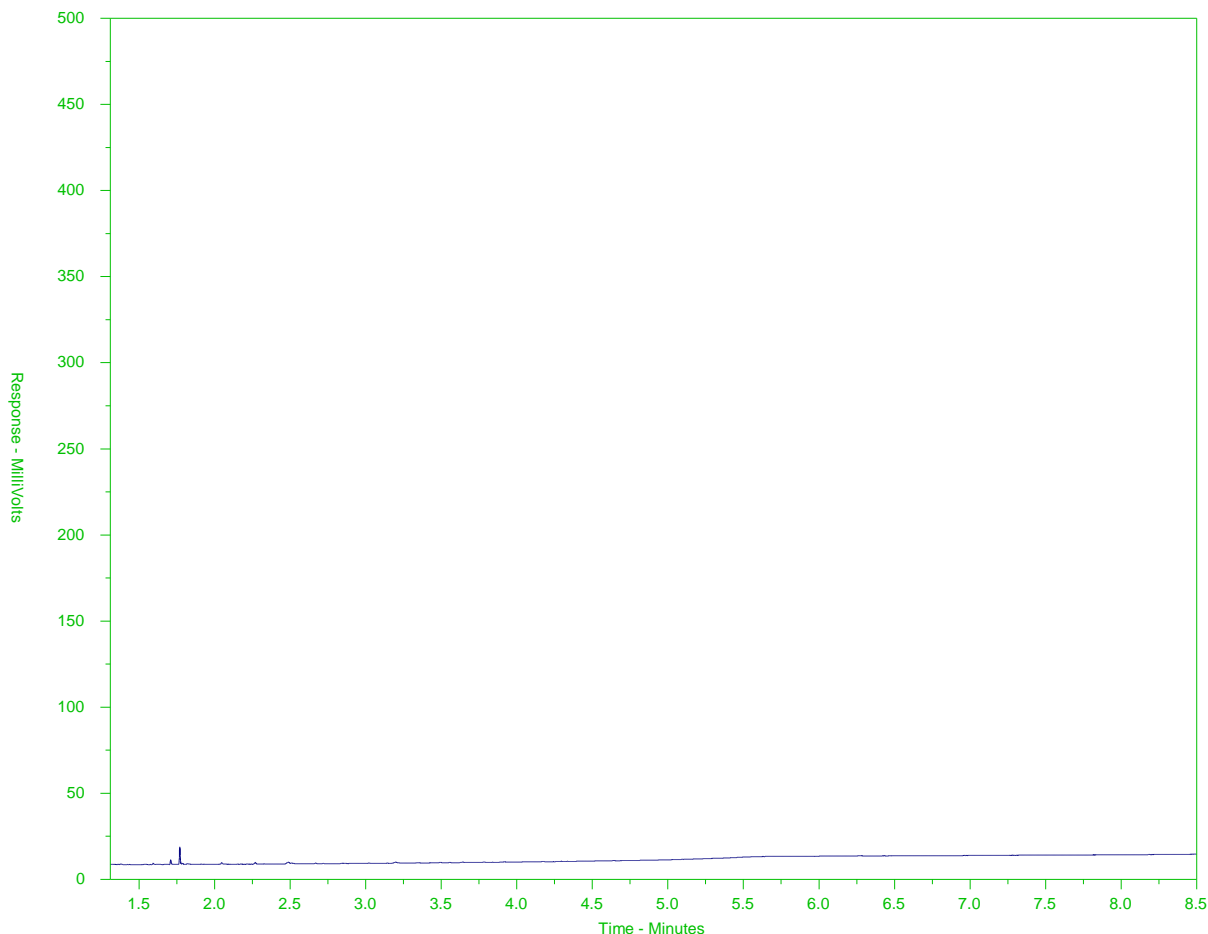
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-4
Client Sample ID: HMM-BH-04-A



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

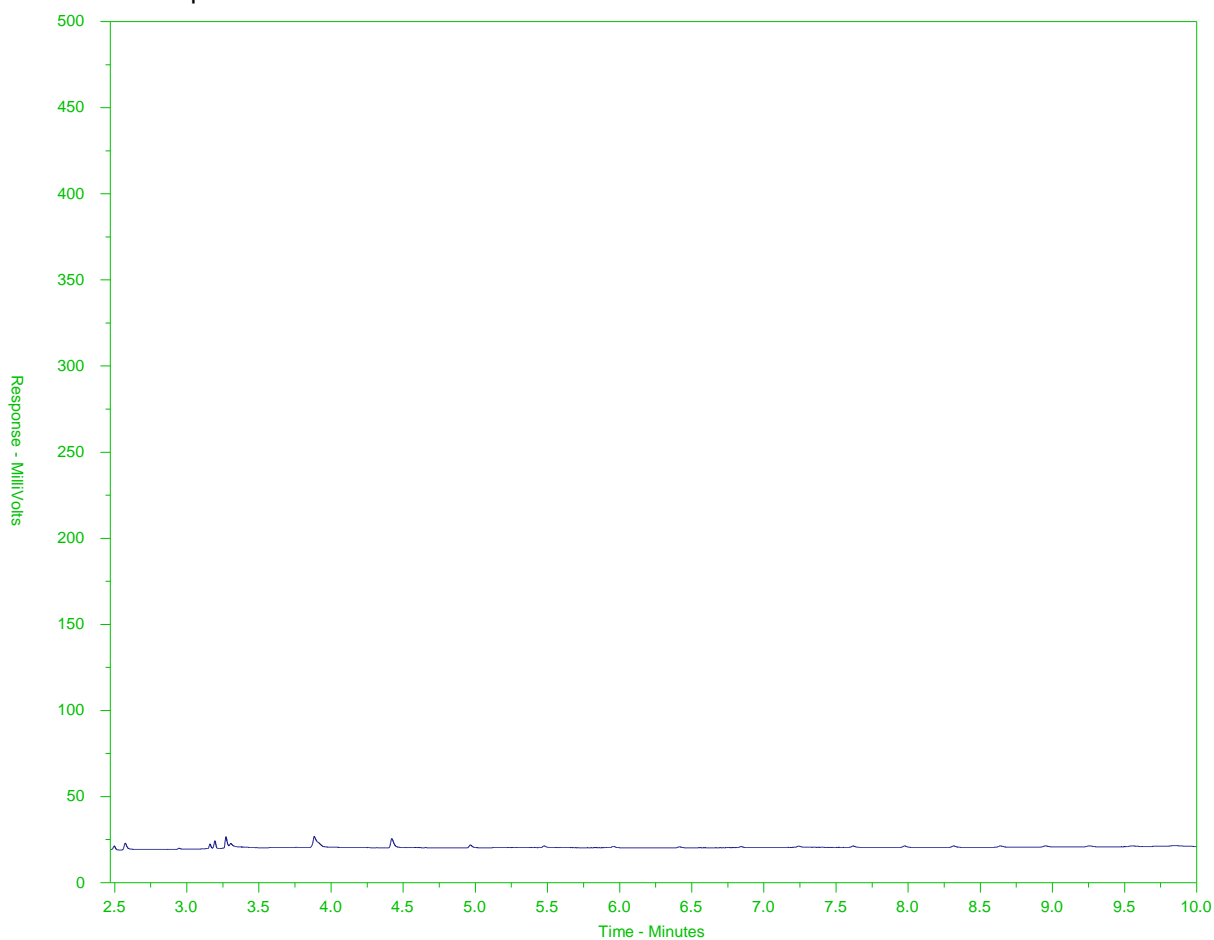
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-5
Client Sample ID: HMM-BH-04-B



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

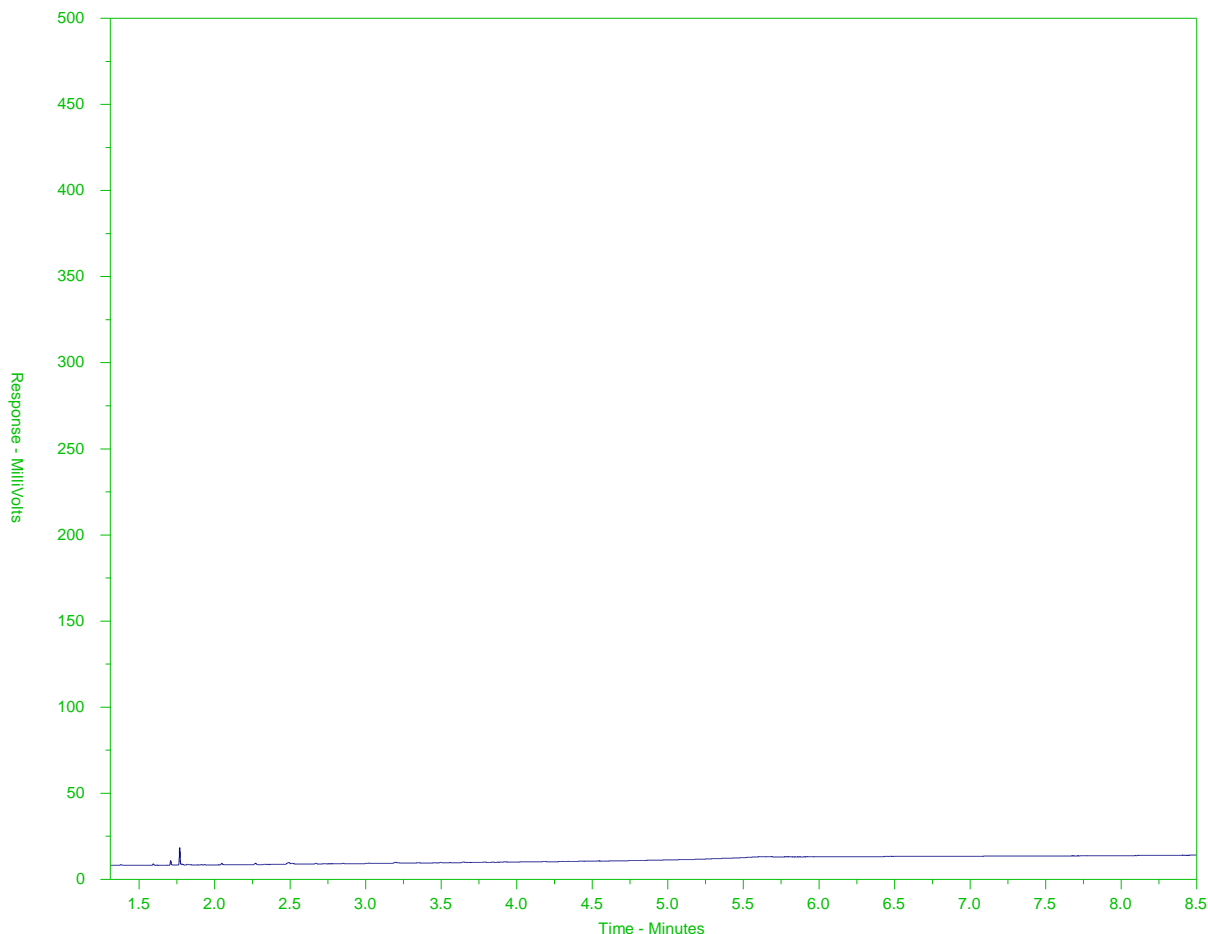
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-5
Client Sample ID: HMM-BH-04-B



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

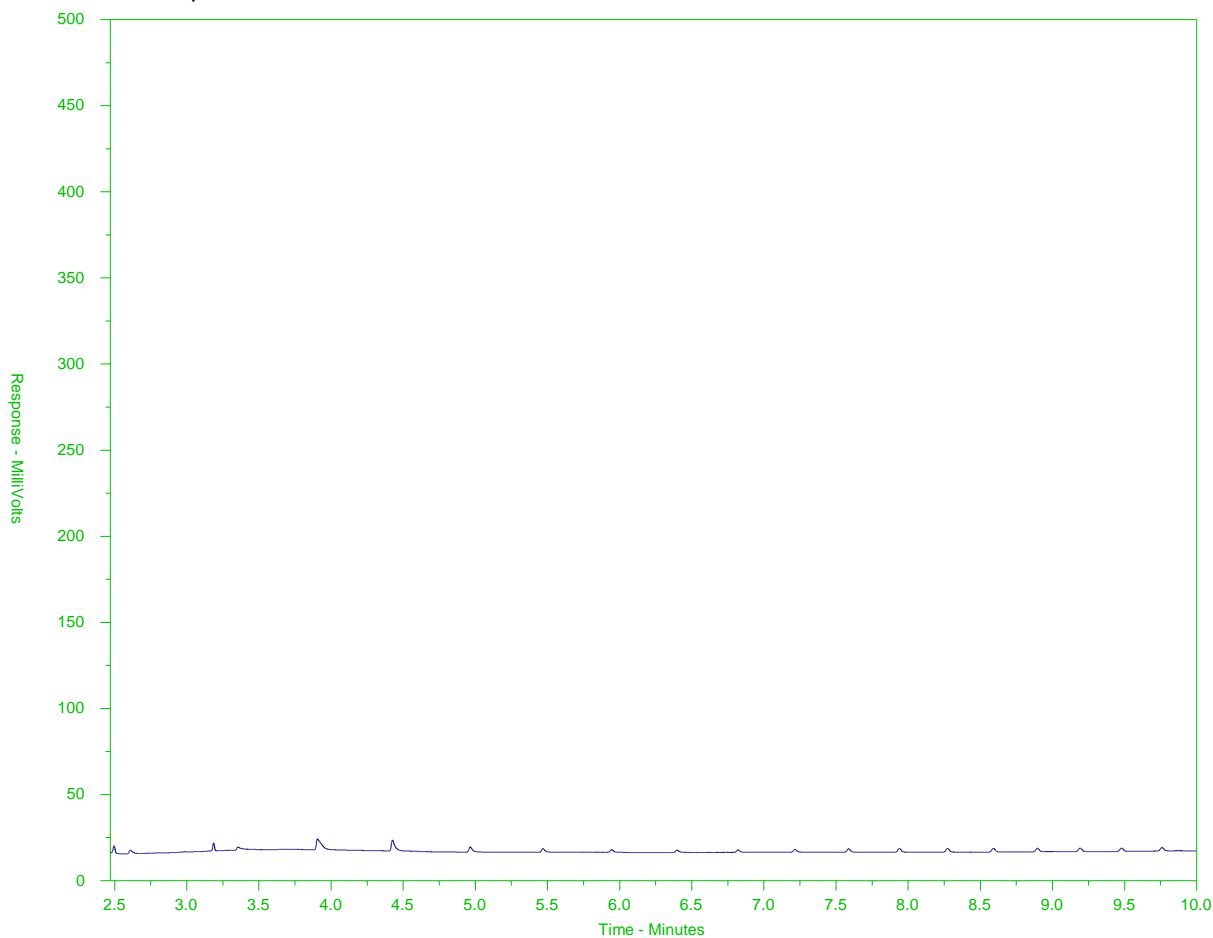
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-6
Client Sample ID: DUPLICATE



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

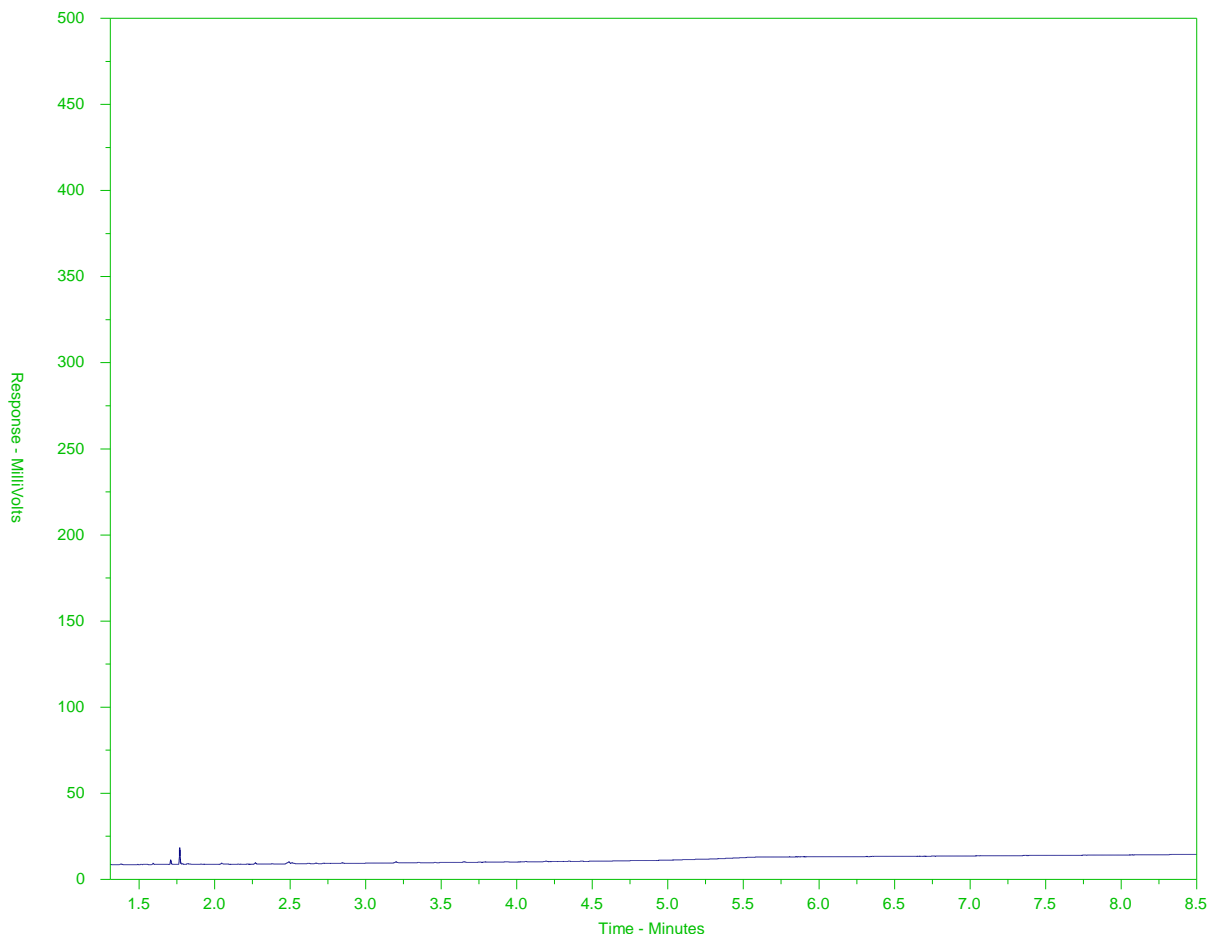
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2280800-C-6
Client Sample ID: DUPLICATE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2280800-COFC

COC Number: 15 -

Page of

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ALS Lab Work Order # (lab use only)		ALS Contact: B. Mack		Sampler: MF / CS																																																																
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	HMM-BH-03	28-MAY-19		Water																																																																
	HMM-BH-03			Water																																																																
	HMM-PW-01	28-MAY-19	11:45	Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	13																																																					
	HMM-MW-01-A		13:20	Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																																																						
	HMM-MW-01-B		14:45	Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																																																						
	HMM-BH-04-A		14:40	Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																																																						
	HMM-BH-04-B		15:15	Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																																																						
	DUPLICATE			Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																																																						
Drinking Water (DW) Samples¹ (client use)					Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)					SAMPLE CONDITION AS RECEIVED (lab use only)																																																										
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO					* Routine - EC, TDS, pH, true colour, hardness & turbidity. ** Nutrients - NO2, NO3, TKN, O-PO4					Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>																																																										
Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO										Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>																																																										
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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FORM

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX O

**Westridge Marine Terminal—Water Quality Results: February
and March 2018 and May, July and August 2019**



**Westridge Marine Terminal—
Water Quality Results: February
and March 2018 and May, July
and August 2019**

Trans Mountain Expansion Project

October 2, 2019

Prepared for:

Trans Mountain Pipeline ULC

Prepared by:


Stantec Consulting Ltd.

WESTRIDGE MARINE TERMINAL—WATER QUALITY RESULTS: FEBRUARY AND MARCH 2018 AND MAY 2019

This document entitled Westridge Marine Terminal—Water Quality Results: February and March 2018 and May, July and August 2019 was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Trans Mountain Pipeline ULC (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Reviewed by 
(signature)

Karen Munro

Reviewed by  Pam Hayward
2019.10.02
13:24:27 -07'00'
(signature)

Pam Hayward

Approved by  Lucy Harrison
Digitally signed by Lucy Harrison
Date: 2019.10.02
12:54:59 -07'00'
(signature)

Lucy Harrison



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Abbreviations

ALS	ALS Environmental Laboratories
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
CALA	Canadian Associated for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
DO	dissolved oxygen
EMA	<i>Environmental Management Act</i>
IRT	Information Requirements Table
NTU	nephelometric turbidity units
QA/QC	Quality assurance/quality control
RPD	relative percent difference
SFU	Simon Fraser University
TAR	Technical Assessment Report
TEH	total extractable hydrocarbons
TSS	total suspended solids
WQG	Water Quality Guideline



WESTRIDGE MARINE TERMINAL—WATER QUALITY RESULTS: FEBRUARY AND MARCH 2018 AND MAY, JULY AND AUGUST 2019

Introduction
October 2, 2019

1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) intends to upgrade and expand the Westridge Marine Terminal (the Terminal) to increase its crude oil product delivery and export capacity. The Terminal's current wastewater discharge permit (#3678) under the British Columbia *Environmental Management Act* (EMA) authorizes discharge of effluent from the dyked tank farm into Burrard Inlet through a west and an east outfall. This permit will require an amendment, for which the BC Ministry of Environment and Climate Change Strategy (BC ENV) issued an Information Requirements Table (IRT) for the Technical Assessment Report (TAR) that supports the amendment. Trans Mountain retained Stantec Consulting Ltd. (Stantec) to characterize baseline water quality at the Terminal to support Phase 3 construction activities and address IRT #4.2.

This report presents and compares results for four water quality sampling events during February and March 2018, four events in May 2019, and four events in July and August 2019.

A detailed description of the fieldwork methods is provided in the Westridge Terminal Baseline Water Quality and Quantity Sampling Plan (Sampling Plan) (Stantec 2017).

2.0 METHODS

The water samples were collected as surface grab samples in accordance with the BC Field Sampling Manual (BC MWLAP 2013). All sampling and reporting tasks adhered to Stantec's quality assurance/quality control (QA/QC) program. Marine samples were collected by boat at various tidal levels.

Stream samples were collected by immersing the collection bottle into the water until the opening was below the surface with the water flowing into the opening, until the bottle was full. Marine grab samples were collected as surface grab samples (at 0.5 m below the surface) by immersing the collection bottle vertically into the water and allowing the water to flow into the bottle until full. Where sample bottles were pre-charged with a preservative the water was collected in a non-pre-charged collection bottle and transferred until the bottle was full. Deep-water marine samples were collected using a Niskin water sampler and emptied into the collection bottles until full.

Samples were kept cool for submission to the laboratory. The water quality sample bottles were provided by and shipped to ALS Environmental Laboratories (ALS) in Burnaby, British Columbia for analysis. ALS is registered under the inter-laboratory comparison program as identified in the Environmental Data Quality Assurance Regulation and is accredited by the Canadian Association for Laboratory Accreditation (CALA). Duplicate samples were collected from randomly selected sample sites for each field visit. Field, travel, and filter blanks were also collected and analysed as part of the QA/QC program.



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In situ measurements were collected for selected physicochemical parameters (water temperature, dissolved oxygen [DO], conductivity, pH, and turbidity) using a YSI Quatro water quality meter. The meter was calibrated prior to use in the field.

Some modifications of the Sampling Plan were required based on field conditions, logistics, and safety:

- No collection of stream flow measurements, given the low flows at the sites
- Addition or deletion of stream sampling sites due to low flow and access concerns
- Addition of precipitation data review at weather stations in close proximity to the terminal

2.1 SAMPLE SITES

2.1.1 2018 Sampling Program

Ten sites were sampled in 2018: the original seven identified in the Sampling Plan (WT1 through WT7) plus three identified during the monitoring program (WT8 through WT10). Sample site names, locations, and rationale for selection are provided in Table 2-1. Sample site locations are presented in Figure 2-1. An unnamed watercourse at the terminal is referred to as “Watercourse BC-789” for this report. All sites sampled are freshwater except for WT5, WT6 and WT7, which are marine sites.

2.1.2 2019 Sampling Program

Nine sites were sampled in 2019: four of the original sites identified in the Sampling Plan (WT2, WT3, WT5-surface and WT7-surface); two sites from the 2018 monitoring program (WT8 and WT10); and two additional marine sites (WT5-deep and WT7-deep). Monitoring sites were approved by BC ENV prior to starting the 2019 water quality program. Sample site names, locations, and rationale for locations removed/added from the 2018 sampling program are provided in Table 2-1. Site locations are presented in Figure 2-1.

2.2 SAMPLE COLLECTION TIMING

Sampling events were scheduled to characterize water quality of surface drainages at the Terminal during precipitation events when possible. Water samples collected on dates where no rainfall events occurred were to represent the water quality on site during spring and summer 2019.

Freshwater sampling dates are listed in Table 2-2 and marine sampling dates, times, and tidal stages are listed in Table 2-3.

Burnaby Simon Fraser University (SFU) is the closest Environment and Climate Change Canada weather station to the Terminal, but precipitation data were not recorded there for the majority of the sampling trips (Table 2-3). Therefore, the Vancouver Harbour weather station (12 km away) was used to represent total daily precipitation at the Terminal for those dates missing data.



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Table 2-1 Baseline Water Quality Sampling Locations (Westridge Terminal)

Location ID	Location	UTM Coordinates (UTM Zone 10)		Sampling Year		Rationale
		Easting	Northing	2018	2019	
WT1	Within the eastern side of the Terminal on watercourse BC-789. W10 is directly downstream, WT8 is upstream	503418	5459572	Y	N	Eastern sampling site within the Terminal. Upstream portion of catch basin receiving water from watercourse BC-789 and a culverted drainage from the west. Discontinued and replaced with WT9 on March 13, 2018.
WT2	Within the Terminal	503351	5459587	Y	Y	Western sampling site upstream of runoff from the Terminal to the CP rail ditch and into Burrard Inlet via a non-permit outfall. Receives water from road runoff and pipes draining onto the road.
WT3	Within the Terminal along the west boundary	503175	5459508	Y	Y	Western sampling site at higher elevation within the Terminal. Sample taken directly upstream of open culvert. Water flows to Burrard Inlet via the same non-permit outfall as WT2.
WT4	Dynamite Creek, west of Terminal boundary	503138	5459324	Y	N	Reference site. No influence from Terminal on Dynamite Creek; discontinued on February 28, 2018 due to difficult access and lack of defined channel.
WT5-surface	Marine environment—Burrard Inlet	503092	5459551	Y	Y	Western sampling site within Burrard Inlet, approximately 50 m from western Terminal discharge permit #3678 outfall.
WT5-deep	Marine environment—Burrard Inlet	503092	5459551	N	Y	Western sampling site within Burrard Inlet, approximately 50 m from western Terminal discharge permit #3678 outfall, approximately half the depth of water column
WT6	Marine environment—Burrard Inlet	503171	5459587	Y	N	Central sampling site within Burrard Inlet, approximately 25 m from western non-permit outfall. Discontinued after Trip 1 due to lack of access during construction.
WT7-surface	Marine environment—Burrard Inlet	503318	5459673	Y	Y	Eastern sampling site within Burrard Inlet, approximately 25 m from eastern Terminal discharge permit #3678 outfall.
WT7-deep	Marine environment—Burrard Inlet	503318	5459673	N	Y	Eastern sampling site within Burrard Inlet, approximately 25 m from eastern Terminal discharge permit #3678 outfall, approximately half the depth of water column
WT8	Upstream of WT1 and culvert, in a forested location	503464	5459504	Y	Y	Reference site. Eastern field-identified site at higher elevation on watercourse BC-789, uninfluenced by Terminal and onsite clearing. Added February 28, 2018.
WT9	Within the Terminal along the east boundary in a forested location	503505	5459562	Y	N	Reference site. Eastern field-identified site, uninfluenced by Terminal. Replaced WT4 on March 22, 2018. Discontinued due to construction activities affecting or near the location.
WT10	Within the eastern side of the Terminal, directly downstream of WT1	503418	5459572	Y	Y	Eastern field-identified site within the Terminal. Downstream portion of catch basin receiving water from upstream on Watercourse BC-789, a culverted drainage from the west, and a road drainage. Water flows downstream via a culvert to Burrard Inlet (non-permit outfall). Site is sampled at entrance to culvert conveying water downstream. Replaced WT1 on March 13, 2018, as water quality was more representative of surrounding influences.
WT11	Within the western side of the Terminal in the CP Rail ditch	503196	5459542	N	Y	CP Rail ditch to characterize site drainage before it enters the marine environment.



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**Table 2-2 Baseline Water Quality Sampling Dates—Freshwater Locations
(Westridge Terminal)**

Location ID	Sampling Date											
	Feb 7, 2018	Feb 28, 2018	Mar 13, 2018	Mar 22, 2018	May 3, 2019	May 9, 2019	May 16, 2019	May 29, 2019	July 25, 2019	Aug 1, 2019	Aug 23, 2019	Aug 29, 2019
WT1	✓	✓	-	-	-	-	-	-	-	-	-	-
WT2	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓
WT3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WT4	✓	-	-	-	-	-	-	-	-	-	-	-
WT8	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
WT9	-	-	-	✓	✓	-	-	-	-	-	-	-
WT10	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
WT11	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓

**Table 2-3 Baseline Water Quality Sampling Dates, Times and Tidal Stage—Marine Locations
(Westridge Terminal)**

Date Sampling		WT5-surface	WT5-deep	WT6	WT7-surface	WT7-deep
February 7, 2018	Sample Time	12:44	-	12:30	12:13	-
	Tidal Stage	Ebbing	-	Ebbing	Ebbing	-
February 28, 2018	Sample Time	14:20	-	-	14:42	-
	Tidal Stage	Flooding	-	-	Flooding	-
March 13, 2018	Sample Time	16:27	-	-	16:37	-
	Tidal Stage	Ebbing	-	-	Ebbing	-
March 22, 2018	Sample Time	12:00	-	-	12:14	-
	Tidal Stage	Ebbing	-	-	Ebbing	-
May 3, 2019	Sample Time	09:00	09:20	-	09:30	09:40
	Tidal Stage	Ebbing	Ebbing	-	Ebbing	Ebbing
May 9, 2019	Sample Time	09:30	09:00	-	09:40	09:20
	Tidal Stage	Ebbing	Ebbing	-	Ebbing	Ebbing
May 16, 2019	Sample Time	09:20	09:30	-	09:50	10:00
	Tidal Stage	Ebbing	Ebbing	-	Ebbing	Ebbing
May 29, 2019	Sample Time	09:30	09:45	-	10:15	10:00
	Tidal Stage	Slack Tide (Low)	Slack Tide (Low)	-	Slack Tide (Low)	Slack Tide (Low)
July 25, 2019	Sample Time	09:40	09:45	-	10:15	10:00
	Tidal Stage	Flooding	Flooding	-	Flooding	Flooding



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Date Sampling		WT5-surface	WT5-deep	WT6	WT7-surface	WT7-deep
August 1, 2019	Sample Time	09:35	09:25	-	-	-
	Tidal Stage	Ebbing	Ebbing	-	-	-
August 23, 2019	Sample Time	09:45	09:25	-	10:15	10:00
	Tidal Stage	Flooding	Flooding	-	Flooding	Flooding
August 29, 2019	Sample Time	09:55	09:45	-	10:20	10:10
	Tidal Stage	Ebbing	Ebbing	-	Ebbing	Ebbing



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Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project, Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
3. Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
4. This document is provided by Trans Mountain Pipeline ULC (Trans Mountain) for use by the intended recipient only. This information is confidential and proprietary to Trans Mountain and is not to be provided to any other recipient without the written consent of Trans Mountain. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around Trans Mountain's pipelines and facilities, all of which require Trans Mountain's prior written approval.

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- Highway
 - Local Street
 - Railway
 - Watercourse
 - High Water Coastline
 - Low Water Coastline
 - Existing Building/Facility
 - Burnaby Park Inventory
 - Legal Parcel
 - Project Property Boundary
- ▲ Permit #3678 Discharge and Monitoring Location
 - ➔ Permit #3678 Outfall
 - ➔ Non-Permitted Outfall
 - Existing Watercourse
 - Existing Culvert
 - Permit #3678 Discharge Area

Baseline Water Quality Sampling Locations*

- Sampled in 2018 and 2019
- Sampled in 2018, Not Sampled in 2019
- Not Sampled in 2018, Sampled in 2019

*WT10 samples from 3 water sources:
- BC-789,
- Drainage from west
- Runoff from road



Location Information	Project Number 123512431
NTS: 092G07	Prepared by TDINNEEN 20190708
BCGS: 92G.026	PM Review LHARRISON PENDING
UTM: 10U 503370 5459515	

Client/Project	Project Contact
Trans Mountain Pipeline ULC	Bronwyn Pountney
Trans Mountain Expansion Project	403-514-6726
	Suite 2700, 300 5th Avenue SW,
	Calgary, AB, T2P 5J2

Figure No.	Rev.	Page No.	Doc No.
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2018 and 2019 Baseline Water Quality Sampling Locations for the Westridge Terminal

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2.3 SAMPLE COLLECTION AND ANALYSIS

Field methods were conducted in accordance with the BC Field Sampling Manual (BC MWLAP 2013). Water was analyzed for *in situ* temperature, pH, dissolved oxygen, specific conductivity, and turbidity. Samples were submitted to the laboratory for analysis of total suspended solids (TSS), nutrients, total and dissolved metals, pH, hydrocarbons, and volatile organic compounds. The Sampling Plan further details the methods and study design accepted by BC ENV to support the waste water discharge permit (#3678) amendment.

Water quality results were compared to BC Approved and Working Water Quality Guidelines ((BC WQG) for Aquatic Life (BC ENV 2019), and Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 2019).

3.0 RESULTS

Sampling trips were planned to characterize water quality in runoff during precipitation events where possible. Minimal precipitation was recorded in May 2019 and sampling was conducted to represent the spring conditions.

Simon Fraser University (SFU) is the closest Environment and Climate Change Canada weather station to the Terminal, but precipitation data were not recorded there for the majority of the sampling trips. Therefore, the Vancouver Harbour weather station (12 km away) was used to represent total daily precipitation at the Terminal for those dates missing data. The total precipitation recorded is presented in Table 3-1.

Table 3-1 Recorded Precipitation Before and During Sampling Events

Sampling Date ¹	Weather Station Name (Station ID)	
	SFU (1101158) (mm)	Vancouver Harbour (1108446) (mm)
02/05/2018	NR	0.2
02/06/2018	NR	3.7
02/07/2018	NR	13.4
02/2/2018	NR	0
02/27/2018	NR	3.9
02/28/2018	NR	7.8
03/11/2018	NR	0
03/12/2018	NR	0
03/13/2018	NR	7.1
03/20/2018	NR	0



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Table 3-1 Recorded Precipitation Before and During Sampling Events

Sampling Date ¹	Weather Station Name (Station ID)	
	SFU (1101158) (mm)	Vancouver Harbour (1108446) (mm)
03/21/2018	NR	Trace
03/22/2018	NR	26.5
05/01/2019	0	0
05/02/2019	0	0.1
05/03/2019	0	0
05/07/2019	0	0
05/08/2019	0	0
05/09/2019	0	0
05/14/2019	18.6	13.1
05/15/2019	4.2	2.2
05/16/2019	8.0	0.2
05/27/2019	NR	0
05/28/2019	NR	0
05/29/2019	NR	0
07/23/2019	NR	0
07/24/2019	NR	3.0
07/25/2019	NR	0
07/30/2019	NR	0.2
07/31/2019	0	0
08/01/2019	4.0	0
08/21/2019	NR	15.5
08/22/2019	NR	0
08/23/2019	NR	0.3
08/27/2019	NR	0
08/28/2019	NR	0
08/29/2019	NR	0.1
Site Information		
Station Elevation (m)	365.80	2.50
Distance from Westridge Terminal (km)	3	12
NOTES: NR: no record ¹ Dates in bold indicate sampling date		



WESTRIDGE MARINE TERMINAL—WATER QUALITY RESULTS: FEBRUARY AND MARCH 2018 AND MAY, JULY AND AUGUST 2019

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3.1 IN SITU WATER QUALITY

Table 3-2 provides in situ water quality results for the sampling trips. Appendix A.1 provides summary statistics for each site (minimum, maximum, mean, median, standard deviation, standard error, and number of exceedances of water quality guidelines).

3.1.1 Freshwater Sites

At freshwater sites, temperature ranged from 4.6 to 9.2°C in the February and March 2018 samples, from 10.4 to 16.3°C in May 2019 samples and from 12.3 to 18.3°C in July and August 2019. Dissolved oxygen levels were consistently high ranging from 11.1 to 13.4 mg/L in February and March 2018, from 6.5 to 11.6 mg/L in May 2019 and from 6.0 to 14.7 mg/L in July and August 2019. Specific conductivity ranged from 24 µS/cm to 4052 µS/cm in February and March 2018. Specific conductivity ranged from 192.2 to 268.1 µS/cm in May 2019. Specific conductivity ranged from 192.2 to 268.1 µS/cm in July and August 2019. In February and March 2018, pH ranged from 6.5 to 8.1, except for higher values on February 28 (9.8 to 10.4), which were attributed to sampling equipment malfunction, as the corresponding lab samples did not have elevated pH. May 2019 pH levels ranged from 6.92 to 8.19 and 6.7 to 8.1 in July and August 2019. Relatively low to moderate turbidity values were recorded for the freshwater sites in February and March 2018 (0.7 to 42.9 NTU), except for WT2 on March 13 (1,385 NTU, with corresponding lab-measured TSS of 631 mg/L). This high value is likely associated with low flow causing higher levels of sediment in the water sample as the water flows out of the concrete wall at this site. Low turbidity values were recorded in May 2019, ranging from 0.01 to 25.9 NTU and in July and August 2019, ranging from 0.26 to 13.4.

3.1.2 Marine Sites

Marine water temperatures ranged from 7.0 to 10.5°C in February and March 2018, from 10.1 to 16.3°C in May 2019 and from 15.2 to 18.1°C in July and August 2019. Dissolved oxygen concentrations ranged from 7.9 to 13.2 mg/L in February and March 2018, from 9.9 to 13.3 mg/L in May 2019 and from 8.0 to 11.9 mg/L in July and August 2019. In 2018, pH ranged from 7.6 to 8.4, excluding two elevated results that were attributed to sampling equipment malfunction. In May 2019, pH ranged from 7.7 to 8.3 and from 7.2 to 8.4 in July and August 2019. Specific conductivity ranged from about 33,000 to 40,000 µS/cm in February and March 2018, except for the single reading taken at WT6, which had a value of 10,600 µS/cm (suggesting freshwater influence from the non-permit outfall approximately 25 m from the sample site). Specific conductivity ranged from about 31,500 to 42,000 µS/cm in May 2019 and from 31,140 to 40,600 µS/cm in July and August 2019. Turbidity levels were low, ranging from 0.6 to 2.8 NTU in February and March 2018, 0.38 to 4.05 NTU in May 2019, and 0.5 to 3.2 NTU in July and August 2019.



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Table 3-2 In Situ Water Quality Measurements at Baseline Sampling Sites at Westridge Terminal

Parameter	Date	Freshwater Sites								Marine Sites				
		WT1	WT2	WT3	WT4	WT8	WT9	WT10	WT11	WT5- surface	WT5- deep	WT6	WT7- surface	WT7- deep
Temperature (°C)	7-Feb-18	8.3	7.4	7.5	EM	-	-	-	-	7.2	-	10.5	7.1	-
	28-Feb-18	5.7	4.6	4.6	-	5.6	-	-	-	7.0	-	-	7.0	-
	13-Mar-18	-	7.7	6.5	-	9.2	LF	8.1	-	8.5	-	-	8.6	-
	22-Mar-18	-	7.7	7.4	-	8.6	6.8	7.8	-	9.0	-	-	9.0	-
	3-May-19	-	11.1	10.4	-	11.0	13.1	12.3	12.3	12.0	11.0	-	11.3	10.1
	9-May-19	-	-	10.4	-	13.1	-	13.7	16.3	13.1	12.7	-	12.8	11.1
	16-May-19	-	-	11.5	-	12.4	-	13.1	14.2	14.2	14.0	-	14.9	12.9
	29-May-19	-	14.3	11.2	-	12.7	-	12.8	13.5	15.8	13.5	-	16.3	13.1
	25-Jul-19	-	16.8	13.0	-	13.8	-	14.0	13.5	17.7	15.2	-	17.6	15.1
	1-Aug-19	-	17.9	12.3	-	14.1	-	14.9	12.3	18.1	16.4	-	-	-
	23-Aug-19	-	18.1	12.5	-	15.0	-	14.5	12.4	15.8	15.9	-	15.8	15.8
	29-Aug-19	-	18.3	15.3	-	14.9	-	-	13.3	17.1	16.9	-	17.4	16.9



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Parameter	Date	Freshwater Sites								Marine Sites				
		WT1	WT2	WT3	WT4	WT8	WT9	WT10	WT11	WT5- surface	WT5- deep	WT6	WT7- surface	WT7- deep
Dissolved Oxygen (mg/L)	7-Feb-18	12.8	13.1	13.2	EM	-	-	-	-	9.9	-	8.6	10.8	-
	28-Feb-18	11.9	11.9	11.6	-	11.5	-	-	-	8.0	-	-	7.9	-
	13-Mar-18	-	13.4	12.5	-	12.4	LF	13.0	-	12.3	-	-	12.7	-
	22-Mar-18	-	13.3	13.0	-	12.3	13.3	11.1	-	13.2	-	-	12.8	-
	3-May-19	-	9.1	10.0	-	11.3	6.5	9.3	76.8	13.3	EM	-	12.9	EM
	9-May-19	-	-	11.1	-	10.2	-	10.6	10.0	11.2	11.4	-	11.1	10.3
	16-May-19	-	-	10.6	-	10.8	-	10.5	9.4	10.2	10.6	-	10.7	10.1
	29-May-19	-	9.9	10.4	-	11.4	-	11.6	8.4	11.1	10.0	-	11.9	9.9
	25-Jul-19	-	8.7	14.7	-	6.5	-	11.1	10.3	-	-	-	11.9	9.8
	1-Aug-19	-	7.8	10.6	-	7.3	-	8.9	8.8	8.1	8.0	-	-	-
	23-Aug-19	-	8.1	9.8	-	9.3	-	7.9	10.1	8.9	8.7	-	9.0	8.2
	29-Aug-19	-	6	6.5	-	3.9	-	-	7.6	10.2	9.6	-	8.4	8.4
Specific Conductivity (µS/cm)	7-Feb-18	202.0	124.0	106.0	EM	-	-	-	-	37,000.0	-	10,600.0	33,044.0	-
	28-Feb-18	158.0	339.0	1,016.0	-	157.0	-	-	-	39,293.0	-	-	39,051.0	-
	13-Mar-18	-	4,052.0	473.0	-	234.0	LF	39.0	-	40,383.0	-	-	39,996.0	-
	22-Mar-18	-	122.0	161.0	-	196.0	91.0	24.0	-	38,228.0	-	-	37,541.0	-
	3-May-19	-	192.2	265.2	-	246.4	226.6	237.4	260.9	35,105.0	36,537.0	-	34,601.0	41,846.0
	9-May-19	-	-	249.4	-	247.7	-	247.1	260.3	37,742.0	38,551.0	-	37,810.0	41,505.0
	16-May-19	-	-	267.4	-	239.4	-	243.2	259.7	33,946.0	34,540.0	-	31,662.0	37,112.0
	29-May-19	-	210.1	268.1	-	244.3	-	235.7	263.8	35,046.0	36,159.0	-	33,224.0	37,162.0
	25-Jul-19	-	193.0	452.0	-	203.0	-	188.0	200.0	31,320.0	31,150.0	-	31,380.0	31,140.0
	1-Aug-19	-	196.0	196.0	-	204.0	-	197.0	165.0	32,050.0	31,910.0	-	-	-
	23-Aug-19	-	207.0	318.0	-	202.0	-	143.0	193.0	31,590.0	31,720.0	-	31,470.0	31,520.0
	29-Aug-19	-	162.0	195.0	-	191.0	-	-	188.0	40,600.0	38,900.0	-	40,600.0	39,700.0



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Parameter	Date	Freshwater Sites								Marine Sites				
		WT1	WT2	WT3	WT4	WT8	WT9	WT10	WT11	WT5- surface	WT5- deep	WT6	WT7- surface	WT7- deep
pH (pH units)	7-Feb-18	7.2	7.0	6.8	EM	-	-	-	-	7.7	-	7.6	7.7	-
	28-Feb-18	EM	EM	EM	-	EM	-	-	-	EM	-	-	EM	-
	13-Mar-18	-	8.1	6.7	-	6.5	LF	7.2	-	8.2	-	-	8.3	-
	22-Mar-18	-	7.2	7.0	-	7.3	6.9	7.0	-	8.3	-	-	8.4	-
	3-May-19	-	7.6	7.9	-	6.9	7.2	7.6	7.3	7.8	7.9	-	8.0	7.7
	9-May-19	-	-	7.8	-	6.9	-	7.2	7.2	7.9	7.9	-	7.9	7.8
	16-May-19	-	-	8.0	-	7.4	-	7.2	7.7	8.0	8.2	-	8.2	8.1
	29-May-19	-	7.7	8.1	-	8.2	-	8.0	7.5	8.1	8.0	-	8.3	8.0
	25-Jul-19	-	7.7	8.8	-	7.1	-	7.5	6.9	8.4	8.1	-	8.4	8.1
	1-Aug-19	-	7.5	8.01	-	6.8	-	7.8	6.7	8.2	7.9	-		-
	23-Aug-19	-	8.1	7.6	-	7.3	-	6.8	6.9	7.7	7.9	-	7.4	7.2
	29-Aug-19	-	7.9	8.3	-	6.8	-	-	7.0	8.3	7.4	-	8.3	8.2



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Parameter	Date	Freshwater Sites								Marine Sites				
		WT1	WT2	WT3	WT4	WT8	WT9	WT10	WT11	WT5- surface	WT5- deep	WT6	WT7- surface	WT7- deep
Turbidity (NTU)	7-Feb-18	33.4	4.7	5.7	5.1	-	-	-	-	1.4	-	1.7	1.3	-
	28-Feb-18	6.6	42.9	32.2	-	6.1	-	-	-	1.1	-	-	1.5	-
	13-Mar-18	-	1,385.0	0.7	-	3.7	LF	2.5	-	0.7	-	-	0.6	-
	22-Mar-18	-	24.6	11.6	-	7.6	19.5	12.2	-	2.8	-	-	1.2	-
	3-May-19	-	4.1	0.0	-	10.7	9.9	9.0	37.1	0.4	0.5	-	0.6	3.1
	9-May-19	-	-	0.2	-	2.5	-	7.6	19.0	0.5	3.5	-	4.1	1.0
	16-May-19	-	-	0.5	-	7.5	-	19.9	25.9	0.9	1.1	-	2.7	0.9
	29-May-19	-	3.4	0.1	-	5.4	-	2.5	13.7	1.4	1.2	-	1.0	1.3
	25-Jul-19	-	1.4	0.3	-	6.2	-	4.9	1.7	1.1	1.6	-	2.6	-
	1-Aug-19	-	1.2	1.9	-	13.4	-	6.3	0.6	0.5	1.6	-	-	-
	23-Aug-19	-	2.6	0.4	-	2.1	-	2.2	0.5	0.9	3.2	-	0.8	1.3
	29-Aug-19	-	8.9	0.4	-	1.9	-	-	3.5	1.4	1.6	-	1.8	2.8
NOTES: LF: low flow, measurements not taken EM: equipment malfunction, measurements not taken - not sampled (see Table 2-1 for details)														



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3.2 WATER CHEMISTRY

Full laboratory results with screening against guidelines and QA/QC results are provided in Appendix A.1. Laboratory reports are found in Appendix A.2.

3.2.1 Freshwater Sites

Key findings for the freshwater sites were as follows:

- TSS ranged from 3 to 631 mg/L and was notably elevated at WT2, WT3, WT4 and WT9 in February and March 2018, associated with elevated total metals levels. TSS values measured in May 2019 (<3–77 mg/L), July 2019 (<3–120 mg/L), and August (<3–45 mg/L) were generally lower than 2018 values.
- Total aluminum concentrations (0.132–28.900 mg/L) exceeded the CCME guideline (0.1 mg/L) at all sites in February and March 2018. All locations except WT3 and one sampling occurrence at WT8 exceeded the CCME guideline in May 2019 (0.012–1.040 mg/L). Locations WT 8 and WT10 exceeded the CCME guideline in July 2019 (0.016–1.020 mg/L). All locations except WT3, WT11 and one WT8 occurrence exceeded the CCME guideline in August 2019 (0.008–0.663 mg/L).
- Dissolved aluminum concentration exceeded the BC WQG (short term or long term; 0.1 or 0.05 mg/L) in five samples, across four sites in 2018 and exceeded the BC WQG once at WT9 in 2019 (0.0016–0.3140 mg/L).
- Total copper levels (<0.0005–0.0558 mg/L) exceeded the CCME guideline (0.002 mg/L), or the BC hardness dependent guideline at most sites in February and March 2018. Eight of nineteen sampling occurrences exceeded the CCME guideline in May 2019 (<0.00050–0.00673 mg/L). One sample occurrence, WT8 (0.00415 mg/L), exceeded CCME guidelines in July and August 2019 (<0.0005–0.00415 mg/L).
- Total iron levels (0.01–27.20 mg/L) frequently exceeded the CCME guideline (0.3 mg/L) and the BC guideline (1 mg/L) at multiple sites upstream and downstream of terminal influence in both 2018 and 2019.
- There was one exceedance of the BC WQG for dissolved iron (0.35 mg/L) at WT9 in both 2018 and 2019 (<0.010–0.556 mg/L).
- Total zinc levels (0.0035–0.351 mg/L) exceeded the BC WQG (short term or long term, 0.033 or 0.0075) in most samples in 2018. All but three sample occurrences of WT2, all samples of WT11, and one sample occurrence for each of WT 8 and WT10, exceeded BC WQG guidelines in 2019.
- There were isolated exceedances of WQGs for total cadmium, cobalt and manganese in 2018 but not in 2019. Total arsenic exceeded WQGs in two sample occurrences in 2018 and four sample occurrences in 2019.

Dissolved metal concentrations were low in both 2018 and 2019, indicating the guideline exceedances were related to particulate forms of metals (associated with elevated TSS), and reflect low metal bioavailability.



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Total ammonia, nitrate, nitrite, and total phosphorus concentrations were below CCME WQG and BC WQG in both 2018 and 2019 samples.

Hydrocarbon concentrations were below detection limits with the exception of two site visits at WT2 in 2018 and one site visit at WT8 in 2019.

3.2.2 Marine Sites

Marine samples were below CCME and BC WQG for all parameters except for total zinc in one 2019 sample collected from depth and total boron (above guidelines in all samples) for February and March 2018 and May 2019. Total boron ranged from 1.8 to 3.6 mg/L in 2018 and 2.37 to 3.31 mg/L in 2019, above the BC WQG of 1.2 mg/L. Boron concentrations generally exceed the BC WQG in BC coastal waters, as noted in technical guidance for the guideline (Moss and Nagpal 2003).

The TSS levels were lower in 2019 (<2.0–12.1 mg/L) than 2018 (<2.0–30.5 mg/L).

Total ammonia, nitrate, nitrite, and total phosphorus were below CCME WQG and BC WQG in both the 2018 and 2019 samples collected.

Hydrocarbons and volatile organic compounds were below detection limits in all samples collected in 2018 and 2019.

No notable changes were detected in the marine sample results collected in 2019 when compared to the 2018 results.

3.3 WATER QUALITY QA/QC RESULTS

Field QA/QC for water quality results was conducted by collecting field blanks, carrying travel blanks provided by the laboratory, and collecting field duplicates (Appendix A), and also by following defined field protocols for sample collection.

One parameter was above its detection limit in each field blank from 2018 and one in each of the March 22, 2019, May 3, 2019, July 25, 2019 and August 20, 2019 field blanks. Four parameters were above their detection limit in the March 13, 2018 field blank, seven in the May 29, 2019 field blank, and two in the August 23, 2019 field blank. The concentrations were marginally above the detection limits and would not affect interpretation of results. Dissolved cadmium contamination of the August 23, 2019 blank sample may have occurred; therefore, cadmium results were evaluated with caution. All parameters were below the detection limit in the travel blanks, except for total aluminum on March 22, 2018.

Relative Percent Differences (RPDs) were calculated for laboratory samples, and field samples. The lab RPDs were calculated by comparing a randomly selected sample against a blind duplicate, and the field RPDs were calculated by comparing a blind field duplicate against a parent field sample. RPD is an estimate of precision, with a value below the 20% Data Quality Objective (DQO) for lab tests, and below 1.5 times the lab DQO for field tests, considered an acceptable RPD. Relative Percent Difference is only calculated when both samples are at least five times the detection limit.



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In the lab and field RPDs, several parameters from all trips, particularly total metals, had RPDs greater than the lab or field DQOs. Sites with high TSS can result in variable TSS between the sample and field duplicate and, therefore, high total metal RPDs, as a result of natural heterogeneity in the sampled waters. Laboratory QC was conducted by ALS Environmental. All QC lots met ALS Data Quality Objectives, apart from isolated exceedances in each trip in 2018 and three exceedances in two trips in 2019, which were not expected to influence reliability of sample results. On March 13, 2018, turbidity samples for seawater exceeded the recommended hold time by one day. On August 29, 2019, TSS samples for seawater exceeded the recommended hold time by four days and nitrate and nitrite seawater samples exceeded recommended hold time by nine days. Recommended pH hold times were exceeded for all sample occurrences; however, pH was measured in the field and the field values were used for analysis. Lab duplicates met ALS Data Quality Objectives for all trips. Following review of data quality, the laboratory results are considered reliable and suitable for inclusion in analysis.

4.0 CONCLUSION

Comparing the 2018 and 2019 total and dissolved results for freshwater sampling sites, the following observations were made:

- Total aluminum exceeded the CCME WQG at all sites in February and March 2018 and at 24 of 39 sample occurrences in 2019.
- Total cadmium exceeded the CCME WQG on one sampling occurrence at site WT2 and WT4 in 2018 and no samples in 2019.
- Total cobalt exceeded the BC WQG on two sampling occurrences at site WT2 and WT4 in 2018 and no samples in 2019.
- Total copper exceeded the CCME and BC WQG at sites WT1, WT2, WT3, WT4, WT8, WT9 and WT10 on various sampling occurrences in 2018 and at sites WT2, WT8, WT9, WT10 and WT11 on various sampling occurrences in 2019.
- Total iron exceeded the BC and/or CCME WQGs at all sites except one sampling occurrence at WT2 and WT3 in 2018 and exceeded WQGs in 23 of 39 sample occurrences in 2019. Only location WT3 did not exceed total iron WQGs in 2019.
- Total lead exceeded the BC and/or CCME WQGs at sites WT2, WT4, WT8, WT9 and WT10 on various sampling occurrences in 2018. Total lead exceeded BC WQGs on one sampling occurrence for each of WT2, WT8 and WT10 in 2019.
- Total manganese exceeded the CCME WQG on one occurrence at WT4 in 2018 and no occurrences in 2019.
- Total zinc exceeded the BC and/or CCME WQGs at all sites except WT1 and WT8 in 2018 and on various sampling occurrences at sites WT2, WT8, WT10 and WT11 in 2019.
- Dissolved aluminum exceeded the BC WQG on two occurrences at site WT1 and one occurrence at sites WT8, WT9 and WT10 in 2018 and on one occurrence at site WT9 in 2019.



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- Dissolved iron exceeded the BC WQG on one occurrence at WT9 in both 2018 and 2019.
- Higher precipitation was recorded in February and March of 2018 than in May 2019, which would account for the higher levels of metals detected in the 2018 water sampling from eroded sediment in the runoff water.

Higher TSS values were recorded in February and March 2018 than in May, July and August 2019, and were associated with the elevated levels of total metals and precipitation in 2018. Total ammonia, nitrate, nitrite and total phosphorus concentrations were below CCME WQG and BC WQG in 2018 and 2019 samples. Hydrocarbon concentrations were below detection limits except at WT2 on two site visits in 2018 and one site at WT8 in 2019.

Results for marine sites did not show differences between 2018 and 2019. Boron levels above BC WQG were recorded at all sampled sites, as expected in British Columbia coastal waters (Moss and Nagpal 2003).

Reference site WT9 was heavily affected by construction activities and removed from the 2019 sampling program and WT11 was added to characterize site drainage before it enters the marine environment.



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References
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5.0 REFERENCES

British Columbia Ministry of Environment. 2013. British Columbia Field Sampling Manual. 2013 Edition. Water, Air and Climate Change Branch. Available at:
https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/bc_field_sampling_manual_complete.pdf. Accessed April 2019.

British Columbia Ministry of Environment and Climate Change Strategy (BC ENV). 2019 Approved and Working Water Quality Guidelines for Freshwater Quality.
<https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines>. Accessed April 2019.

Canadian Council of Ministers of the Environment. 2019 Water Quality Guidelines for Protection of Aquatic Life.
https://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html
Accessed April 2019.

Environment and Climate Change Canada. 2018. Environment and Natural Resources. Historical Data.
http://climate.weather.gc.ca/climate_data/daily_data_e.html?StationID=51442&timeframe=2&StartYear=1840&EndYear=2018&Day=10&Year=2017&Month=12# Accessed March 2019.

Moss, S. and N. Nagpal. 2003. Ambient Water Quality Guidelines for Boron Overview Report.
<https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/approved-wqgs/boron-or.pdf>. Accessed April 2019.

Stantec 2017. Westridge Terminal - Baseline Water Quality and Quantity Sampling Plan. Prepared for Trans Mountain Pipeline ULC.



APPENDIX A

Water Quality Data

Table A1-1: Freshwater Chemistry Results with Screening Against Guidelines - Summary Tables

	N	WT1					< BDL
		Sampling Events			2	Standard Deviation	
		Maximum	Minimum	Mean	Median		
Physical Tests (Water)							
Conductivity	2	161.000	131.000	146.000	146.000	21.213	0
Hardness (as CaCO3)	2	59.900	54.100	57.000	57.000	4.101	0
pH	2	7.810	7.450	7.630	7.630	0.255	0
Total Suspended Solids	2	58.800	22.700	40.750	40.750	25.527	0
Turbidity	2	34.100	10.300	22.200	22.200	16.829	0
Anions and Nutrients (Water)							
Ammonia, Total (as N)	1	0.005	0.005	-	-	-	1
Nitrate (as N)	1	0.686	0.686	0.686	0.686	-	0
Nitrite (as N)	1	0.001	0.001	0.001	0.001	-	0
Phosphorus (P)-Total	1	0.019	0.019	0.019	0.019	-	0
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	8.250	8.250	-	-	-	0
Total Metals (Water)							
Aluminum (Al)-Total	2	0.521	0.458	0.490	0.490	0.045	0
Antimony (Sb)-Total	2	0.000	0.000	0.000	0.000	0.000	1
Arsenic (As)-Total	2	0.002	0.001	0.002	0.002	0.001	0
Barium (Ba)-Total	2	0.011	0.010	0.011	0.011	0.001	0
Beryllium (Be)-Total	2	0.000	0.000	-	-	-	2
Bismuth (Bi)-Total	2	0.000	0.000	-	-	-	2
Boron (B)-Total	2	0.011	0.010	0.011	0.011	0.001	1
Cadmium (Cd)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Total	2	15.700	13.700	14.700	14.700	1.414	0
Cesium (Cs)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Chromium (Cr)-Total	2	0.003	0.002	0.003	0.003	0.001	0
Cobalt (Co)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Copper (Cu)-Total	2	0.003	0.002	0.002	0.002	0.000	0
Iron (Fe)-Total	2	2.010	0.865	1.438	1.438	0.810	0
Lead (Pb)-Total	2	0.001	0.001	0.001	0.001	0.000	0
Lithium (Li)-Total	2	0.001	0.001	-	-	-	2
Magnesium (Mg)-Total	2	4.640	3.700	4.170	4.170	0.665	0
Manganese (Mn)-Total	2	0.064	0.049	0.057	0.057	0.011	0
Mercury (Hg)-Total	0	0.000	0.000	-	-	-	0
Molybdenum (Mo)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Nickel (Ni)-Total	2	0.001	0.001	0.001	0.001	0.000	0
Phosphorus (P)-Total	2	0.050	0.050	-	-	-	2
Potassium (K)-Total	2	1.070	0.989	1.030	1.030	0.057	0
Rubidium (Rb)-Total	2	0.001	0.001	0.001	0.001	0.000	0
Selenium (Se)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Silicon (Si)-Total	2	8.310	8.080	8.195	8.195	0.163	0
Silver (Ag)-Total	2	0.000	0.000	0.000	0.000	0.000	1
Sodium (Na)-Total	2	7.340	7.070	7.205	7.205	0.191	0
Strontium (Sr)-Total	2	0.082	0.079	0.080	0.080	0.002	0
Sulfur (S)-Total	2	2.540	2.330	2.435	2.435	0.148	0
Tellurium (Te)-Total	2	0.000	0.000	-	-	-	2
Thallium (Tl)-Total	2	0.000	0.000	-	-	-	2
Thorium (Th)-Total	2	0.000	0.000	-	-	-	2
Tin (Sn)-Total	2	0.000	0.000	-	-	-	2
Titanium (Ti)-Total	2	0.018	0.015	0.017	0.017	0.002	0
Tungsten (W)-Total	2	0.000	0.000	-	-	-	2
Uranium (U)-Total	2	0.000	0.000	0.000	0.000	0.000	0
Vanadium (V)-Total	2	0.004	0.003	0.003	0.003	0.000	0
Zinc (Zn)-Total	2	0.007	0.006	0.006	0.006	0.001	0
Zirconium (Zr)-Total	2	0.000	0.000	0.000	0.000	0.000	1

Table A1-1: Freshwater Chemistry Results

	N	Sampling Events			WT2	10	Standard Deviation
		Maximum	Minimum	Mean	Median		
Physical Tests (Water)							
Conductivity	10	5160.00000	81.60000	707.46000	218.50000	1566.96228	
Hardness (as CaCO3)	10	89.30000	28.70000	67.57000	78.65000	21.81580	
pH	10	8.27000	7.55000	7.91600	8.00000	0.29410	
Total Suspended Solids	10	631.00000	3.20000	78.23000	10.95000	194.89746	
Turbidity	4	601.00000	2.93000	170.13250	38.30000	287.91531	
Anions and Nutrients (Water)							
Ammonia, Total (as N)	7	0.03340	0.00580	0.01421	0.01080	0.00978	
Nitrate (as N)	7	0.44800	0.01720	0.16920	0.15900	0.13944	
Nitrite (as N)	7	0.00360	0.00100	0.00164	0.00140	0.00092	
Phosphorus (P)-Total	7	1.13000	0.01800	0.26150	0.06760	0.40144	
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	1.60000	1.60000	1.60000	1.60000	-	
Total Metals (Water)							
Aluminum (Al)-Total	10	28.90000	0.04380	3.41628	0.22150	8.99312	
Antimony (Sb)-Total	10	0.00131	0.00011	0.00037	0.00024	0.00036	
Arsenic (As)-Total	10	0.00869	0.00071	0.00398	0.00414	0.00226	
Barium (Ba)-Total	10	0.31900	0.00707	0.04564	0.01245	0.09641	
Beryllium (Be)-Total	10	0.00042	0.00010	0.00013	0.00010	0.00010	
Bismuth (Bi)-Total	10	0.00014	0.00005	0.00006	0.00005	0.00003	
Boron (B)-Total	10	0.08400	0.01000	0.05070	0.07050	0.03249	
Cadmium (Cd)-Total	10	0.00043	0.00001	0.00007	0.00002	0.00013	
Calcium (Ca)-Total	10	41.20000	8.88000	21.98800	22.85000	8.73825	
Cesium (Cs)-Total	10	0.00114	0.00001	0.00015	0.00001	0.00035	
Chromium (Cr)-Total	10	0.02640	0.00013	0.00336	0.00033	0.00816	
Cobalt (Co)-Total	10	0.01130	0.00010	0.00149	0.00020	0.00347	
Copper (Cu)-Total	10	0.05580	0.00063	0.00816	0.00148	0.01696	
Iron (Fe)-Total	10	27.20000	0.16700	4.07670	1.39000	8.15888	
Lead (Pb)-Total	10	0.01870	0.00005	0.00275	0.00050	0.00573	
Lithium (Li)-Total	10	0.01890	0.00100	0.00294	0.00100	0.00562	
Magnesium (Mg)-Total	10	12.70000	1.09000	4.83600	4.90000	3.19100	
Manganese (Mn)-Total	10	0.75700	0.00579	0.12065	0.05530	0.22448	
Mercury (Hg)-Total	6	0.00001	0.00001	-	-	-	
Molybdenum (Mo)-Total	10	0.00190	0.00041	0.00105	0.00116	0.00047	
Nickel (Ni)-Total	10	0.01990	0.00050	0.00289	0.00050	0.00603	
Phosphorus (P)-Total	10	0.81000	0.05000	0.19190	0.12900	0.22299	
Potassium (K)-Total	10	5.77000	1.04000	2.75200	2.79000	1.30917	
Rubidium (Rb)-Total	10	0.01450	0.00075	0.00265	0.00131	0.00418	
Selenium (Se)-Total	10	0.00034	0.00005	0.00009	0.00006	0.00009	
Silicon (Si)-Total	10	46.80000	2.89000	10.81400	7.95000	12.80536	
Silver (Ag)-Total	10	0.00014	0.00001	0.00002	0.00001	0.00004	
Sodium (Na)-Total	10	684.00000	4.72000	86.18200	15.35000	210.79340	
Strontium (Sr)-Total	10	0.21800	0.03070	0.08440	0.07820	0.05051	
Sulfur (S)-Total	10	9.70000	0.58000	2.16300	1.37500	2.67926	
Tellurium (Te)-Total	10	0.00040	0.00020	-	-	-	
Thallium (Tl)-Total	10	0.00008	0.00001	0.00002	0.00001	0.00002	
Thorium (Th)-Total	10	0.00050	0.00010	0.00014	0.00010	0.00013	
Tin (Sn)-Total	10	0.00170	0.00010	0.00039	0.00013	0.00055	
Titanium (Ti)-Total	10	0.93400	0.00131	0.11106	0.00699	0.29056	
Tungsten (W)-Total	10	0.00028	0.00010	0.00020	0.00023	0.00008	
Uranium (U)-Total	10	0.00058	0.00002	0.00011	0.00006	0.00017	
Vanadium (V)-Total	10	0.05420	0.00087	0.00726	0.00151	0.01657	
Zinc (Zn)-Total	10	0.31500	0.02070	0.06274	0.03360	0.08946	
Zirconium (Zr)-Total	10	0.00114	0.00008	0.00026	0.00020	0.00032	

Table A1-1: Freshwater Chemistry Results

	N	WT3 Sampling Events			12	Standard Deviation
		Maximum	Minimum	Mean	Median	
Physical Tests (Water)						
Conductivity	12	1020.000	73.900	320.075	264.000	238.680
Hardness (as CaCO3)	12	109.000	17.900	82.992	103.500	35.005
pH	12	8.260	7.410	8.003	8.175	0.320
Total Suspended Solids	12	98.100	3.000	21.258	4.950	29.798
Turbidity	4	48.400	14.100	23.775	16.300	16.522
Anions and Nutrients (Water)						
Ammonia, Total (as N)	9	0.054	0.005	0.013	0.005	0.016
Nitrate (as N)	9	0.441	0.016	0.094	0.054	0.131
Nitrite (as N)	9	0.002	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	9	0.070	0.013	0.054	0.067	0.023
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	1	4.040	4.040	4.040	4.040	-
Total Metals (Water)						
Aluminum (Al)-Total	12	1.910	0.008	0.303	0.017	0.587
Antimony (Sb)-Total	12	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Total	12	0.005	0.000	0.003	0.005	0.002
Barium (Ba)-Total	12	0.095	0.005	0.018	0.006	0.026
Beryllium (Be)-Total	12	0.000	0.000	-	-	-
Bismuth (Bi)-Total	12	0.000	0.000	-	-	-
Boron (B)-Total	12	0.018	0.010	0.014	0.015	0.003
Cadmium (Cd)-Total	12	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	12	28.100	5.530	21.610	26.000	8.112
Cesium (Cs)-Total	12	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Total	12	0.002	0.000	0.000	0.000	0.001
Cobalt (Co)-Total	12	0.001	0.000	0.000	0.000	0.000
Copper (Cu)-Total	12	0.005	0.001	0.002	0.001	0.002
Iron (Fe)-Total	12	2.190	0.010	0.309	0.015	0.646
Lead (Pb)-Total	12	0.002	0.000	0.000	0.000	0.001
Lithium (Li)-Total	12	0.002	0.001	0.001	0.001	0.000
Magnesium (Mg)-Total	12	9.690	1.220	7.037	9.030	3.468
Manganese (Mn)-Total	12	0.072	0.005	0.020	0.009	0.021
Mercury (Hg)-Total	7	0.000	0.000	-	-	-
Molybdenum (Mo)-Total	12	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)-Total	12	0.002	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	12	0.099	0.050	0.076	0.080	0.018
Potassium (K)-Total	12	3.080	0.670	2.427	2.880	0.865
Rubidium (Rb)-Total	12	0.002	0.001	0.001	0.001	0.000
Selenium (Se)-Total	12	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Total	12	11.100	2.730	8.321	10.250	3.363
Silver (Ag)-Total	12	0.000	0.000	0.000	0.000	0.000
Sodium (Na)-Total	12	148.000	7.200	28.275	11.550	41.258
Strontium (Sr)-Total	12	0.131	0.031	0.088	0.095	0.028
Sulfur (S)-Total	12	4.940	0.550	3.430	4.360	1.673
Tellurium (Te)-Total	12	0.000	0.000	-	-	-
Thallium (Tl)-Total	12	0.000	0.000	-	-	-
Thorium (Th)-Total	12	0.000	0.000	-	-	-
Tin (Sn)-Total	12	0.000	0.000	0.000	0.000	0.000
Titanium (Ti)-Total	12	0.074	0.000	0.011	0.001	0.022
Tungsten (W)-Total	12	0.000	0.000	-	-	-
Uranium (U)-Total	12	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Total	12	0.005	0.001	0.001	0.001	0.001
Zinc (Zn)-Total	12	0.048	0.003	0.012	0.004	0.014
Zirconium (Zr)-Total	12	0.000	0.000	0.000	0.000	0.000

Table A1-1: Freshwater Chemistry Results

	WT4				1	Standard Deviation
	N	Maximum	Minimum	Mean		
Physical Tests (Water)						
Conductivity	1	154.000	154.000	-	-	-
Hardness (as CaCO3)	1	52.100	52.100	-	-	-
pH	1	7.270	7.270	-	-	-
Total Suspended Solids	1	80.800	80.800	-	-	-
Turbidity	1	24.100	24.100	-	-	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	1	0.011	0.011	-	-	-
Nitrate (as N)	1	2.200	2.200	-	-	-
Nitrite (as N)	1	0.001	0.001	-	-	-
Phosphorus (P)-Total	1	0.051	0.051	-	-	-
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	1	7.830	7.830	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	1	3.360	3.360	-	-	-
Antimony (Sb)-Total	1	0.000	0.000	-	-	-
Arsenic (As)-Total	1	0.005	0.005	-	-	-
Barium (Ba)-Total	1	0.166	0.166	-	-	-
Beryllium (Be)-Total	1	0.000	0.000	-	-	-
Bismuth (Bi)-Total	1	0.000	0.000	-	-	-
Boron (B)-Total	1	0.016	0.016	-	-	-
Cadmium (Cd)-Total	1	0.001	0.001	-	-	-
Calcium (Ca)-Total	1	22.700	22.700	-	-	-
Cesium (Cs)-Total	1	0.000	0.000	-	-	-
Chromium (Cr)-Total	1	0.004	0.004	-	-	-
Cobalt (Co)-Total	1	0.005	0.005	-	-	-
Copper (Cu)-Total	1	0.032	0.032	-	-	-
Iron (Fe)-Total	1	21.300	21.300	-	-	-
Lead (Pb)-Total	1	0.031	0.031	-	-	-
Lithium (Li)-Total	1	0.001	0.001	-	-	-
Magnesium (Mg)-Total	1	3.320	3.320	-	-	-
Manganese (Mn)-Total	1	2.480	2.480	-	-	-
Mercury (Hg)-Total	0	0.000	0.000	-	-	-
Molybdenum (Mo)-Total	1	0.000	0.000	-	-	-
Nickel (Ni)-Total	1	0.015	0.015	-	-	-
Phosphorus (P)-Total	1	0.419	0.419	-	-	-
Potassium (K)-Total	1	2.630	2.630	-	-	-
Rubidium (Rb)-Total	1	0.002	0.002	-	-	-
Selenium (Se)-Total	1	0.000	0.000	-	-	-
Silicon (Si)-Total	1	8.870	8.870	-	-	-
Silver (Ag)-Total	1	0.000	0.000	-	-	-
Sodium (Na)-Total	1	9.480	9.480	-	-	-
Strontium (Sr)-Total	1	0.136	0.136	-	-	-
Sulfur (S)-Total	1	2.180	2.180	-	-	-
Tellurium (Te)-Total	1	0.000	0.000	-	-	-
Thallium (Tl)-Total	1	0.000	0.000	-	-	-
Thorium (Th)-Total	1	0.000	0.000	-	-	-
Tin (Sn)-Total	1	0.000	0.000	-	-	-
Titanium (Ti)-Total	1	0.083	0.083	-	-	-
Tungsten (W)-Total	1	0.000	0.000	-	-	-
Uranium (U)-Total	1	0.000	0.000	-	-	-
Vanadium (V)-Total	1	0.009	0.009	-	-	-
Zinc (Zn)-Total	1	0.351	0.351	-	-	-
Zirconium (Zr)-Total	1	0.000	0.000	-	-	-

Table A1-1: Freshwater Chemistry Results

	N	WT8			11	Standard Deviation
		Sampling Events				
		Maximum	Minimum	Mean		
Physical Tests (Water)						
Conductivity	11	267.000	161.000	235.455	245.000	30.998
Hardness (as CaCO3)	11	107.000	56.100	83.655	78.400	16.134
pH	11	8.100	7.800	7.976	8.010	0.090
Total Suspended Solids	11	120.000	5.800	36.945	25.300	34.128
Turbidity	3	11.800	11.500	11.667	11.700	0.153
Anions and Nutrients (Water)						
Ammonia, Total (as N)	8	0.013	0.005	0.007	0.005	0.003
Nitrate (as N)	8	1.490	1.050	1.343	1.390	0.138
Nitrite (as N)	8	0.004	0.001	0.001	0.001	0.001
Phosphorus (P)-Total	8	0.127	0.002	0.032	0.023	0.039
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	-	-	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	11	1.020	0.085	0.307	0.224	0.273
Antimony (Sb)-Total	11	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Total	11	0.003	0.000	0.001	0.001	0.001
Barium (Ba)-Total	11	0.199	0.010	0.043	0.013	0.059
Beryllium (Be)-Total	11	0.000	0.000	FALSE	-	-
Bismuth (Bi)-Total	11	0.000	0.000	FALSE	-	-
Boron (B)-Total	11	0.019	0.010	0.014	0.012	0.003
Cadmium (Cd)-Total	11	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	11	27.400	15.800	22.682	21.800	3.736
Cesium (Cs)-Total	11	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Total	11	0.005	0.001	0.003	0.003	0.001
Cobalt (Co)-Total	11	0.001	0.000	0.000	0.000	0.000
Copper (Cu)-Total	11	0.004	0.001	0.001	0.001	0.001
Iron (Fe)-Total	11	1.620	0.173	0.634	0.503	0.446
Lead (Pb)-Total	11	0.002	0.000	0.001	0.001	0.001
Lithium (Li)-Total	11	0.002	0.001	0.001	0.001	0.000
Magnesium (Mg)-Total	11	8.850	4.790	6.691	6.190	1.412
Manganese (Mn)-Total	11	0.117	0.020	0.051	0.053	0.029
Mercury (Hg)-Total	7	0.000	0.000	FALSE	-	-
Molybdenum (Mo)-Total	11	0.001	0.000	0.000	0.000	0.000
Nickel (Ni)-Total	11	0.002	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	11	0.099	0.050	0.056	0.050	0.015
Potassium (K)-Total	11	1.820	0.609	1.143	1.010	0.454
Rubidium (Rb)-Total	11	0.001	0.000	0.001	0.001	0.000
Selenium (Se)-Total	11	0.001	0.000	0.000	0.000	0.000
Silicon (Si)-Total	11	12.600	8.700	11.424	11.900	1.259
Silver (Ag)-Total	11	0.000	0.000	0.000	0.000	0.000
Sodium (Na)-Total	11	17.100	7.530	13.253	13.600	3.392
Strontium (Sr)-Total	11	0.155	0.081	0.134	0.136	0.021
Sulfur (S)-Total	11	4.890	2.550	3.999	4.160	0.687
Tellurium (Te)-Total	11	0.0002000	0.0002000	FALSE	-	-
Thallium (Tl)-Total	11	0.000	0.000	FALSE	-	-
Thorium (Th)-Total	11	0.000	0.000	FALSE	-	-
Tin (Sn)-Total	11	0.001	0.000	0.000	0.000	0.000
Titanium (Ti)-Total	11	0.035	0.003	0.011	0.008	0.009
Tungsten (W)-Total	11	0.000	0.000	FALSE	-	-
Uranium (U)-Total	11	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Total	11	0.005	0.001	0.002	0.002	0.001
Zinc (Zn)-Total	11	0.009	0.003	0.004	0.004	0.002
Zirconium (Zr)-Total	11	0.001	0.000	0.000	0.000	0.000

Table A1-1: Freshwater Chemistry Results

	N	WT9				Standard Deviation
		Sampling Events			2	
		Maximum	Minimum	Mean	Median	
Physical Tests (Water)						
Conductivity	2	221.000	88.800	154.900	154.900	93.480
Hardness (as CaCO3)	2	91.500	37.400	64.450	64.450	38.254
pH	2	8.020	7.570	7.795	7.795	0.318
Total Suspended Solids	2	202.000	63.900	132.950	132.950	97.651
Turbidity	1	63.100	63.100	63.100	63.100	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	1	0.015	0.015	0.015	0.015	-
Nitrate (as N)	1	0.046	0.046	0.046	0.046	-
Nitrite (as N)	1	0.001	0.001	0.001	0.001	-
Phosphorus (P)-Total	1	0.030	0.030	0.030	0.030	-
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	-	-	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	2	3.380	0.663	2.022	2.022	1.921
Antimony (Sb)-Total	2	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Total	2	0.003	0.002	0.003	0.003	0.001
Barium (Ba)-Total	2	0.026	0.018	0.022	0.022	0.006
Beryllium (Be)-Total	2	0.000	0.000	-	-	-
Bismuth (Bi)-Total	2	0.000	0.000	-	-	-
Boron (B)-Total	2	0.010	0.010	0.010	0.010	0.000
Cadmium (Cd)-Total	2	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	2	24.000	10.300	17.150	17.150	9.687
Cesium (Cs)-Total	2	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Total	2	0.005	0.002	0.004	0.004	0.002
Cobalt (Co)-Total	2	0.002	0.001	0.002	0.002	0.000
Copper (Cu)-Total	2	0.007	0.002	0.004	0.004	0.003
Iron (Fe)-Total	2	3.910	1.160	2.535	2.535	1.945
Lead (Pb)-Total	2	0.002	0.001	0.002	0.002	0.001
Lithium (Li)-Total	2	0.002	0.002	0.002	0.002	0.000
Magnesium (Mg)-Total	2	9.520	5.220	7.370	7.370	3.041
Manganese (Mn)-Total	2	0.687	0.189	0.438	0.438	0.352
Mercury (Hg)-Total	1	0.000	0.000	0.000	0.000	-
Molybdenum (Mo)-Total	2	0.000	0.000	0.000	0.000	0.000
Nickel (Ni)-Total	2	0.005	0.003	0.004	0.004	0.002
Phosphorus (P)-Total	2	0.218	0.050	0.134	0.134	0.119
Potassium (K)-Total	2	2.420	1.420	1.920	1.920	0.707
Rubidium (Rb)-Total	2	0.002	0.002	0.002	0.002	0.000
Selenium (Se)-Total	2	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Total	2	10.600	9.380	9.990	9.990	0.863
Silver (Ag)-Total	2	0.000	0.000	0.000	0.000	0.000
Sodium (Na)-Total	2	8.960	3.790	6.375	6.375	3.656
Strontium (Sr)-Total	2	0.107	0.054	0.080	0.080	0.038
Sulfur (S)-Total	2	1.830	0.940	1.385	1.385	0.629
Tellurium (Te)-Total	2	0.000	0.000	-	-	-
Thallium (Tl)-Total	2	0.000	0.000	0.000	0.000	0.000
Thorium (Th)-Total	2	0.000	0.000	0.000	0.000	0.000
Tin (Sn)-Total	2	0.006	0.000	0.003	0.003	0.004
Titanium (Ti)-Total	2	0.098	0.028	0.063	0.063	0.050
Tungsten (W)-Total	2	0.000	0.000	-	-	-
Uranium (U)-Total	2	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Total	2	0.011	0.004	0.007	0.007	0.005
Zinc (Zn)-Total	2	0.017	0.006	0.012	0.012	0.007
Zirconium (Zr)-Total	2	0.000	0.000	0.000	0.000	0.000

Table A1-1: Freshwater Chemistry Results

	N	WT10				Standard Deviation
		Sampling Events			10	
		Maximum	Minimum	Mean	Median	
Physical Tests (Water)						
Conductivity	10	258.000	153.000	229.800	233.000	29.386
Hardness (as CaCO3)	10	105.000	58.100	86.900	88.650	12.048
pH	10	8.130	7.790	8.055	8.080	0.098
Total Suspended Solids	10	43.000	5.200	21.830	19.550	11.390
Turbidity	2	29.500	7.710	18.605	18.605	15.408
Anions and Nutrients (Water)						
Ammonia, Total (as N)	8	0.032	0.006	0.013	0.009	0.009
Nitrate (as N)	8	1.270	0.927	1.070	1.055	0.119
Nitrite (as N)	8	0.004	0.001	0.002	0.001	0.001
Phosphorus (P)-Total	8	0.086	0.023	0.049	0.052	0.021
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	0.000	0.000	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	10	1.030	0.111	0.452	0.319	0.318
Antimony (Sb)-Total	10	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Total	10	0.002	0.001	0.002	0.002	0.000
Barium (Ba)-Total	10	0.228	0.012	0.054	0.038	0.064
Beryllium (Be)-Total	10	0.000	0.000	-	-	-
Bismuth (Bi)-Total	10	0.000	0.000	-	-	-
Boron (B)-Total	10	0.018	0.010	0.015	0.015	0.002
Cadmium (Cd)-Total	10	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	10	28.800	15.000	23.390	23.200	3.548
Cesium (Cs)-Total	10	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Total	10	0.004	0.001	0.003	0.002	0.001
Cobalt (Co)-Total	10	0.001	0.000	0.000	0.000	0.000
Copper (Cu)-Total	10	0.005	0.001	0.002	0.001	0.001
Iron (Fe)-Total	10	1.750	0.153	0.788	0.588	0.488
Lead (Pb)-Total	10	0.001	0.000	0.001	0.000	0.000
Lithium (Li)-Total	10	0.002	0.001	0.002	0.002	0.000
Magnesium (Mg)-Total	10	8.660	5.040	7.298	7.495	0.952
Manganese (Mn)-Total	10	0.089	0.021	0.053	0.047	0.022
Mercury (Hg)-Total	7	0.000	0.000	0.000	0.000	0.000
Molybdenum (Mo)-Total	10	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)-Total	10	0.002	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	10	0.106	0.050	0.066	0.057	0.022
Potassium (K)-Total	10	2.330	1.350	1.782	1.835	0.362
Rubidium (Rb)-Total	10	0.001	0.001	0.001	0.001	0.000
Selenium (Se)-Total	10	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Total	10	12.500	8.690	11.339	11.500	1.097
Silver (Ag)-Total	10	0.000	0.000	0.000	0.000	0.000
Sodium (Na)-Total	10	13.400	8.360	11.586	11.650	1.468
Strontium (Sr)-Total	10	0.139	0.082	0.123	0.126	0.017
Sulfur (S)-Total	10	5.430	2.150	4.020	4.100	0.806
Tellurium (Te)-Total	10	0.000	0.000	-	-	-
Thallium (Tl)-Total	10	0.000	0.000	-	-	-
Thorium (Th)-Total	10	0.000	0.000	-	-	-
Tin (Sn)-Total	10	0.001	0.000	0.000	0.000	0.000
Titanium (Ti)-Total	10	0.036	0.004	0.016	0.012	0.011
Tungsten (W)-Total	10	0.000	0.000	-	-	-
Uranium (U)-Total	10	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Total	10	0.005	0.002	0.003	0.002	0.001
Zinc (Zn)-Total	10	0.029	0.003	0.011	0.010	0.008
Zirconium (Zr)-Total	10	0.000	0.000	0.000	0.000	0.000

Table A1-1: Freshwater Chemistry Results

	N	WT11				Standard Deviation
		Sampling Events			8	
		Maximum	Minimum	Mean	Median	
Physical Tests (Water)						
Conductivity	8	269.0000	244.0000	253.6250	253.5000	8.0700
Hardness (as CaCO3)	8	116.0000	98.5000	108.4375	107.5000	5.6025
pH	8	8.2200	7.3500	7.9925	8.1600	0.3120
Total Suspended Solids	8	77.1000	3.0000	24.6125	16.8000	26.7928
Turbidity	0	0.0000	0.0000	-	-	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	8	0.0172	0.0050	0.0112	0.0111	0.0044
Nitrate (as N)	8	0.2680	0.1750	0.2320	0.2390	0.0308
Nitrite (as N)	8	0.0038	0.0010	0.0018	0.0013	0.0010
Phosphorus (P)-Total	8	0.1610	0.0203	0.0558	0.0384	0.0442
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	0.0000	0.0000	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	8	1.1400	0.0164	0.4575	0.3291	0.4914
Antimony (Sb)-Total	8	0.0003	0.0002	0.0002	0.0002	0.0000
Arsenic (As)-Total	8	0.0031	0.0025	0.0028	0.0028	0.0002
Barium (Ba)-Total	8	0.0347	0.0162	0.0238	0.0234	0.0076
Beryllium (Be)-Total	8	0.0001	0.0001	-	-	-
Bismuth (Bi)-Total	8	0.0001	0.0001	-	-	-
Boron (B)-Total	8	0.0260	0.0200	0.0236	0.0245	0.0023
Cadmium (Cd)-Total	8	0.0000	0.0000	0.0000	0.0000	0.0000
Calcium (Ca)-Total	8	32.1000	25.8000	29.8375	30.1000	1.8875
Cesium (Cs)-Total	8	0.0001	0.0000	0.0000	0.0000	0.0000
Chromium (Cr)-Total	8	0.0010	0.0001	0.0005	0.0004	0.0004
Cobalt (Co)-Total	8	0.0006	0.0001	0.0003	0.0002	0.0002
Copper (Cu)-Total	8	0.0047	0.0006	0.0023	0.0018	0.0019
Iron (Fe)-Total	8	1.2200	0.0390	0.5059	0.3315	0.5226
Lead (Pb)-Total	8	0.0008	0.0001	0.0004	0.0003	0.0004
Lithium (Li)-Total	8	0.0010	0.0010	-	-	-
Magnesium (Mg)-Total	8	8.6300	7.5200	8.0213	7.9700	0.4099
Manganese (Mn)-Total	8	0.0575	0.0073	0.0284	0.0236	0.0223
Mercury (Hg)-Total	7	0.0000	0.0000	-	-	-
Molybdenum (Mo)-Total	8	0.0011	0.0009	0.0010	0.0010	0.0001
Nickel (Ni)-Total	8	0.0011	0.0005	0.0007	0.0006	0.0002
Phosphorus (P)-Total	8	0.0850	0.0500	0.0600	0.0550	0.0125
Potassium (K)-Total	8	3.5400	2.8700	3.2838	3.3200	0.2077
Rubidium (Rb)-Total	8	0.0020	0.0013	0.0016	0.0016	0.0002
Selenium (Se)-Total	8	0.0002	0.0002	0.0002	0.0002	0.0000
Silicon (Si)-Total	8	9.8900	8.1300	8.8238	8.7250	0.5248
Silver (Ag)-Total	8	0.0000	0.0000	0.0000	0.0000	0.0000
Sodium (Na)-Total	8	10.5000	8.7600	9.5325	9.4450	0.5666
Strontium (Sr)-Total	8	0.1130	0.0939	0.1067	0.1085	0.0060
Sulfur (S)-Total	8	5.8200	4.6200	5.2950	5.4450	0.4304
Tellurium (Te)-Total	8	0.0002	0.0002	-	-	-
Thallium (Tl)-Total	8	0.0000	0.0000	0.0000	0.0000	0.0000
Thorium (Th)-Total	8	0.0001	0.0001	-	-	-
Tin (Sn)-Total	8	0.0008	0.0001	0.0002	0.0001	0.0003
Titanium (Ti)-Total	8	0.0372	0.0006	0.0147	0.0105	0.0156
Tungsten (W)-Total	8	0.0001	0.0001	-	-	-
Uranium (U)-Total	8	0.0002	0.0001	0.0001	0.0001	0.0000
Vanadium (V)-Total	8	0.0028	0.0008	0.0017	0.0015	0.0009
Zinc (Zn)-Total	8	0.0385	0.0278	0.0337	0.0340	0.0030
Zirconium (Zr)-Total	8	0.0002	0.0001	0.0002	0.0002	0.0000

Table A1-1: Freshwater Chemistry Results with Screening Against Guidelines - Summary Tables

	N	WT1			2	Standard Deviation	< BDL
		Sampling Events					
		Maximum	Minimum	Mean	Median		
Dissolved Metals (Water)							
Dissolved Metals Filtration Location							
Aluminum (Al)-Dissolved	2	0.072	0.057	0.064	0.064	0.010	0
Antimony (Sb)-Dissolved	2	0.000	0.000	-	-	-	2
Arsenic (As)-Dissolved	2	0.001	0.001	0.001	0.001	0.000	0
Barium (Ba)-Dissolved	2	0.007	0.006	0.007	0.007	0.001	0
Beryllium (Be)-Dissolved	2	0.000	0.000	-	-	-	2
Bismuth (Bi)-Dissolved	2	0.000	0.000	-	-	-	2
Boron (B)-Dissolved	2	0.010	0.010	0.010	0.010	0.000	1
Cadmium (Cd)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Dissolved	2	16.400	14.000	15.200	15.200	1.697	0
Cesium (Cs)-Dissolved	2	0.000	0.000	-	-	-	2
Chromium (Cr)-Dissolved	2	0.001	0.001	0.001	0.001	0.000	0
Cobalt (Co)-Dissolved	2	0.000	0.000	-	-	-	2
Copper (Cu)-Dissolved	2	0.002	0.001	0.001	0.001	0.000	0
Iron (Fe)-Dissolved	2	0.134	0.106	0.120	0.120	0.020	0
Lead (Pb)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Lithium (Li)-Dissolved	2	0.001	0.001	-	-	-	2
Magnesium (Mg)-Dissolved	2	4.660	4.620	4.640	4.640	0.028	0
Manganese (Mn)-Dissolved	2	0.007	0.002	0.005	0.005	0.003	0
Mercury (Hg)-Dissolved	2	0.000	0.000	-	-	-	0
Molybdenum (Mo)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Nickel (Ni)-Dissolved	2	0.001	0.001	0.001	0.001	0.000	1
Phosphorus (P)-Dissolved	2	0.050	0.050	-	-	-	2
Potassium (K)-Dissolved	2	1.050	1.040	1.045	1.045	0.007	0
Rubidium (Rb)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Selenium (Se)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Silicon (Si)-Dissolved	2	7.430	7.400	7.415	7.415	0.021	0
Silver (Ag)-Dissolved	2	0.000	0.000	-	-	-	2
Sodium (Na)-Dissolved	2	7.940	7.260	7.600	7.600	0.481	0
Strontium (Sr)-Dissolved	2	0.077	0.070	0.073	0.073	0.005	0
Sulfur (S)-Dissolved	2	2.160	1.970	2.065	2.065	0.134	0
Tellurium (Te)-Dissolved	2	0.000	0.000	-	-	-	2
Thallium (Tl)-Dissolved	2	0.000	0.000	-	-	-	2
Thorium (Th)-Dissolved	2	0.000	0.000	-	-	-	2
Tin (Sn)-Dissolved	2	0.000	0.000	-	-	-	2
Titanium (Ti)-Dissolved	2	0.003	0.001	0.002	0.002	0.001	1
Tungsten (W)-Dissolved	2	0.000	0.000	-	-	-	2
Uranium (U)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	0
Vanadium (V)-Dissolved	2	0.001	0.001	0.001	0.001	0.000	0
Zinc (Zn)-Dissolved	2	0.002	0.002	0.002	0.002	0.000	0
Zirconium (Zr)-Dissolved	2	0.000	0.000	0.000	0.000	0.000	1
Volatile Organic Compounds (Water)							
F1 (C6-C10)	0	0.000	0.000	-	-	-	0
Hydrocarbons (Water)							
F2 (C10-C16)	0	0.000	0.000	-	-	-	0
F3 (C16-C34)	0	0.000	0.000	-	-	-	0
F4 (C34-C50)	0	0.000	0.000	-	-	-	0
2-Bromobenzotrifluoride, F2-F4	0	0.000	0.000	-	-		0
EPH10-19	2	0.250	0.250	-	-	-	2
EPH19-32	2	0.250	0.250	-	-	-	2
2-Bromobenzotrifluoride	2	89.900	82.000	85.950	85.950	5.586	0

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	Sampling Events		WT2	10	Standard Deviation
		Maximum	Minimum	Mean	Median	
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	10	0.04860	0.00160	0.01655	0.00300	0.01975
Antimony (Sb)-Dissolved	10	0.00051	0.00010	0.00025	0.00020	0.00014
Arsenic (As)-Dissolved	10	0.00216	0.00048	0.00130	0.00159	0.00062
Barium (Ba)-Dissolved	10	0.07880	0.00551	0.01624	0.00938	0.02216
Beryllium (Be)-Dissolved	10	0.00050	0.00010	-	-	-
Bismuth (Bi)-Dissolved	10	0.00025	0.00005	-	-	-
Boron (B)-Dissolved	10	0.08300	0.01000	0.05360	0.06650	0.03166
Cadmium (Cd)-Dissolved	10	0.00008	0.00001	0.00002	0.00001	0.00002
Calcium (Ca)-Dissolved	10	31.90000	9.34000	20.69400	22.70000	6.64429
Cesium (Cs)-Dissolved	10	0.00006	0.00001	0.00002	0.00001	0.00002
Chromium (Cr)-Dissolved	10	0.00053	0.00010	0.00018	0.00012	0.00014
Cobalt (Co)-Dissolved	10	0.00050	0.00010	-	-	-
Copper (Cu)-Dissolved	10	0.00540	0.00020	0.00107	0.00039	0.00158
Iron (Fe)-Dissolved	10	0.07500	0.01000	0.03180	0.02300	0.02042
Lead (Pb)-Dissolved	10	0.00025	0.00005	0.00007	0.00005	0.00006
Lithium (Li)-Dissolved	10	0.00500	0.00100	0.00146	0.00100	0.00126
Magnesium (Mg)-Dissolved	10	5.51000	1.22000	3.86900	5.12000	1.89998
Manganese (Mn)-Dissolved	10	0.05210	0.00039	0.01455	0.01182	0.01436
Mercury (Hg)-Dissolved	10	0.00001	0.00001	0.00001	0.00001	0.00000
Molybdenum (Mo)-Dissolved	10	0.00143	0.00034	0.00095	0.00112	0.00039
Nickel (Ni)-Dissolved	10	0.00250	0.00050	-	-	-
Phosphorus (P)-Dissolved	10	0.25000	0.05000	-	-	-
Potassium (K)-Dissolved	10	3.83000	1.02000	2.56400	2.84500	0.94312
Rubidium (Rb)-Dissolved	10	0.00280	0.00060	0.00124	0.00121	0.00060
Selenium (Se)-Dissolved	10	0.00025	0.00005	0.00007	0.00005	0.00006
Silicon (Si)-Dissolved	10	8.54000	1.34000	5.43000	7.10500	3.09779
Silver (Ag)-Dissolved	10	0.00005	0.00001	-	-	-
Sodium (Na)-Dissolved	10	868.00000	4.86000	105.06600	15.45000	268.69695
Strontium (Sr)-Dissolved	10	0.15700	0.02960	0.07658	0.07840	0.03424
Sulfur (S)-Dissolved	10	9.00000	0.50000	2.12700	1.43000	2.46859
Tellurium (Te)-Dissolved	10	0.00100	0.00020	-	-	-
Thallium (Tl)-Dissolved	10	0.00005	0.00001	-	-	-
Thorium (Th)-Dissolved	10	0.00050	0.00010	-	-	-
Tin (Sn)-Dissolved	10	0.00050	0.00010	0.00015	0.00010	0.00013
Titanium (Ti)-Dissolved	10	0.00150	0.00030	0.00051	0.00030	0.00040
Tungsten (W)-Dissolved	10	0.00050	0.00010	0.00019	0.00017	0.00012
Uranium (U)-Dissolved	10	0.00012	0.00001	0.00004	0.00004	0.00003
Vanadium (V)-Dissolved	10	0.00250	0.00050	0.00073	0.00050	0.00063
Zinc (Zn)-Dissolved	10	0.01940	0.00640	0.01265	0.01180	0.00416
Zirconium (Zr)-Dissolved	10	0.00030	0.00006	0.00014	0.00014	0.00009
Volatile Organic Compounds (Water)						
F1 (C6-C10)	8	0.10000	0.10000	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	8	0.33000	0.30000	-	-	-
F3 (C16-C34)	8	1.06000	0.30000	0.39875	0.30000	0.26739
F4 (C34-C50)	8	1.97000	0.30000	0.51250	0.30000	0.58901
2-Bromobenzotrifluoride, F2-F4	8	104.00000	63.70000	85.50000	87.90000	11.54432
EPH10-19	2	0.25000	0.25000	-	-	-
EPH19-32	2	0.25000	0.25000	-	-	-
2-Bromobenzotrifluoride	2	88.40000	82.40000	85.40000	85.40000	4.24264

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	WT3			12	Standard Deviation
		Sampling Events				
		Maximum	Minimum	Mean		
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	12	0.075	0.003	0.017	0.004	0.023
Antimony (Sb)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Dissolved	12	0.005	0.000	0.003	0.005	0.002
Barium (Ba)-Dissolved	12	0.077	0.005	0.015	0.006	0.022
Beryllium (Be)-Dissolved	12	0.000	0.000	-	-	-
Bismuth (Bi)-Dissolved	12	0.000	0.000	-	-	-
Boron (B)-Dissolved	12	0.017	0.010	0.014	0.015	0.003
Cadmium (Cd)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	12	28.100	5.530	21.671	25.850	8.223
Cesium (Cs)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Cobalt (Co)-Dissolved	12	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	12	0.003	0.000	0.001	0.000	0.001
Iron (Fe)-Dissolved	12	0.053	0.010	0.016	0.010	0.014
Lead (Pb)-Dissolved	12	0.001	0.000	0.000	0.000	0.000
Lithium (Li)-Dissolved	12	0.001	0.001	0.001	0.001	0.000
Magnesium (Mg)-Dissolved	12	9.760	0.987	7.054	9.450	3.646
Manganese (Mn)-Dissolved	12	0.010	0.000	0.003	0.002	0.003
Mercury (Hg)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Molybdenum (Mo)-Dissolved	12	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)-Dissolved	12	0.001	0.001	-	-	-
Phosphorus (P)-Dissolved	12	0.077	0.050	0.060	0.060	0.010
Potassium (K)-Dissolved	12	3.090	0.677	2.441	2.875	0.868
Rubidium (Rb)-Dissolved	12	0.002	0.001	0.001	0.001	0.000
Selenium (Se)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Dissolved	12	11.000	1.800	7.698	9.805	3.822
Silver (Ag)-Dissolved	12	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	12	169.000	7.590	30.333	11.100	47.089
Strontium (Sr)-Dissolved	12	0.126	0.027	0.089	0.097	0.029
Sulfur (S)-Dissolved	12	4.780	0.500	3.311	4.225	1.618
Tellurium (Te)-Dissolved	12	0.000	0.000	-	-	-
Thallium (Tl)-Dissolved	12	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	12	0.000	0.000	-	-	-
Tin (Sn)-Dissolved	12	0.000	0.000	-	-	-
Titanium (Ti)-Dissolved	12	0.001	0.000	0.000	0.000	0.000
Tungsten (W)-Dissolved	12	0.000	0.000	-	-	-
Uranium (U)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Dissolved	12	0.001	0.001	-	-	-
Zinc (Zn)-Dissolved	12	0.022	0.001	0.007	0.004	0.007
Zirconium (Zr)-Dissolved	12	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds (Water)						
F1 (C6-C10)	10	0.100	0.100	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	10	0.300	0.300	-	-	-
F3 (C16-C34)	10	0.300	0.300	-	-	-
F4 (C34-C50)	10	0.300	0.300	-	-	-
2-Bromobenzotrifluoride, F2-F4	10	95.400	74.400	84.020	84.150	6.794
EPH10-19	2	0.250	0.250	-	-	-
EPH19-32	2	0.250	0.250	-	-	-
2-Bromobenzotrifluoride	2	97.000	89.100	93.050	93.050	5.586

Table A1-1: Freshwater Chemistry Results

	WT4				1	Standard Deviation
	N	Maximum	Minimum	Mean		
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	1	0.016	0.016	-	-	-
Antimony (Sb)-Dissolved	1	0.000	0.000	-	-	-
Arsenic (As)-Dissolved	1	0.000	0.000	-	-	-
Barium (Ba)-Dissolved	1	0.029	0.029	-	-	-
Beryllium (Be)-Dissolved	1	0.000	0.000	-	-	-
Bismuth (Bi)-Dissolved	1	0.000	0.000	-	-	-
Boron (B)-Dissolved	1	0.013	0.013	-	-	-
Cadmium (Cd)-Dissolved	1	0.000	0.000	-	-	-
Calcium (Ca)-Dissolved	1	16.400	16.400	-	-	-
Cesium (Cs)-Dissolved	1	0.000	0.000	-	-	-
Chromium (Cr)-Dissolved	1	0.000	0.000	-	-	-
Cobalt (Co)-Dissolved	1	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	1	0.002	0.002	-	-	-
Iron (Fe)-Dissolved	1	0.041	0.041	-	-	-
Lead (Pb)-Dissolved	1	0.000	0.000	-	-	-
Lithium (Li)-Dissolved	1	0.001	0.001	-	-	-
Magnesium (Mg)-Dissolved	1	2.720	2.720	-	-	-
Manganese (Mn)-Dissolved	1	0.001	0.001	-	-	-
Mercury (Hg)-Dissolved	1	0.000	0.000	-	-	-
Molybdenum (Mo)-Dissolved	1	0.000	0.000	-	-	-
Nickel (Ni)-Dissolved	1	0.001	0.001	-	-	-
Phosphorus (P)-Dissolved	1	0.050	0.050	-	-	-
Potassium (K)-Dissolved	1	2.500	2.500	-	-	-
Rubidium (Rb)-Dissolved	1	0.002	0.002	-	-	-
Selenium (Se)-Dissolved	1	0.000	0.000	-	-	-
Silicon (Si)-Dissolved	1	6.160	6.160	-	-	-
Silver (Ag)-Dissolved	1	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	1	9.870	9.870	-	-	-
Strontium (Sr)-Dissolved	1	0.088	0.088	-	-	-
Sulfur (S)-Dissolved	1	2.210	2.210	-	-	-
Tellurium (Te)-Dissolved	1	0.000	0.000	-	-	-
Thallium (Tl)-Dissolved	1	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	1	0.000	0.000	-	-	-
Tin (Sn)-Dissolved	1	0.000	0.000	-	-	-
Titanium (Ti)-Dissolved	1	0.000	0.000	-	-	-
Tungsten (W)-Dissolved	1	0.000	0.000	-	-	-
Uranium (U)-Dissolved	1	0.000	0.000	-	-	-
Vanadium (V)-Dissolved	1	0.001	0.001	-	-	-
Zinc (Zn)-Dissolved	1	0.015	0.015	-	-	-
Zirconium (Zr)-Dissolved	1	0.000	0.000	-	-	-
Volatile Organic Compounds (Water)						
F1 (C6-C10)	0	-	-	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	0	0.000	0.000	-	-	-
F3 (C16-C34)	0	0.000	0.000	-	-	-
F4 (C34-C50)	0	0.000	0.000	-	-	-
2-Bromobenzotrifluoride, F2-F4	0	0.000	0.000	-	-	-
EPH10-19	1	0.250	0.250	-	-	-
EPH19-32	1	0.250	0.250	-	-	-
2-Bromobenzotrifluoride	1	85.900	85.900	-	-	-

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	WT8			11	Standard Deviation
		Sampling Events				
		Maximum	Minimum	Mean		
Dissolved Metals (Water)	11	0.000	0.000	#DIV/0!	#NUM!	#DIV/0!
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	11	0.059	0.008	0.018	0.009	0.020
Antimony (Sb)-Dissolved	11	0.000	0.000	FALSE	-	-
Arsenic (As)-Dissolved	11	0.001	0.000	0.001	0.000	0.000
Barium (Ba)-Dissolved	11	0.059	0.007	0.024	0.009	0.023
Beryllium (Be)-Dissolved	11	0.000	0.000	FALSE	-	-
Bismuth (Bi)-Dissolved	11	0.000	0.000	FALSE	-	-
Boron (B)-Dissolved	11	0.018	0.010	0.013	0.011	0.003
Cadmium (Cd)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	11	28.100	14.400	22.491	21.100	4.148
Cesium (Cs)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Dissolved	11	0.002	0.001	0.001	0.001	0.000
Cobalt (Co)-Dissolved	11	0.000	0.000	FALSE	-	-
Copper (Cu)-Dissolved	11	0.001	0.000	0.000	0.000	0.000
Iron (Fe)-Dissolved	11	0.087	0.010	0.032	0.020	0.028
Lead (Pb)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Dissolved	11	0.002	0.001	0.001	0.001	0.000
Magnesium (Mg)-Dissolved	11	8.920	4.860	6.674	6.360	1.487
Manganese (Mn)-Dissolved	11	0.041	0.000	0.009	0.003	0.013
Mercury (Hg)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Molybdenum (Mo)-Dissolved	11	0.001	0.000	0.000	0.000	0.000
Nickel (Ni)-Dissolved	11	0.001	0.001	FALSE	-	-
Phosphorus (P)-Dissolved	11	0.050	0.050	FALSE	-	-
Potassium (K)-Dissolved	11	1.830	0.668	1.153	0.991	0.469
Rubidium (Rb)-Dissolved	11	0.001	0.000	0.000	0.000	0.000
Selenium (Se)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Dissolved	11	11.900	7.740	10.693	11.100	1.239
Silver (Ag)-Dissolved	11	0.000	0.000	FALSE	-	-
Sodium (Na)-Dissolved	11	17.400	8.510	13.401	13.700	2.865
Strontium (Sr)-Dissolved	11	0.169	0.080	0.135	0.140	0.024
Sulfur (S)-Dissolved	11	4.750	2.380	3.753	3.760	0.767
Tellurium (Te)-Dissolved	11	0.000	0.000	FALSE	-	-
Thallium (Tl)-Dissolved	11	0.000	0.000	FALSE	-	-
Thorium (Th)-Dissolved	11	0.000	0.000	FALSE	-	-
Tin (Sn)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Titanium (Ti)-Dissolved	11	0.002	0.000	0.001	0.000	0.001
Tungsten (W)-Dissolved	11	0.000	0.000	FALSE	-	-
Uranium (U)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Dissolved	11	0.001	0.001	0.001	0.001	0.000
Zinc (Zn)-Dissolved	11	0.002	0.001	0.001	0.001	0.000
Zirconium (Zr)-Dissolved	11	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds (Water)						
F1 (C6-C10)	10	0.100	0.100	FALSE	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	10	0.300	0.300	FALSE	-	-
F3 (C16-C34)	10	0.480	0.300	0.318	0.300	0.057
F4 (C34-C50)	10	0.300	0.300	FALSE	-	-
2-Bromobenzotrifluoride, F2-F4	10	105.000	61.300	88.330	90.550	12.578
EPH10-19	1	0.250	0.250	FALSE	-	-
EPH19-32	1	0.250	0.250	FALSE	-	-
2-Bromobenzotrifluoride	1	92.500	92.500	92.500	92.500	-

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	WT9			2	Standard Deviation
		Sampling Events		Mean		
		Maximum	Minimum			
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	2	0.314	0.137	0.226	0.226	0.125
Antimony (Sb)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Arsenic (As)-Dissolved	2	0.003	0.001	0.002	0.002	0.001
Barium (Ba)-Dissolved	2	0.014	0.006	0.010	0.010	0.006
Beryllium (Be)-Dissolved	2	0.000	0.000	-	-	-
Bismuth (Bi)-Dissolved	2	0.000	0.000	-	-	-
Boron (B)-Dissolved	2	0.010	0.010	-	-	-
Cadmium (Cd)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	2	20.600	8.270	14.435	14.435	8.719
Cesium (Cs)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Chromium (Cr)-Dissolved	2	0.001	0.001	0.001	0.001	0.000
Cobalt (Co)-Dissolved	2	0.001	0.000	0.001	0.001	0.001
Copper (Cu)-Dissolved	2	0.002	0.001	0.002	0.002	0.001
Iron (Fe)-Dissolved	2	0.556	0.374	0.465	0.465	0.129
Lead (Pb)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Dissolved	2	0.002	0.001	0.001	0.001	0.000
Magnesium (Mg)-Dissolved	2	9.710	4.070	6.890	6.890	3.988
Manganese (Mn)-Dissolved	2	0.606	0.012	0.309	0.309	0.420
Mercury (Hg)-Dissolved	2	0.000	0.000	0.000	0.000	-
Molybdenum (Mo)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Nickel (Ni)-Dissolved	2	0.002	0.001	0.002	0.002	0.001
Phosphorus (P)-Dissolved	2	0.050	0.050	-	-	-
Potassium (K)-Dissolved	2	2.120	1.070	1.595	1.595	0.742
Rubidium (Rb)-Dissolved	2	0.001	0.001	0.001	0.001	0.000
Selenium (Se)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Dissolved	2	9.080	4.990	7.035	7.035	2.892
Silver (Ag)-Dissolved	2	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	2	8.180	3.280	5.730	5.730	3.465
Strontium (Sr)-Dissolved	2	0.107	0.038	0.073	0.073	0.049
Sulfur (S)-Dissolved	2	1.620	0.730	1.175	1.175	0.629
Tellurium (Te)-Dissolved	2	0.000	0.000	-	-	-
Thallium (Tl)-Dissolved	2	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	2	0.000	0.000	-	-	-
Tin (Sn)-Dissolved	2	0.001	0.000	0.001	0.001	0.001
Titanium (Ti)-Dissolved	2	0.020	0.008	0.014	0.014	0.009
Tungsten (W)-Dissolved	2	0.000	0.000	-	-	-
Uranium (U)-Dissolved	2	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Dissolved	2	0.002	0.002	0.002	0.002	0.000
Zinc (Zn)-Dissolved	2	0.004	0.002	0.003	0.003	0.001
Zirconium (Zr)-Dissolved	2	0.001	0.000	0.000	0.000	0.000
Volatile Organic Compounds (Water)						
F1 (C6-C10)	2	0.100	0.100	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	2	0.300	0.300	-	-	-
F3 (C16-C34)	2	0.300	0.300	-	-	-
F4 (C34-C50)	2	0.300	0.300	-	-	-
2-Bromobenzotrifluoride, F2-F4	2	95.600	88.200	91.900	91.900	5.233
EPH10-19	0	0.000	0.000	-	-	-
EPH19-32	0	0.000	0.000	-	-	-
2-Bromobenzotrifluoride	0	0.000	0.000	-	-	-

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	WT10 Sampling Events			10	Standard Deviation
		Maximum	Minimum	Mean	Median	
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	10	0.117	0.010	0.028	0.022	0.032
Antimony (Sb)-Dissolved	10	0.000	0.000	-	-	-
Arsenic (As)-Dissolved	10	0.002	0.001	0.001	0.001	0.000
Barium (Ba)-Dissolved	10	0.057	0.008	0.027	0.029	0.016
Beryllium (Be)-Dissolved	10	0.000	0.000	-	-	-
Bismuth (Bi)-Dissolved	10	0.000	0.000	-	-	-
Boron (B)-Dissolved	10	0.017	0.010	0.014	0.014	0.002
Cadmium (Cd)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	10	27.800	15.000	22.800	23.150	3.254
Cesium (Cs)-Dissolved	10	0.000	0.000	-	-	-
Chromium (Cr)-Dissolved	10	0.002	0.001	0.001	0.001	0.000
Cobalt (Co)-Dissolved	10	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	10	0.002	0.000	0.001	0.000	0.001
Iron (Fe)-Dissolved	10	0.164	0.020	0.057	0.049	0.043
Lead (Pb)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Dissolved	10	0.002	0.001	0.001	0.001	0.000
Magnesium (Mg)-Dissolved	10	8.750	5.040	7.293	7.440	1.003
Manganese (Mn)-Dissolved	10	0.016	0.009	0.013	0.012	0.003
Mercury (Hg)-Dissolved	9	0.000	0.000	0.000	0.000	0.000
Molybdenum (Mo)-Dissolved	10	0.001	0.000	0.001	0.001	0.000
Nickel (Ni)-Dissolved	10	0.001	0.001	0.001	0.001	0.000
Phosphorus (P)-Dissolved	10	0.050	0.050	-	-	-
Potassium (K)-Dissolved	10	2.200	1.240	1.744	1.840	0.350
Rubidium (Rb)-Dissolved	10	0.001	0.000	0.001	0.001	0.000
Selenium (Se)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Silicon (Si)-Dissolved	10	11.800	7.500	10.461	10.550	1.248
Silver (Ag)-Dissolved	10	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	10	13.100	8.620	11.512	11.850	1.229
Strontium (Sr)-Dissolved	10	0.133	0.081	0.120	0.126	0.016
Sulfur (S)-Dissolved	10	5.490	2.160	3.780	3.635	0.868
Tellurium (Te)-Dissolved	10	0.000	0.000	-	-	-
Thallium (Tl)-Dissolved	10	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	10	0.000	0.000	-	-	-
Tin (Sn)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Titanium (Ti)-Dissolved	10	0.004	0.000	0.001	0.000	0.001
Tungsten (W)-Dissolved	10	0.000	0.000	-	-	-
Uranium (U)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Vanadium (V)-Dissolved	10	0.002	0.001	0.001	0.001	0.000
Zinc (Zn)-Dissolved	10	0.017	0.001	0.004	0.003	0.005
Zirconium (Zr)-Dissolved	10	0.000	0.000	0.000	0.000	0.000
Volatile Organic Compounds (Water)						
F1 (C6-C10)	10	0.100	0.100	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	10	0.300	0.300	-	-	-
F3 (C16-C34)	10	0.300	0.300	-	-	-
F4 (C34-C50)	10	0.300	0.300	-	-	-
2-Bromobenzotrifluoride, F2-F4	10	102.900	78.800	90.520	89.900	7.333
EPH10-19	0	0.000	0.000	-	-	-
EPH19-32	0	0.000	0.000	-	-	-
2-Bromobenzotrifluoride	0	0.000	0.000	-	-	-

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-1: Freshwater Chemistry Results

	N	WT11 Sampling Events			8	Standard Deviation
		Maximum	Minimum	Mean	Median	
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	8	0.0176	0.0029	0.0086	0.0075	0.0062
Antimony (Sb)-Dissolved	8	0.0002	0.0001	0.0002	0.0002	0.0000
Arsenic (As)-Dissolved	8	0.0033	0.0021	0.0026	0.0026	0.0004
Barium (Ba)-Dissolved	8	0.0239	0.0169	0.0198	0.0190	0.0028
Beryllium (Be)-Dissolved	8	0.0001	0.0001	-	-	-
Bismuth (Bi)-Dissolved	8	0.0001	0.0001	-	-	-
Boron (B)-Dissolved	8	0.0260	0.0180	0.0224	0.0220	0.0031
Cadmium (Cd)-Dissolved	8	0.0000	0.0000	0.0000	0.0000	0.0000
Calcium (Ca)-Dissolved	8	33.2000	25.8000	30.0875	29.7000	2.3068
Cesium (Cs)-Dissolved	8	0.0000	0.0000	-	-	-
Chromium (Cr)-Dissolved	8	0.0001	0.0001	0.0001	0.0001	0.0000
Cobalt (Co)-Dissolved	8	0.0001	0.0001	-	-	-
Copper (Cu)-Dissolved	8	0.0012	0.0005	0.0008	0.0008	0.0003
Iron (Fe)-Dissolved	8	0.0190	0.0120	0.0160	0.0160	0.0025
Lead (Pb)-Dissolved	8	0.0001	0.0001	-	-	-
Lithium (Li)-Dissolved	8	0.0010	0.0010	-	-	-
Magnesium (Mg)-Dissolved	8	8.2500	7.6900	8.0775	8.1500	0.1885
Manganese (Mn)-Dissolved	8	0.0150	0.0055	0.0083	0.0076	0.0030
Mercury (Hg)-Dissolved	7	0.0000	0.0000	-	-	-
Molybdenum (Mo)-Dissolved	8	0.0012	0.0008	0.0010	0.0010	0.0001
Nickel (Ni)-Dissolved	8	0.0005	0.0005	-	-	-
Phosphorus (P)-Dissolved	8	0.0500	0.0500	-	-	-
Potassium (K)-Dissolved	8	3.5400	3.1300	3.3113	3.2800	0.1610
Rubidium (Rb)-Dissolved	8	0.0016	0.0014	0.0015	0.0015	0.0001
Selenium (Se)-Dissolved	8	0.0002	0.0002	0.0002	0.0002	0.0000
Silicon (Si)-Dissolved	8	8.5700	7.3400	7.9000	7.8100	0.5448
Silver (Ag)-Dissolved	8	0.0000	0.0000	-	-	-
Sodium (Na)-Dissolved	8	11.0000	8.8900	9.7325	9.5900	0.7433
Strontium (Sr)-Dissolved	8	0.1150	0.0925	0.1092	0.1105	0.0071
Sulfur (S)-Dissolved	8	5.4600	4.7500	5.0750	5.0450	0.2155
Tellurium (Te)-Dissolved	8	0.0002	0.0002	-	-	-
Thallium (Tl)-Dissolved	8	0.0000	0.0000	-	-	-
Thorium (Th)-Dissolved	8	0.0001	0.0001	-	-	-
Tin (Sn)-Dissolved	8	0.0008	0.0001	0.0002	0.0001	0.0002
Titanium (Ti)-Dissolved	8	0.0004	0.0003	0.0003	0.0003	0.0000
Tungsten (W)-Dissolved	8	0.0001	0.0001	-	-	-
Uranium (U)-Dissolved	8	0.0001	0.0001	0.0001	0.0001	0.0000
Vanadium (V)-Dissolved	8	0.0008	0.0007	0.0007	0.0007	0.0000
Zinc (Zn)-Dissolved	8	0.0371	0.0182	0.0270	0.0266	0.0089
Zirconium (Zr)-Dissolved	8	0.0002	0.0001	-	-	-
Volatile Organic Compounds (Water)						
F1 (C6-C10)	8	0.1000	0.1000	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	8	0.3000	0.3000	-	-	-
F3 (C16-C34)	8	0.3000	0.3000	-	-	-
F4 (C34-C50)	8	0.3000	0.3000	-	-	-
2-Bromobenzotrifluoride, F2-F4	8	95.1000	80.6000	90.0875	91.8000	5.3755
EPH10-19	0	0.0000	0.0000	-	-	-
EPH19-32	0	0.0000	0.0000	-	-	-
2-Bromobenzotrifluoride	0	0.0000	0.0000	-	-	-

Notes:

When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-2: Marine Water Chemistry Results with Screening Against Guidelines

	WT5				4		
	N	Maximum	Minimum	Mean	Median	Standard Deviation	< BDL
Physical Tests (Water)							
Conductivity	4	39900.000	21500.000	33225.000	34400.000	6073.302	0
Hardness (as CaCO3)	4	4410.000	2250.000	3968.750	4190.000	716.568	0
pH	4	8.040	7.730	7.911	7.915	0.113	0
Total Suspended Solids	4	30.500	2.000	6.875	3.000	9.778	1
Turbidity	4	1.050	0.650	0.870	0.890	0.170	0
Anions and Nutrients (Water)							
Ammonia, Total (as N)	1	0.012	0.005	0.009	0.011	0.003	0
Nitrate (as N)	1	0.500	0.263	0.453	0.500	0.106	0
Nitrite (as N)	1	0.100	0.010	-	-	-	1
Phosphorus (P)-Total	1	0.035	0.020	0.028	0.029	0.008	0
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	1.990	1.990	1.990	1.990	-	0
Total Metals (Water)							
Aluminum (Al)-Total	4	0.150	0.018	0.052	0.038	0.043	1
Antimony (Sb)-Total	4	0.005	0.001	-	-	-	4
Arsenic (As)-Total	4	0.005	0.001	-	-	-	4
Barium (Ba)-Total	4	0.011	0.005	0.008	0.007	0.002	0
Beryllium (Be)-Total	4	0.005	0.001	-	-	-	4
Bismuth (Bi)-Total	4	0.003	0.001	-	-	-	4
Boron (B)-Total	4	3.310	1.810	2.659	2.615	0.434	0
Cadmium (Cd)-Total	4	0.000	0.000	0.000	0.000	0.000	2
Calcium (Ca)-Total	4	284.000	161.000	256.375	265.500	40.060	0
Cesium (Cs)-Total	4	0.001	0.001	-	-	-	4
Chromium (Cr)-Total	4	0.005	0.001	-	-	-	4
Cobalt (Co)-Total	4	0.005	0.000	-	-	-	4
Copper (Cu)-Total	4	0.025	0.001	0.004	0.001	0.009	1
Gallium (Ga)-Total	4	0.005	0.001	0.001	0.001	0.002	2
Iron (Fe)-Total	4	0.500	0.020	0.093	0.035	0.165	1
Lead (Pb)-Total	4	0.003	0.000	-	-	-	4
Lithium (Li)-Total	4	0.142	0.080	0.113	0.116	0.021	0
Magnesium (Mg)-Total	4	998.000	403.000	821.000	883.500	182.491	0
Manganese (Mn)-Total	4	0.007	0.003	0.005	0.005	0.001	1
Mercury (Hg)-Total	4	0.000	0.000	0.000	0.000	0.000	0
Molybdenum (Mo)-Total	4	0.008	0.005	0.007	0.008	0.001	0
Nickel (Ni)-Total	4	0.025	0.001	0.004	0.001	0.009	3
Phosphorus (P)-Total	4	2.500	0.050	0.362	0.054	0.864	2
Potassium (K)-Total	4	315.000	142.000	265.750	277.000	56.568	0
Rhenium (Re)-Total	4	0.005	0.001	0.001	0.001	0.002	1
Rubidium (Rb)-Total	4	0.087	0.057	0.077	0.078	0.010	0
Selenium (Se)-Total	4	0.003	0.001	-	-	-	4
Silicon (Si)-Total	4	5.000	1.000	1.613	1.000	1.405	3
Silver (Ag)-Total	4	0.001	0.000	-	-	-	4
Sodium (Na)-Total	4	7850.000	3690.000	6553.750	6840.000	1228.657	0
Strontium (Sr)-Total	4	5.150	2.230	4.479	4.645	0.948	0
Sulfur (S)-Total	4	755.000	306.000	623.750	656.500	142.674	0
Tellurium (Te)-Total	4	0.010	0.001	-	-	-	4
Thallium (Tl)-Total	4	0.001	0.000	-	-	-	4
Thorium (Th)-Total	4	0.005	0.001	-	-	-	4
Tin (Sn)-Total	4	0.005	0.001	-	-	-	4
Titanium (Ti)-Total	4	0.015	0.005	-	-	-	4
Tungsten (W)-Total	4	0.005	0.001	-	-	-	4
Uranium (U)-Total	4	0.002	0.001	0.002	0.002	0.000	0
Vanadium (V)-Total	4	0.025	0.001	0.004	0.001	0.008	1
Yttrium (Y)-Total	4	0.001	0.001	0.001	0.001	0.000	0
Zinc (Zn)-Total	4	0.150	0.003	0.022	0.003	0.052	2
Zirconium (Zr)-Total	4	0.003	0.001	-	-	-	4

Table A1-2: Marine Water Chemistry I

		WT6 Sampling Events				1
	N	Maximum	Minimum	Mean	Median	Standard Deviation
Physical Tests (Water)						
Conductivity	1	21600.000	21600.000	-	-	-
Hardness (as CaCO3)	1	2160.000	2160.000	-	-	-
pH	1	7.760	7.760	-	-	-
Total Suspended Solids	1	2.000	2.000	-	-	-
Turbidity	1	0.680	0.680	-	-	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	1	0.010	0.010	-	-	-
Nitrate (as N)	1	0.266	0.266	-	-	-
Nitrite (as N)	1	0.010	0.010	-	-	-
Phosphorus (P)-Total	1	0.037	0.037	-	-	-
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	1	1.610	1.610	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	1	0.077	0.077	-	-	-
Antimony (Sb)-Total	1	0.001	0.001	-	-	-
Arsenic (As)-Total	1	0.002	0.002	-	-	-
Barium (Ba)-Total	1	0.007	0.007	-	-	-
Beryllium (Be)-Total	1	0.001	0.001	-	-	-
Bismuth (Bi)-Total	1	0.001	0.001	-	-	-
Boron (B)-Total	1	1.860	1.860	-	-	-
Cadmium (Cd)-Total	1	0.000	0.000	-	-	-
Calcium (Ca)-Total	1	152.000	152.000	-	-	-
Cesium (Cs)-Total	1	0.001	0.001	-	-	-
Chromium (Cr)-Total	1	0.001	0.001	-	-	-
Cobalt (Co)-Total	1	0.000	0.000	-	-	-
Copper (Cu)-Total	1	0.001	0.001	-	-	-
Gallium (Ga)-Total	1	0.005	0.005	-	-	-
Iron (Fe)-Total	1	0.040	0.040	-	-	-
Lead (Pb)-Total	1	0.000	0.000	-	-	-
Lithium (Li)-Total	1	0.087	0.087	-	-	-
Magnesium (Mg)-Total	1	452.000	452.000	-	-	-
Manganese (Mn)-Total	1	0.006	0.006	-	-	-
Mercury (Hg)-Total	1	0.000	0.000	-	-	-
Molybdenum (Mo)-Total	1	0.005	0.005	-	-	-
Nickel (Ni)-Total	1	0.001	0.001	-	-	-
Phosphorus (P)-Total	1	0.051	0.051	-	-	-
Potassium (K)-Total	1	135.000	135.000	-	-	-
Rhenium (Re)-Total	1	0.005	0.005	-	-	-
Rubidium (Rb)-Total	1	0.058	0.058	-	-	-
Selenium (Se)-Total	1	0.002	0.002	-	-	-
Silicon (Si)-Total	1	2.200	2.200	-	-	-
Silver (Ag)-Total	1	0.000	0.000	-	-	-
Sodium (Na)-Total	1	3620.000	3620.000	-	-	-
Strontium (Sr)-Total	1	2.120	2.120	-	-	-
Sulfur (S)-Total	1	347.000	347.000	-	-	-
Tellurium (Te)-Total	1	0.001	0.001	-	-	-
Thallium (Tl)-Total	1	0.000	0.000	-	-	-
Thorium (Th)-Total	1	0.001	0.001	-	-	-
Tin (Sn)-Total	1	0.001	0.001	-	-	-
Titanium (Ti)-Total	1	0.005	0.005	-	-	-
Tungsten (W)-Total	1	0.001	0.001	-	-	-
Uranium (U)-Total	1	0.001	0.001	-	-	-
Vanadium (V)-Total	1	0.001	0.001	-	-	-
Yttrium (Y)-Total	1	0.000	0.000	-	-	-
Zinc (Zn)-Total	1	0.003	0.003	-	-	-
Zirconium (Zr)-Total	1	0.001	0.001	-	-	-

Table A1-2: Marine Water Chemistry I

	WT7				4		
	N	Maximum	Minimum	Mean	Median	Standard Deviation	< BDL
Physical Tests (Water)							
Conductivity	4	40200.000	21900.000	32475.000	33250.000	6036.969	0
Hardness (as CaCO3)	4	4460.000	2150.000	3922.500	4115.000	738.855	0
pH	4	8.090	7.780	7.946	7.980	0.117	0
Total Suspended Solids	4	25.100	2.000	7.363	4.250	7.903	1
Turbidity	4	1.950	0.440	1.153	1.110	0.618	0
Anions and Nutrients (Water)							
Ammonia, Total (as N)	1	0.013	0.007	0.010	0.011	0.002	0
Nitrate (as N)	1	0.500	0.265	0.453	0.500	0.105	0
Nitrite (as N)	1	0.100	0.010	-	-	-	1
Phosphorus (P)-Total	1	0.039	0.020	0.029	0.030	0.008	0
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	1.730	1.730	-	-	-	0
Total Metals (Water)							
Aluminum (Al)-Total	4	0.162	0.017	0.068	0.063	0.048	1
Antimony (Sb)-Total	4	0.002	0.001	-	-	-	4
Arsenic (As)-Total	4	0.002	0.001	-	-	-	4
Barium (Ba)-Total	4	0.010	0.007	0.008	0.008	0.001	0
Beryllium (Be)-Total	4	0.002	0.001	-	-	-	4
Bismuth (Bi)-Total	4	0.001	0.001	-	-	-	4
Boron (B)-Total	4	3.610	1.900	2.780	2.730	0.529	0
Cadmium (Cd)-Total	4	0.000	0.000	0.000	0.000	0.000	2
Calcium (Ca)-Total	4	296.000	156.000	259.000	272.500	46.232	0
Cesium (Cs)-Total	4	0.001	0.000	0.000	0.001	0.000	3
Chromium (Cr)-Total	4	0.002	0.001	-	-	-	4
Cobalt (Co)-Total	4	0.002	0.000	-	-	-	4
Copper (Cu)-Total	4	0.010	0.001	0.002	0.001	0.003	1
Gallium (Ga)-Total	4	0.005	0.001	0.002	0.001	0.002	2
Iron (Fe)-Total	4	0.200	0.014	0.081	0.057	0.073	1
Lead (Pb)-Total	4	0.001	0.000	-	-	-	4
Lithium (Li)-Total	4	0.150	0.083	0.119	0.120	0.019	0
Magnesium (Mg)-Total	4	911.000	457.000	809.750	854.500	146.136	0
Manganese (Mn)-Total	4	0.007	0.003	0.005	0.006	0.001	0
Mercury (Hg)-Total	4	0.000	0.000	0.000	0.000	0.000	0
Molybdenum (Mo)-Total	4	0.009	0.004	0.007	0.008	0.001	0
Nickel (Ni)-Total	4	0.010	0.001	0.002	0.001	0.003	3
Phosphorus (P)-Total	4	1.000	0.050	0.176	0.055	0.333	2
Potassium (K)-Total	4	310.000	138.000	264.500	287.000	57.191	0
Rhenium (Re)-Total	4	0.005	0.001	0.001	0.001	0.002	1
Rubidium (Rb)-Total	4	0.091	0.052	0.076	0.078	0.011	0
Selenium (Se)-Total	4	0.002	0.001	-	-	-	4
Silicon (Si)-Total	4	2.000	1.000	1.250	1.000	0.463	3
Silver (Ag)-Total	4	0.000	0.000	-	-	-	4
Sodium (Na)-Total	4	7980.000	3660.000	6573.750	6780.000	1282.842	0
Strontium (Sr)-Total	4	5.780	2.450	4.510	4.605	0.978	0
Sulfur (S)-Total	4	709.000	359.000	620.250	658.500	116.548	0
Tellurium (Te)-Total	4	0.004	0.001	-	-	-	4
Thallium (Tl)-Total	4	0.000	0.000	-	-	-	4
Thorium (Th)-Total	4	0.002	0.001	-	-	-	4
Tin (Sn)-Total	4	0.002	0.001	-	-	-	4
Titanium (Ti)-Total	4	0.010	0.005	-	-	-	4
Tungsten (W)-Total	4	0.002	0.001	-	-	-	4
Uranium (U)-Total	4	0.003	0.001	0.002	0.002	0.000	0
Vanadium (V)-Total	4	0.010	0.001	0.002	0.001	0.003	1
Yttrium (Y)-Total	4	0.001	0.001	0.001	0.001	0.000	0
Zinc (Zn)-Total	4	0.060	0.003	0.011	0.004	0.020	2
Zirconium (Zr)-Total	4	0.001	0.001	-	-	-	4

Table A1-2: Marine Water Chemistry I

	WT7-Surface Sampling Events				7	Standard Deviation	< BDL
	N	Maximum	Minimum	Mean			
Physical Tests (Water)							
Conductivity	7	38900.000	36100.000	37300.000	36900.000	1442.221	0
Hardness (as CaCO3)	6	4410.000	4410.000	-	-	-	0
pH	7	8.030	7.910	7.967	7.960	0.060	0
Total Suspended Solids	7	2.600	2.100	2.333	2.300	0.252	0
Turbidity	1	0.000	0.000	-	-	-	0
Anions and Nutrients (Water)							
Ammonia, Total (as N)	7	0.014	0.005	0.008	0.005	0.005	1
Nitrate (as N)	7	0.500	0.500	0.500	0.500	0.000	6
Nitrite (as N)	7	0.100	0.100	0.100	0.100	0.000	6
Phosphorus (P)-Total	7	0.952	0.036	0.355	0.078	0.517	0
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	0.000	0.000	-	-	-	0
Total Metals (Water)							
Aluminum (Al)-Total	7	0.031	0.005	0.015	0.008	0.014	0
Antimony (Sb)-Total	7	0.001	0.001	0.001	0.001	0.000	5
Arsenic (As)-Total	7	0.002	0.001	0.001	0.001	0.000	0
Barium (Ba)-Total	7	0.011	0.007	0.009	0.009	0.002	0
Beryllium (Be)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Bismuth (Bi)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Boron (B)-Total	7	3.190	2.950	3.040	2.980	0.131	0
Cadmium (Cd)-Total	7	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Total	7	331.000	301.000	312.000	304.000	16.523	0
Cesium (Cs)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Chromium (Cr)-Total	7	0.001	0.001	0.001	0.001	0.000	5
Cobalt (Co)-Total	7	0.000	0.000	0.000	0.000	0.000	2
Copper (Cu)-Total	7	0.001	0.001	0.001	0.001	0.000	0
Gallium (Ga)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Iron (Fe)-Total	7	0.035	0.010	0.020	0.014	0.013	0
Lead (Pb)-Total	7	0.000	0.000	0.000	0.000	0.000	1
Lithium (Li)-Total	7	0.128	0.115	0.123	0.126	0.007	0
Magnesium (Mg)-Total	7	937.000	750.000	862.667	901.000	99.219	0
Manganese (Mn)-Total	7	0.005	0.001	0.003	0.003	0.002	0
Mercury (Hg)-Total	6	0.000	0.000	0.000	0.000	0.000	5
Molybdenum (Mo)-Total	7	0.009	0.008	0.008	0.008	0.000	0
Nickel (Ni)-Total	7	0.001	0.001	0.001	0.001	0.000	4
Phosphorus (P)-Total	7	1.050	0.050	0.406	0.117	0.559	2
Potassium (K)-Total	7	302.000	265.000	285.000	288.000	18.682	0
Rhenium (Re)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Rubidium (Rb)-Total	7	0.088	0.081	0.084	0.082	0.004	0
Selenium (Se)-Total	7	0.001	0.001	0.001	0.001	0.000	5
Silicon (Si)-Total	7	1.000	1.000	1.000	1.000	0.000	6
Silver (Ag)-Total	7	0.000	0.000	0.000	0.000	0.000	6
Sodium (Na)-Total	7	8210.000	7130.000	7733.333	7860.000	551.029	0
Strontium (Sr)-Total	7	6.200	5.520	5.757	5.550	0.384	0
Sulfur (S)-Total	7	828.000	545.000	682.667	675.000	141.656	0
Tellurium (Te)-Total	7	0.001	0.001	0.001	0.001	0.000	5
Thallium (Tl)-Total	7	0.000	0.000	0.000	0.000	0.000	6
Thorium (Th)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Tin (Sn)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Titanium (Ti)-Total	7	0.005	0.005	0.005	0.005	0.000	5
Tungsten (W)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Uranium (U)-Total	7	0.002	0.002	0.002	0.002	0.000	0
Vanadium (V)-Total	7	0.002	0.001	0.002	0.001	0.000	1
Yttrium (Y)-Total	7	0.001	0.001	0.001	0.001	0.000	6
Zinc (Zn)-Total	7	0.003	0.003	0.003	0.003	0.000	5
Zirconium (Zr)-Total	7	0.001	0.001	0.001	0.001	0.000	6

Table A1-2: Marine Water Chemistry I

	WT5-Surface				8	Standard Deviation	< BDL
	N	Maximum	Minimum	Mean			
Physical Tests (Water)							
Conductivity	8	38600.000	34800.000	36650.000	36600.000	1571.623	0
Hardness (as CaCO3)	7	4930.000	4420.000	4670.000	4660.000	255.147	0
pH	8	8.030	7.860	7.955	7.965	0.073	0
Total Suspended Solids	8	2.200	2.000	2.075	2.050	0.096	3
Turbidity	1	0.000	0.000	-	-	-	0
Anions and Nutrients (Water)							
Ammonia, Total (as N)	8	0.012	0.005	0.009	0.009	0.003	1
Nitrate (as N)	8	0.500	0.500	-	-	-	8
Nitrite (as N)	8	0.100	0.100	-	-	-	8
Phosphorus (P)-Total	8	0.040	0.025	0.033	0.034	0.006	0
Organic / Inorganic Carbon (Water)							
Total Organic Carbon	1	0.000	0.000	-	-	-	0
Total Metals (Water)							
Aluminum (Al)-Total	8	0.020	0.005	0.013	0.014	0.007	1
Antimony (Sb)-Total	8	0.001	0.001	-	-	-	8
Arsenic (As)-Total	8	0.001	0.001	0.001	0.001	0.000	0
Barium (Ba)-Total	8	0.010	0.007	0.008	0.008	0.001	0
Beryllium (Be)-Total	8	0.001	0.001	-	-	-	8
Bismuth (Bi)-Total	8	0.001	0.001	-	-	-	8
Boron (B)-Total	8	3.030	2.510	2.850	2.930	0.241	0
Cadmium (Cd)-Total	8	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Total	8	315.000	289.000	298.250	294.500	11.644	0
Cesium (Cs)-Total	8	0.001	0.001	-	-	-	8
Chromium (Cr)-Total	8	0.001	0.001	-	-	-	8
Cobalt (Co)-Total	8	0.000	0.000	0.000	0.000	0.000	7
Copper (Cu)-Total	8	0.001	0.001	0.001	0.001	0.000	0
Gallium (Ga)-Total	8	0.001	0.001	-	-	-	8
Iron (Fe)-Total	8	0.025	0.010	0.018	0.018	0.007	1
Lead (Pb)-Total	8	0.000	0.000	0.000	0.000	0.000	2
Lithium (Li)-Total	8	0.124	0.115	0.120	0.121	0.004	0
Magnesium (Mg)-Total	8	906.000	754.000	833.000	836.000	72.618	0
Manganese (Mn)-Total	7	0.005	0.002	0.003	0.003	0.001	0
Mercury (Hg)-Total	7	0.000	0.000	-	-	-	7
Molybdenum (Mo)-Total	8	0.008	0.008	0.008	0.008	0.000	0
Nickel (Ni)-Total	8	0.001	0.001	-	-	-	8
Phosphorus (P)-Total	8	0.053	0.050	0.051	0.050	0.002	5
Potassium (K)-Total	8	297.000	261.000	273.000	267.000	16.971	0
Rhenium (Re)-Total	8	0.001	0.001	-	-	-	8
Rubidium (Rb)-Total	8	0.086	0.076	0.080	0.080	0.004	0
Selenium (Se)-Total	8	0.001	0.001	-	-	-	8
Silicon (Si)-Total	8	1.000	1.000	-	-	-	8
Silver (Ag)-Total	8	0.000	0.000	-	-	-	8
Sodium (Na)-Total	8	8220.000	7010.000	7657.500	7700.000	496.681	0
Strontium (Sr)-Total	8	5.900	5.200	5.513	5.475	0.342	0
Sulfur (S)-Total	8	734.000	557.000	669.750	694.000	77.706	0
Tellurium (Te)-Total	8	0.001	0.001	0.001	0.001	0.000	7
Thallium (Tl)-Total	8	0.000	0.000	-	-	-	8
Thorium (Th)-Total	8	0.001	0.001	-	-	-	8
Tin (Sn)-Total	8	0.001	0.001	-	-	-	8
Titanium (Ti)-Total	8	0.005	0.005	-	-	-	8
Tungsten (W)-Total	8	0.001	0.001	-	-	-	8
Uranium (U)-Total	8	0.002	0.002	0.002	0.002	0.000	0
Vanadium (V)-Total	8	0.002	0.001	0.002	0.002	0.000	1
Yttrium (Y)-Total	8	0.001	0.001	-	-	-	8
Zinc (Zn)-Total	8	0.003	0.003	-	-	-	8
Zirconium (Zr)-Total	8	0.001	0.001	-	-	-	8

Table A1-2: Marine Water Chemistry I

	WT7-Deep				7	
	N	Maximum	Minimum	Mean	Median	Standard Deviation
Physical Tests (Water)						
Conductivity	7	40300.000	33200.000	36585.714	36900.000	2664.225
Hardness (as CaCO3)	6	5350.000	4380.000	4862.000	4760.000	381.536
pH	7	8.000	7.890	7.941	7.950	0.047
Total Suspended Solids	7	4.200	2.600	3.243	2.900	0.616
Turbidity	0	0.000	0.000	-	-	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	7	0.027	0.005	0.016	0.018	0.007
Nitrate (as N)	7	0.500	0.500	-	-	-
Nitrite (as N)	7	0.100	0.100	-	-	-
Phosphorus (P)-Total	7	0.069	0.033	0.050	0.050	0.013
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	0.000	0.000	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	7	0.068	0.012	0.044	0.051	0.021
Antimony (Sb)-Total	7	0.001	0.001	-	-	-
Arsenic (As)-Total	7	0.002	0.001	0.001	0.001	0.000
Barium (Ba)-Total	7	0.011	0.008	0.010	0.010	0.001
Beryllium (Be)-Total	7	0.001	0.001	-	-	-
Bismuth (Bi)-Total	7	0.001	0.001	-	-	-
Boron (B)-Total	7	3.310	2.720	2.953	2.900	0.189
Cadmium (Cd)-Total	7	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	7	349.000	293.000	312.429	310.000	19.372
Cesium (Cs)-Total	7	0.001	0.001	-	-	-
Chromium (Cr)-Total	7	0.001	0.001	-	-	-
Cobalt (Co)-Total	7	0.000	0.000	0.000	0.000	0.000
Copper (Cu)-Total	7	0.001	0.001	0.001	0.001	0.000
Gallium (Ga)-Total	7	0.001	0.001	-	-	-
Iron (Fe)-Total	7	0.079	0.020	0.052	0.060	0.023
Lead (Pb)-Total	7	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Total	7	0.141	0.111	0.128	0.129	0.010
Magnesium (Mg)-Total	7	1130.000	737.000	971.000	982.000	127.481
Manganese (Mn)-Total	7	0.006	0.003	0.005	0.005	0.001
Mercury (Hg)-Total	6	0.000	0.000	-	-	-
Molybdenum (Mo)-Total	7	0.009	0.008	0.008	0.008	0.000
Nickel (Ni)-Total	7	0.001	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	7	0.087	0.050	0.074	0.075	0.013
Potassium (K)-Total	7	419.000	258.000	331.857	325.000	50.841
Rhenium (Re)-Total	7	0.001	0.001	-	-	-
Rubidium (Rb)-Total	7	0.104	0.081	0.089	0.087	0.008
Selenium (Se)-Total	7	0.001	0.001	0.001	0.001	0.000
Silicon (Si)-Total	7	1.400	1.000	1.100	1.000	0.173
Silver (Ag)-Total	7	0.000	0.000	-	-	-
Sodium (Na)-Total	7	8420.000	7250.000	8032.857	8250.000	472.289
Strontium (Sr)-Total	7	6.290	5.260	5.641	5.540	0.334
Sulfur (S)-Total	7	1030.000	597.000	773.571	771.000	137.683
Tellurium (Te)-Total	7	0.002	0.001	0.001	0.001	0.000
Thallium (Tl)-Total	7	0.000	0.000	-	-	-
Thorium (Th)-Total	7	0.001	0.001	-	-	-
Tin (Sn)-Total	7	0.001	0.001	-	-	-
Titanium (Ti)-Total	7	0.005	0.005	-	-	-
Tungsten (W)-Total	7	0.001	0.001	-	-	-
Uranium (U)-Total	7	0.002	0.002	0.002	0.002	0.000
Vanadium (V)-Total	7	0.003	0.001	0.002	0.002	0.000
Yttrium (Y)-Total	7	0.001	0.001	-	-	-
Zinc (Zn)-Total	7	0.003	0.003	-	-	-
Zirconium (Zr)-Total	7	0.001	0.001	-	-	-

Table A1-2: Marine Water Chemistry I

	WT5-Deep					8
	Sampling Events					
	N	Maximum	Minimum	Mean	Median	Standard Deviation
Physical Tests (Water)						
Conductivity	8	38600.000	28900.000	35175.000	36250.000	3304.002
Hardness (as CaCO3)	7	4950.000	4350.000	4645.000	4650.000	216.679
pH	8	8.030	7.880	7.964	7.965	0.054
Total Suspended Solids	8	5.600	2.200	3.050	2.600	1.174
Turbidity	0	0.000	0.000	-	-	-
Anions and Nutrients (Water)						
Ammonia, Total (as N)	8	0.013	0.005	0.009	0.009	0.003
Nitrate (as N)	8	0.500	0.500	-	-	-
Nitrite (as N)	8	0.100	0.100	-	-	-
Phosphorus (P)-Total	8	0.052	0.022	0.035	0.035	0.011
Organic / Inorganic Carbon (Water)						
Total Organic Carbon	0	0.000	0.000	-	-	-
Total Metals (Water)						
Aluminum (Al)-Total	8	0.063	0.009	0.031	0.027	0.017
Antimony (Sb)-Total	8	0.001	0.001	-	-	-
Arsenic (As)-Total	8	0.002	0.001	0.001	0.001	0.000
Barium (Ba)-Total	8	0.010	0.005	0.008	0.008	0.002
Beryllium (Be)-Total	8	0.001	0.001	-	-	-
Bismuth (Bi)-Total	8	0.001	0.001	-	-	-
Boron (B)-Total	8	3.200	2.510	2.786	2.665	0.271
Cadmium (Cd)-Total	8	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Total	8	337.000	270.000	296.375	292.500	21.646
Cesium (Cs)-Total	8	0.001	0.001	-	-	-
Chromium (Cr)-Total	8	0.001	0.001	-	-	-
Cobalt (Co)-Total	8	0.000	0.000	0.000	0.000	0.000
Copper (Cu)-Total	8	0.001	0.001	0.001	0.001	0.000
Gallium (Ga)-Total	8	0.001	0.001	-	-	-
Iron (Fe)-Total	8	0.094	0.013	0.035	0.028	0.026
Lead (Pb)-Total	8	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Total	8	0.131	0.092	0.121	0.125	0.013
Magnesium (Mg)-Total	8	1040.000	757.000	908.375	931.000	86.932
Manganese (Mn)-Total	8	0.005	0.003	0.004	0.004	0.001
Mercury (Hg)-Total	7	0.000	0.000	-	-	-
Molybdenum (Mo)-Total	8	0.009	0.007	0.008	0.008	0.001
Nickel (Ni)-Total	8	0.001	0.001	0.001	0.001	0.000
Phosphorus (P)-Total	8	0.081	0.050	0.057	0.050	0.013
Potassium (K)-Total	8	335.000	265.000	302.250	304.500	26.305
Rhenium (Re)-Total	8	0.001	0.001	-	-	-
Rubidium (Rb)-Total	8	0.092	0.077	0.083	0.083	0.005
Selenium (Se)-Total	8	0.001	0.001	-	-	-
Silicon (Si)-Total	8	1.100	1.000	1.013	1.000	0.035
Silver (Ag)-Total	8	0.000	0.000	-	-	-
Sodium (Na)-Total	8	8330.000	6910.000	7578.750	7600.000	471.485
Strontium (Sr)-Total	8	6.080	4.660	5.379	5.505	0.452
Sulfur (S)-Total	8	783.000	608.000	741.625	764.500	60.703
Tellurium (Te)-Total	8	0.001	0.001	-	-	-
Thallium (Tl)-Total	8	0.000	0.000	-	-	-
Thorium (Th)-Total	8	0.001	0.001	-	-	-
Tin (Sn)-Total	8	0.001	0.001	-	-	-
Titanium (Ti)-Total	8	0.005	0.005	-	-	-
Tungsten (W)-Total	8	0.001	0.001	-	-	-
Uranium (U)-Total	8	0.002	0.002	0.002	0.002	0.000
Vanadium (V)-Total	8	0.002	0.001	0.002	0.002	0.000
Yttrium (Y)-Total	8	0.001	0.001	-	-	-
Zinc (Zn)-Total	8	0.010	0.003	0.004	0.003	0.003
Zirconium (Zr)-Total	8	0.001	0.001	-	-	-

Table A1-2: Marine Water Chemistry Results with Screening Against Guidelines

	WT5				4		
	Sampling Events						
	N	Maximum	Minimum	Mean	Median	Standard Deviation	< BDL
Dissolved Metals (Water)							
Dissolved Metals Filtration Location							
Aluminum (Al)-Dissolved	4	0.044	0.005	0.017	0.008	0.017	2
Antimony (Sb)-Dissolved	4	0.002	0.001	-	-	-	4
Arsenic (As)-Dissolved	4	0.002	0.001	-	-	-	4
Barium (Ba)-Dissolved	4	0.010	0.004	0.007	0.006	0.002	0
Beryllium (Be)-Dissolved	4	0.002	0.001	-	-	-	4
Bismuth (Bi)-Dissolved	4	0.001	0.001	-	-	-	4
Boron (B)-Dissolved	4	3.580	1.890	2.741	2.530	0.611	0
Cadmium (Cd)-Dissolved	4	0.000	0.000	0.000	0.000	0.000	2
Calcium (Ca)-Dissolved	4	311.000	157.000	263.375	274.000	46.028	0
Cesium (Cs)-Dissolved	4	0.001	0.000	-	-	-	4
Chromium (Cr)-Dissolved	4	0.002	0.001	-	-	-	4
Cobalt (Co)-Dissolved	4	0.002	0.000	-	-	-	4
Copper (Cu)-Dissolved	4	0.004	0.001	0.001	0.001	0.001	1
Gallium (Ga)-Dissolved	4	0.001	0.001	0.001	0.001	0.000	3
Iron (Fe)-Dissolved	4	0.200	0.010	-	-	-	4
Lead (Pb)-Dissolved	4	0.001	0.000	-	-	-	4
Lithium (Li)-Dissolved	4	0.149	0.085	0.117	0.119	0.021	0
Magnesium (Mg)-Dissolved	4	913.000	450.000	804.000	846.000	150.643	0
Manganese (Mn)-Dissolved	4	0.005	0.002	0.004	0.004	0.001	0
Mercury (Hg)-Dissolved	4	0.000	0.000	0.000	0.000	0.000	0
Molybdenum (Mo)-Dissolved	4	0.008	0.005	0.007	0.008	0.001	0
Nickel (Ni)-Dissolved	4	0.010	0.001	0.002	0.001	0.003	3
Phosphorus (P)-Dissolved	4	1.000	0.050	-	-	-	4
Potassium (K)-Dissolved	4	324.000	137.000	268.875	284.000	59.328	0
Rhenium (Re)-Dissolved	4	0.005	0.001	0.001	0.001	0.002	1
Rubidium (Rb)-Dissolved	4	0.088	0.055	0.078	0.080	0.010	0
Selenium (Se)-Dissolved	4	0.004	0.001	0.001	0.001	0.001	3
Silicon (Si)-Dissolved	4	2.100	1.000	1.263	1.000	0.487	2
Silver (Ag)-Dissolved	4	0.000	0.000	-	-	-	4
Sodium (Na)-Dissolved	4	7590.000	3700.000	6672.500	6925.000	1253.073	0
Strontium (Sr)-Dissolved	4	5.440	2.140	4.533	4.765	1.009	0
Sulfur (S)-Dissolved	4	737.000	346.000	635.625	689.500	131.003	0
Tellurium (Te)-Dissolved	4	0.004	0.001	-	-	-	4
Thallium (Tl)-Dissolved	4	0.000	0.000	-	-	-	4
Thorium (Th)-Dissolved	4	0.002	0.001	-	-	-	4
Tin (Sn)-Dissolved	4	0.002	0.001	-	-	-	4
Titanium (Ti)-Dissolved	4	0.006	0.005	-	-	-	4
Tungsten (W)-Dissolved	4	0.002	0.001	-	-	-	4
Uranium (U)-Dissolved	4	0.003	0.001	0.002	0.002	0.000	0
Vanadium (V)-Dissolved	4	0.010	0.001	0.002	0.001	0.003	1
Yttrium (Y)-Dissolved	4	0.005	0.001	0.001	0.001	0.002	2
Zinc (Zn)-Dissolved	4	0.020	0.001	0.005	0.002	0.006	3
Zirconium (Zr)-Dissolved	4	0.001	0.001	-	-	-	4
Volatile Organic Compounds (Water)							
F1 (C6-C10)	2	0.100	0.100	-	-	-	2
Hydrocarbons (Water)							
F2 (C10-C16)	2	0.300	0.300	-	-	-	2
F3 (C16-C34)	2	0.300	0.300	-	-	-	2
F4 (C34-C50)	2	0.300	0.300	-	-	-	2
2-Bromobenzotrifluoride, F2-F4	2	119.700	71.300	88.367	85.050	17.953	0
EPH10-19	3	0.250	0.125	0.188	0.188	-	2
EPH19-32	3	0.250	0.125	0.188	0.188	-	2
2-Bromobenzotrifluoride	3	87.900	0.000	43.950	43.950	62.155	0

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Table A1-2: Marine Water Chemistry I

	WT6 Sampling Events					1
	N	Maximum	Minimum	Mean	Median	Standard Deviation
Dissolved Metals (Water)						
Dissolved Metals Filtration Location						
Aluminum (Al)-Dissolved	1	0.040	0.040	-	-	-
Antimony (Sb)-Dissolved	1	0.001	0.001	-	-	-
Arsenic (As)-Dissolved	1	0.002	0.002	-	-	-
Barium (Ba)-Dissolved	1	0.007	0.007	-	-	-
Beryllium (Be)-Dissolved	1	0.001	0.001	-	-	-
Bismuth (Bi)-Dissolved	1	0.001	0.001	-	-	-
Boron (B)-Dissolved	1	1.850	1.850	-	-	-
Cadmium (Cd)-Dissolved	1	0.000	0.000	-	-	-
Calcium (Ca)-Dissolved	1	152.000	152.000	-	-	-
Cesium (Cs)-Dissolved	1	0.001	0.001	-	-	-
Chromium (Cr)-Dissolved	1	0.001	0.001	-	-	-
Cobalt (Co)-Dissolved	1	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	1	0.001	0.001	-	-	-
Gallium (Ga)-Dissolved	1	0.001	0.001	-	-	-
Iron (Fe)-Dissolved	1	0.010	0.010	-	-	-
Lead (Pb)-Dissolved	1	0.000	0.000	-	-	-
Lithium (Li)-Dissolved	1	0.086	0.086	-	-	-
Magnesium (Mg)-Dissolved	1	432.000	432.000	-	-	-
Manganese (Mn)-Dissolved	1	0.004	0.004	-	-	-
Mercury (Hg)-Dissolved	1	0.000	0.000	-	-	-
Molybdenum (Mo)-Dissolved	1	0.005	0.005	-	-	-
Nickel (Ni)-Dissolved	1	0.001	0.001	-	-	-
Phosphorus (P)-Dissolved	1	0.050	0.050	-	-	-
Potassium (K)-Dissolved	1	129.000	129.000	-	-	-
Rhenium (Re)-Dissolved	1	0.000	0.000	-	-	-
Rubidium (Rb)-Dissolved	1	0.057	0.057	-	-	-
Selenium (Se)-Dissolved	1	0.002	0.002	-	-	-
Silicon (Si)-Dissolved	1	2.000	2.000	-	-	-
Silver (Ag)-Dissolved	1	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	1	3490.000	3490.000	-	-	-
Strontium (Sr)-Dissolved	1	2.190	2.190	-	-	-
Sulfur (S)-Dissolved	1	332.000	332.000	-	-	-
Tellurium (Te)-Dissolved	1	0.001	0.001	-	-	-
Thallium (Tl)-Dissolved	1	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	1	0.001	0.001	-	-	-
Tin (Sn)-Dissolved	1	0.001	0.001	-	-	-
Titanium (Ti)-Dissolved	1	0.005	0.005	-	-	-
Tungsten (W)-Dissolved	1	0.001	0.001	-	-	-
Uranium (U)-Dissolved	1	0.001	0.001	-	-	-
Vanadium (V)-Dissolved	1	0.001	0.001	-	-	-
Yttrium (Y)-Dissolved	1	0.001	0.001	-	-	-
Zinc (Zn)-Dissolved	1	0.003	0.003	-	-	-
Zirconium (Zr)-Dissolved	1	0.001	0.001	-	-	-
Volatile Organic Compounds (Water)						
F1 (C6-C10)	0	-	-	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	0	0.000	0.000	-	-	-
F3 (C16-C34)	0	0.000	0.000	-	-	-
F4 (C34-C50)	0	0.000	0.000	-	-	-
2-Bromobenzotrifluoride, F2-F4	0	0.000	0.000	-	-	-
EPH10-19	1	0.250	0.250	-	-	-
EPH19-32	1	0.250	0.250	-	-	-
2-Bromobenzotrifluoride	1	85.700	85.700	-	-	-

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Table A1-2: Marine Water Chemistry I

	WT7						
	Sampling Events			4			
	N	Maximum	Minimum	Mean	Median	Standard Deviation	< BDL
Dissolved Metals (Water)							
Dissolved Metals Filtration Location							
Aluminum (Al)-Dissolved	4	0.041	0.005	0.014	0.010	0.012	2
Antimony (Sb)-Dissolved	4	0.002	0.001	-	-	-	4
Arsenic (As)-Dissolved	4	0.002	0.001	-	-	-	4
Barium (Ba)-Dissolved	4	0.010	0.003	0.007	0.007	0.002	0
Beryllium (Be)-Dissolved	4	0.002	0.001	-	-	-	4
Bismuth (Bi)-Dissolved	4	0.001	0.001	-	-	-	4
Boron (B)-Dissolved	4	3.350	1.970	2.696	2.610	0.528	0
Cadmium (Cd)-Dissolved	4	0.000	0.000	0.000	0.000	0.000	2
Calcium (Ca)-Dissolved	4	303.000	147.000	259.250	266.000	49.704	0
Cesium (Cs)-Dissolved	4	0.001	0.000	0.000	0.001	0.000	3
Chromium (Cr)-Dissolved	4	0.002	0.001	-	-	-	4
Cobalt (Co)-Dissolved	4	0.002	0.000	-	-	-	4
Copper (Cu)-Dissolved	4	0.004	0.001	0.001	0.001	0.001	1
Gallium (Ga)-Dissolved	4	0.001	0.001	0.001	0.001	0.000	3
Iron (Fe)-Dissolved	4	0.200	0.010	-	-	-	4
Lead (Pb)-Dissolved	4	0.001	0.000	-	-	-	4
Lithium (Li)-Dissolved	4	0.138	0.086	0.114	0.114	0.017	0
Magnesium (Mg)-Dissolved	4	904.000	433.000	795.125	843.500	152.097	0
Manganese (Mn)-Dissolved	4	0.005	0.002	0.003	0.003	0.001	0
Mercury (Hg)-Dissolved	4	0.000	0.000	0.000	0.000	0.000	0
Molybdenum (Mo)-Dissolved	4	0.008	0.005	0.007	0.007	0.001	0
Nickel (Ni)-Dissolved	4	0.010	0.001	0.002	0.001	0.003	3
Phosphorus (P)-Dissolved	4	1.000	0.050	-	-	-	4
Potassium (K)-Dissolved	4	301.000	134.000	260.125	277.000	56.022	0
Rhenium (Re)-Dissolved	4	0.005	0.001	0.001	0.001	0.002	1
Rubidium (Rb)-Dissolved	4	0.084	0.057	0.075	0.076	0.008	0
Selenium (Se)-Dissolved	4	0.003	0.001	0.001	0.001	0.001	3
Silicon (Si)-Dissolved	4	1.800	1.000	1.200	1.000	0.370	2
Silver (Ag)-Dissolved	4	0.000	0.000	-	-	-	4
Sodium (Na)-Dissolved	4	7610.000	3630.000	6498.750	6775.000	1229.221	0
Strontium (Sr)-Dissolved	4	5.210	2.320	4.475	4.830	0.921	0
Sulfur (S)-Dissolved	4	736.000	330.000	619.000	660.500	133.631	0
Tellurium (Te)-Dissolved	4	0.004	0.001	-	-	-	4
Thallium (Tl)-Dissolved	4	0.000	0.000	-	-	-	4
Thorium (Th)-Dissolved	4	0.002	0.001	-	-	-	4
Tin (Sn)-Dissolved	4	0.002	0.001	-	-	-	4
Titanium (Ti)-Dissolved	4	0.006	0.005	-	-	-	4
Tungsten (W)-Dissolved	4	0.002	0.001	-	-	-	4
Uranium (U)-Dissolved	4	0.003	0.001	0.002	0.002	0.000	0
Vanadium (V)-Dissolved	4	0.010	0.001	0.002	0.001	0.003	1
Yttrium (Y)-Dissolved	4	0.005	0.001	0.001	0.001	0.002	2
Zinc (Zn)-Dissolved	4	0.020	0.001	0.005	0.003	0.006	3
Zirconium (Zr)-Dissolved	4	0.001	0.001	-	-	-	4
Volatile Organic Compounds (Water)							
F1 (C6-C10)	2	0.100	0.100	-	-	-	2
Hydrocarbons (Water)							
F2 (C10-C16)	2	0.300	0.300	-	-	-	2
F3 (C16-C34)	2	0.300	0.300	-	-	-	2
F4 (C34-C50)	2	0.300	0.300	-	-	-	2
2-Bromobenzotrifluoride, F2-F4	2	97.000	76.600	86.000	85.600	7.833	0
EPH10-19	3	0.250	0.250	-	-	-	2
EPH19-32	3	0.250	0.250	-	-	-	2
2-Bromobenzotrifluoride	3	92.000	86.600	89.300	89.300	3.818	0

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Table A1-2: Marine Water Chemistry I

	WT7-Surface Sampling Events				7	Standard Deviation	< BDL
	N	Maximum	Minimum	Mean			
Dissolved Metals (Water)							
Dissolved Metals Filtration Location							
Aluminum (Al)-Dissolved	7	0.010	0.005	0.007	0.005	0.003	2
Antimony (Sb)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Arsenic (As)-Dissolved	7	0.002	0.001	0.001	0.001	0.000	0
Barium (Ba)-Dissolved	7	0.010	0.008	0.009	0.009	0.001	0
Beryllium (Be)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Bismuth (Bi)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Boron (B)-Dissolved	7	3.030	2.710	2.907	2.980	0.172	0
Cadmium (Cd)-Dissolved	7	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Dissolved	7	337.000	315.000	323.667	319.000	11.719	0
Cesium (Cs)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Chromium (Cr)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Cobalt (Co)-Dissolved	7	0.000	0.000	0.000	0.000	0.000	6
Copper (Cu)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	0
Gallium (Ga)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Iron (Fe)-Dissolved	7	0.012	0.010	0.011	0.010	0.001	5
Lead (Pb)-Dissolved	7	0.000	0.000	0.000	0.000	0.000	5
Lithium (Li)-Dissolved	7	0.133	0.118	0.123	0.119	0.008	0
Magnesium (Mg)-Dissolved	7	1020.000	853.000	917.000	878.000	90.072	0
Manganese (Mn)-Dissolved	7	0.004	0.002	0.003	0.004	0.001	0
Mercury (Hg)-Dissolved	6	0.000	0.000	0.000	0.000	0.000	5
Molybdenum (Mo)-Dissolved	7	0.008	0.008	0.008	0.008	0.000	0
Nickel (Ni)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	5
Phosphorus (P)-Dissolved	7	1.160	0.050	0.423	0.058	0.639	4
Potassium (K)-Dissolved	7	321.000	295.000	308.667	310.000	13.051	0
Rhenium (Re)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Rubidium (Rb)-Dissolved	7	0.091	0.080	0.084	0.080	0.006	0
Selenium (Se)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Silicon (Si)-Dissolved	7	1.000	1.000	1.000	1.000	0.000	6
Silver (Ag)-Dissolved	7	0.000	0.000	0.000	0.000	0.000	6
Sodium (Na)-Dissolved	7	8850.000	7120.000	8066.667	8230.000	876.489	0
Strontium (Sr)-Dissolved	7	6.160	5.470	5.747	5.610	0.365	0
Sulfur (S)-Dissolved	7	866.000	541.000	729.667	782.000	168.702	0
Tellurium (Te)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Thallium (Tl)-Dissolved	7	0.000	0.000	0.000	0.000	0.000	6
Thorium (Th)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Tin (Sn)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Titanium (Ti)-Dissolved	7	0.005	0.005	0.005	0.005	0.000	6
Tungsten (W)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Uranium (U)-Dissolved	7	0.002	0.002	0.002	0.002	0.000	0
Vanadium (V)-Dissolved	7	0.002	0.001	0.001	0.001	0.000	0
Yttrium (Y)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Zinc (Zn)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	2
Zirconium (Zr)-Dissolved	7	0.001	0.001	0.001	0.001	0.000	6
Volatile Organic Compounds (Water)							
F1 (C6-C10)	7	0.100	0.100	0.100	0.100	0.000	6
Hydrocarbons (Water)							
F2 (C10-C16)	7	0.300	0.300	0.300	0.300	0.000	6
F3 (C16-C34)	7	0.300	0.300	0.300	0.300	0.000	6
F4 (C34-C50)	7	0.300	0.300	0.300	0.300	0.000	6
2-Bromobenzotrifluoride, F2-F4	7	100.900	85.700	91.633	88.300	8.130	0
EPH10-19	7	0.000	0.000	-	-	-	0
EPH19-32	7	0.000	0.000	-	-	-	0
2-Bromobenzotrifluoride	7	0.000	0.000	-	-	-	0

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Table A1-2: Marine Water Chemistry I

	WT5-Surface					Standard Deviation	< BDL
	Sampling Events			8			
	N	Maximum	Minimum	Mean	Median		
Dissolved Metals (Water)							
Dissolved Metals Filtration Location							
Aluminum (Al)-Dissolved	8	0.005	0.005	0.005	0.005	0.000	4
Antimony (Sb)-Dissolved	8	0.001	0.001	-	-	-	8
Arsenic (As)-Dissolved	8	0.001	0.001	0.001	0.001	0.000	0
Barium (Ba)-Dissolved	8	0.009	0.006	0.008	0.009	0.001	0
Beryllium (Be)-Dissolved	8	0.001	0.001	-	-	-	8
Bismuth (Bi)-Dissolved	8	0.001	0.001	-	-	-	8
Boron (B)-Dissolved	8	2.860	2.630	2.758	2.770	0.120	0
Cadmium (Cd)-Dissolved	8	0.000	0.000	0.000	0.000	0.000	0
Calcium (Ca)-Dissolved	8	322.000	303.000	314.500	316.500	8.888	0
Cesium (Cs)-Dissolved	8	0.001	0.001	-	-	-	8
Chromium (Cr)-Dissolved	8	0.001	0.001	-	-	-	8
Cobalt (Co)-Dissolved	8	0.000	0.000	-	-	-	8
Copper (Cu)-Dissolved	8	0.001	0.000	0.001	0.001	0.000	0
Gallium (Ga)-Dissolved	8	0.001	0.001	-	-	-	8
Iron (Fe)-Dissolved	8	0.010	0.010	-	-	-	8
Lead (Pb)-Dissolved	8	0.000	0.000	-	-	-	8
Lithium (Li)-Dissolved	8	0.133	0.112	0.120	0.117	0.010	0
Magnesium (Mg)-Dissolved	8	1000.000	836.000	914.000	910.000	72.019	0
Manganese (Mn)-Dissolved	8	0.003	0.001	0.002	0.002	0.001	0
Mercury (Hg)-Dissolved	7	0.000	0.000	-	-	-	7
Molybdenum (Mo)-Dissolved	8	0.008	0.008	0.008	0.008	0.000	0
Nickel (Ni)-Dissolved	8	0.001	0.001	-	-	-	8
Phosphorus (P)-Dissolved	8	0.053	0.050	0.051	0.050	0.002	7
Potassium (K)-Dissolved	8	311.000	285.000	293.250	288.500	12.121	0
Rhenium (Re)-Dissolved	8	0.001	0.001	-	-	-	8
Rubidium (Rb)-Dissolved	8	0.089	0.076	0.082	0.082	0.006	0
Selenium (Se)-Dissolved	8	0.001	0.001	-	-	-	8
Silicon (Si)-Dissolved	8	1.000	1.000	-	-	-	8
Silver (Ag)-Dissolved	8	0.000	0.000	-	-	-	8
Sodium (Na)-Dissolved	8	8990.000	6910.000	7780.000	7610.000	984.209	0
Strontium (Sr)-Dissolved	8	5.840	5.260	5.468	5.385	0.256	0
Sulfur (S)-Dissolved	8	848.000	552.000	719.750	739.500	125.008	0
Tellurium (Te)-Dissolved	8	0.001	0.001	-	-	-	8
Thallium (Tl)-Dissolved	8	0.000	0.000	-	-	-	8
Thorium (Th)-Dissolved	8	0.001	0.001	-	-	-	8
Tin (Sn)-Dissolved	8	0.001	0.001	-	-	-	8
Titanium (Ti)-Dissolved	8	0.005	0.005	-	-	-	8
Tungsten (W)-Dissolved	8	0.001	0.001	-	-	-	8
Uranium (U)-Dissolved	8	0.002	0.002	0.002	0.002	0.000	0
Vanadium (V)-Dissolved	8	0.002	0.001	0.001	0.001	0.000	0
Yttrium (Y)-Dissolved	8	0.001	0.001	-	-	-	8
Zinc (Zn)-Dissolved	8	0.001	0.001	0.001	0.001	0.000	3
Zirconium (Zr)-Dissolved	8	0.001	0.001	-	-	-	8
Volatile Organic Compounds (Water)							
F1 (C6-C10)	8	0.100	0.100	-	-	-	8
Hydrocarbons (Water)							
F2 (C10-C16)	8	0.300	0.300	-	-	-	8
F3 (C16-C34)	8	0.300	0.300	-	-	-	8
F4 (C34-C50)	8	0.300	0.300	-	-	-	8
2-Bromobenzotrifluoride, F2-F4	8	93.600	83.000	89.175	90.050	4.599	0
EPH10-19	8	0.000	0.000	-	-	-	0
EPH19-32	8	0.000	0.000	-	-	-	0
2-Bromobenzotrifluoride	8	0.000	0.000	-	-	-	0

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Table A1-2: Marine Water Chemistry I

	WT7-Deep					7
	Sampling Events					
	N	Maximum	Minimum	Mean	Median	
Dissolved Metals (Water)						
Dissolved Metals Filtration Location	7	0.000	0.000	-	-	-
Aluminum (Al)-Dissolved	7	0.006	0.005	0.005	0.005	0.000
Antimony (Sb)-Dissolved	7	0.001	0.001	-	-	-
Arsenic (As)-Dissolved	7	0.001	0.001	0.001	0.001	0.000
Barium (Ba)-Dissolved	7	0.009	0.007	0.008	0.008	0.001
Beryllium (Be)-Dissolved	7	0.001	0.001	-	-	-
Bismuth (Bi)-Dissolved	7	0.001	0.001	-	-	-
Boron (B)-Dissolved	7	3.140	2.710	2.879	2.770	0.195
Cadmium (Cd)-Dissolved	7	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	7	355.000	291.000	322.714	318.000	22.209
Cesium (Cs)-Dissolved	7	0.001	0.001	-	-	-
Chromium (Cr)-Dissolved	7	0.001	0.001	-	-	-
Cobalt (Co)-Dissolved	7	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	7	0.001	0.000	0.001	0.001	0.000
Gallium (Ga)-Dissolved	7	0.001	0.001	-	-	-
Iron (Fe)-Dissolved	7	0.010	0.010	0.010	0.010	0.000
Lead (Pb)-Dissolved	7	0.000	0.000	-	-	-
Lithium (Li)-Dissolved	7	0.143	0.107	0.127	0.126	0.013
Magnesium (Mg)-Dissolved	7	1110.000	861.000	973.429	954.000	86.698
Manganese (Mn)-Dissolved	7	0.004	0.002	0.003	0.003	0.001
Mercury (Hg)-Dissolved	6	0.000	0.000	-	-	-
Molybdenum (Mo)-Dissolved	7	0.009	0.008	0.008	0.008	0.000
Nickel (Ni)-Dissolved	7	0.001	0.001	-	-	-
Phosphorus (P)-Dissolved	7	0.073	0.050	0.058	0.057	0.009
Potassium (K)-Dissolved	7	410.000	316.000	339.286	327.000	34.155
Rhenium (Re)-Dissolved	7	0.001	0.001	-	-	-
Rubidium (Rb)-Dissolved	7	0.100	0.081	0.088	0.085	0.007
Selenium (Se)-Dissolved	7	0.001	0.001	-	-	-
Silicon (Si)-Dissolved	7	1.200	1.000	1.043	1.000	0.079
Silver (Ag)-Dissolved	7	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	7	8670.000	7550.000	8070.000	8070.000	413.239
Strontium (Sr)-Dissolved	7	6.620	5.440	5.826	5.780	0.454
Sulfur (S)-Dissolved	7	1010.000	615.000	820.714	810.000	125.360
Tellurium (Te)-Dissolved	7	0.001	0.001	-	-	-
Thallium (Tl)-Dissolved	7	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	7	0.001	0.001	-	-	-
Tin (Sn)-Dissolved	7	0.001	0.001	-	-	-
Titanium (Ti)-Dissolved	7	0.005	0.005	-	-	-
Tungsten (W)-Dissolved	7	0.001	0.001	-	-	-
Uranium (U)-Dissolved	7	0.002	0.002	0.002	0.002	0.000
Vanadium (V)-Dissolved	7	0.002	0.001	0.002	0.002	0.000
Yttrium (Y)-Dissolved	7	0.001	0.001	-	-	-
Zinc (Zn)-Dissolved	7	0.002	0.001	0.001	0.001	0.001
Zirconium (Zr)-Dissolved	7	0.001	0.001	-	-	-
Volatile Organic Compounds (Water)						
F1 (C6-C10)	7	0.100	0.100	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	7	0.300	0.300	-	-	-
F3 (C16-C34)	7	0.300	0.300	-	-	-
F4 (C34-C50)	7	0.300	0.300	-	-	-
2-Bromobenzotrifluoride, F2-F4	7	101.800	80.500	90.114	89.400	6.381
EPH10-19	7	0.000	0.000	-	-	-
EPH19-32	7	0.000	0.000	-	-	-
2-Bromobenzotrifluoride	7	0.000	0.000	-	-	-

Notes:
When there is fewer than 2 samples which were above the detection limit a dash "-" is indicated and statistics (other than max and min) are not calculated

Table A1-2: Marine Water Chemistry I

	N	WT5-Deep Sampling Events			8	Standard Deviation
		Maximum	Minimum	Mean	Median	
Dissolved Metals (Water)						
Dissolved Metals Filtration Location	8	0.000	0.000	-	-	-
Aluminum (Al)-Dissolved	8	0.011	0.005	0.007	0.005	0.003
Antimony (Sb)-Dissolved	8	0.001	0.001	-	-	-
Arsenic (As)-Dissolved	8	0.002	0.001	0.001	0.001	0.000
Barium (Ba)-Dissolved	8	0.010	0.002	0.007	0.007	0.002
Beryllium (Be)-Dissolved	8	0.001	0.001	-	-	-
Bismuth (Bi)-Dissolved	8	0.001	0.001	-	-	-
Boron (B)-Dissolved	8	3.180	2.380	2.715	2.675	0.274
Cadmium (Cd)-Dissolved	8	0.000	0.000	0.000	0.000	0.000
Calcium (Ca)-Dissolved	8	344.000	270.000	302.875	295.500	27.383
Cesium (Cs)-Dissolved	8	0.001	0.001	-	-	-
Chromium (Cr)-Dissolved	8	0.001	0.001	-	-	-
Cobalt (Co)-Dissolved	8	0.000	0.000	-	-	-
Copper (Cu)-Dissolved	8	0.001	0.000	0.001	0.001	0.000
Gallium (Ga)-Dissolved	8	0.001	0.001	-	-	-
Iron (Fe)-Dissolved	8	0.010	0.010	-	-	-
Lead (Pb)-Dissolved	8	0.000	0.000	0.000	0.000	0.000
Lithium (Li)-Dissolved	8	0.136	0.094	0.121	0.124	0.014
Magnesium (Mg)-Dissolved	8	1000.000	811.000	931.750	952.500	60.194
Manganese (Mn)-Dissolved	8	0.004	0.002	0.003	0.003	0.001
Mercury (Hg)-Dissolved	7	0.000	0.000	-	-	-
Molybdenum (Mo)-Dissolved	8	0.009	0.007	0.008	0.008	0.000
Nickel (Ni)-Dissolved	8	0.001	0.001	-	-	-
Phosphorus (P)-Dissolved	8	0.050	0.050	-	-	-
Potassium (K)-Dissolved	8	350.000	292.000	311.500	309.000	17.238
Rhenium (Re)-Dissolved	8	0.001	0.001	-	-	-
Rubidium (Rb)-Dissolved	8	0.091	0.074	0.083	0.085	0.006
Selenium (Se)-Dissolved	8	0.001	0.001	-	-	-
Silicon (Si)-Dissolved	8	50.000	1.000	-	-	-
Silver (Ag)-Dissolved	8	0.000	0.000	-	-	-
Sodium (Na)-Dissolved	8	8630.000	7090.000	7602.500	7400.000	581.544
Strontium (Sr)-Dissolved	8	5.940	4.880	5.408	5.385	0.409
Sulfur (S)-Dissolved	8	819.000	593.000	724.500	718.000	73.731
Tellurium (Te)-Dissolved	8	0.001	0.001	-	-	-
Thallium (Tl)-Dissolved	8	0.000	0.000	-	-	-
Thorium (Th)-Dissolved	8	0.001	0.001	-	-	-
Tin (Sn)-Dissolved	8	0.001	0.001	-	-	-
Titanium (Ti)-Dissolved	8	0.005	0.005	-	-	-
Tungsten (W)-Dissolved	8	0.001	0.001	-	-	-
Uranium (U)-Dissolved	8	0.002	0.002	0.002	0.002	0.000
Vanadium (V)-Dissolved	8	0.002	0.001	0.001	0.001	0.000
Yttrium (Y)-Dissolved	8	0.001	0.001	-	-	-
Zinc (Zn)-Dissolved	8	0.010	0.001	0.002	0.001	0.003
Zirconium (Zr)-Dissolved	8	0.001	0.001	-	-	-
Volatile Organic Compounds (Water)						
F1 (C6-C10)	8	0.100	0.100	-	-	-
Hydrocarbons (Water)						
F2 (C10-C16)	8	0.300	0.300	-	-	-
F3 (C16-C34)	8	0.300	0.300	-	-	-
F4 (C34-C50)	8	0.300	0.300	-	-	-
2-Bromobenzotrifluoride, F2-F4	8	98.300	79.800	87.838	87.000	5.443
EPH10-19	8	0.000	0.000	-	-	-
EPH19-32	8	0.000	0.000	-	-	-
2-Bromobenzotrifluoride	8	0.000	0.000	-	-	-

Notes:
When there is fewer than 2 samples
which were above the detection limit a
dash "-" is indicated and statistics
(other than max and min) are not
calculated

Job Reference
Report To
Date Received
Report Date
Report Version

[illegible]

Client Sample ID	BLANK-F1	FIELD-BLANK	TRAVEL BLANK	FIELD-BLANK	TRAVEL BLANK	FIELD-BLANK	TRAVEL BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK
Date Sampled	7-Feb-2018	28-Feb-2018	28-Feb-2018	13-Mar-2018	13-Mar-2018	22-Mar-2018	22-Mar-2018	3-May-19	16-May-2019	29-May-2019	25-Jul-2019	23-Aug-2019	29-Aug-2019
Time Sampled	0:00	14:00	0:00	0:00	0:00	12:38	0:00	16:15	0:00	14:00	13:32	0:00	0:00
ALS Sample ID	L2054174-8	L2062216-7	L2062216-9	L2067173-8	L2067173-9	L2071339-9	L2071339-10	L2267589-10	L2274937-9	L2281691-11	L2317366-11	L2335149-11	L2338676-11
Parameter	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Total Metals (Water)													
Aluminum (Al)-Total	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0046	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)-Total	0.000363	<0.000050	<0.000050	<0.000050	<0.000050	0.00024	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Beryllium (Be)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium (Ca)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cesium (Cs)-Total	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Total	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Mercury (Hg)-Total	-	-	-	-	-	-	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Rubidium (Rb)-Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Selenium (Se)-Total	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver (Ag)-Total	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium (Sr)-Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sulfur (S)-Total	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tellurium (Te)-Total	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tungsten (W)-Total	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Total	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060

Client Sample ID	BLANK-F1	FIELD-BLANK	TRAVEL BLANK	FIELD-BLANK	TRAVEL BLANK	FIELD-BLANK	TRAVEL BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK	FIELD BLANK
Date Sampled	7-Feb-2018	28-Feb-2018	28-Feb-2018	13-Mar-2018	13-Mar-2018	22-Mar-2018	22-Mar-2018	3-May-19	16-May-2019	29-May-2019	25-Jul-2019	23-Aug-2019	29-Aug-2019
Time Sampled	0:00	14:00	0:00	0:00	0:00	12:38	0:00	16:15	0:00	14:00	13:32	0:00	0:00
ALS Sample ID	L2054174-8	L2062216-7	L2062216-9	L2067173-8	L2067173-9	L2071339-9	L2071339-10	L2267589-10	L2274937-9	L2281691-11	L2317366-11	L2335149-11	L2338676-11
Parameter	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals (Water)													
Dissolved Metals Filtration Location	LAB	FIELD		FIELD		LAB		FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	<0.0010	0.0018		<0.0010		<0.0010		<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Antimony (Sb)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Barium (Ba)-Dissolved	<0.000050	<0.000050		0.000085		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Beryllium (Be)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	<0.000050	<0.000050		<0.000050		<0.000050		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Dissolved	<0.010	<0.010		<0.010		<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	<0.0000050	<0.0000050		<0.0000050		<0.0000050		<0.0000050	<0.0000050	0.0000696	0.000084	0.000210	<0.0000050
Calcium (Ca)-Dissolved	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cesium (Cs)-Dissolved	<0.000010	<0.000010		<0.000010		<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Chromium (Cr)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	<0.00020	<0.00020		<0.00020		<0.00020		<0.00020	<0.00020	0.00030	<0.00020	<0.00020	<0.00020
Iron (Fe)-Dissolved	<0.010	<0.010		<0.010		<0.010		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	<0.000050	<0.000050		<0.000050		<0.000050		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	<0.0010	<0.0010		<0.0010		<0.0010		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Dissolved	<0.0050	<0.0050		0.0053		<0.0050		<0.0050	<0.0050	0.0054	<0.0050	<0.0050	<0.0050
Manganese (Mn)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010
Mercury (Hg)-Dissolved	-	-		-		-		<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Dissolved	<0.000050	<0.000050		0.000061		<0.000050		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved	<0.00050	<0.00050		<0.00050		<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium (K)-Dissolved	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Rubidium (Rb)-Dissolved	<0.00020	<0.00020		<0.00020		<0.00020		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Selenium (Se)-Dissolved	<0.000050	<0.000050		<0.000050		<0.000050		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Silicon (Si)-Dissolved	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)-Dissolved	<0.000010	<0.000010		<0.000010		<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	<0.050	<0.050		<0.050		<0.050		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Strontium (Sr)-Dissolved	<0.00020	<0.00020		0.00031		<0.00020		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sulfur (S)-Dissolved	<0.50	<0.50		<0.50		<0.50		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tellurium (Te)-Dissolved	<0.00020	<0.00020		<0.00020		<0.00020		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Dissolved	<0.000010	<0.000010		<0.000010		<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	<0.00030	<0.00030		<0.00030		<0.00030		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tungsten (W)-Dissolved	<0.00010	<0.00010		<0.00010		<0.00010		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Dissolved	<0.000010	<0.000010		<0.000010		<0.000010		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Dissolved	<0.00050	<0.00050		<0.00050		<0.00050		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	<0.0010	<0.0010		<0.0010		<0.0010		<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Zirconium (Zr)-Dissolved	<0.000060	<0.000060		<0.000060		<0.000060		<0.000060	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060

[illegible]

Table A1-4: Comparison of Field Duplicates

Client Sample ID	FIELD DUP	FIELD-DUP	FIELD-DUP	FIELD-DUP	DUP	FIELD DUP	DUP	DUP	DUP	DUP	DUP	DUP
Date Sampled	7-Feb-2018	28-Feb-2018	13-Mar-2018	22-Mar-2018	3-May-19	9-May-2019	16-May-2019	29-May-2019	25-Jul-2019	1-Aug-2019	23-Aug-2019	29-Aug-2019
Time Sampled	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	11:56	11:15	0:00	0:00
ALS Sample ID	L2054174-9	L2062216-6	L2067173-7	L2071339-8	L2267589-9	L2270780-9	L2274937-10	L2281691-10	L2317366-10	L2321653-8	L2335149-10	L2338676-10
Parameter	Water	Water	Water	Water	Water	Seawater	Water	Water	Water	Water	Water	Water
Physical Tests (Water)												
Conductivity	156	1070	5010	99.1	264	35500	243	277	267	246	269	270
Hardness (as CaCO3)	44.9	62.9	87.9	15.1	103	4800	80.3	114	105	107	109	107
pH	7.28	7.55	7.58	7.44	8.25	8.06	8.05	8.25	8.33	7.74	8.20	8.00
Total Suspended Solids	41.0	41.7	652	98.0	3.3	2.9	15.2	<3.0	<3.0	<3.0	<3.0	3.8
Turbidity	14.6	41.9	580	61.6	-	-	-	-	-	-	-	-
Anions and Nutrients (Water)												
Ammonia, Total (as N)	<0.0050	-	-	-	<0.0050	<0.0050	<0.0050	<0.0050	0.0468	0.0166	<0.0050	<0.0050
Nitrate (as N)	2.21	-	-	-	0.0538	<0.50	1.43	0.0578	0.0510	0.207	0.0702	0.0505
Nitrite (as N)	<0.0010	-	-	-	<0.0010	<0.10	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Phosphorus (P)-Total	0.0384	-	-	-	0.0682	0.0223	0.0106	0.0683	0.0687	0.0732	0.0681	0.0672
Organic / Inorganic Carbon (Wat)												
Total Organic Carbon	6.99	-	-	-	-	-	-	-	-	-	-	-
Total Metals (Water)												
Aluminum (Al)-Total	0.330	1.64	27.4	2.27	<0.0030	0.0373	0.0483	0.0258	0.0099	0.0208	0.0139	0.0072
Antimony (Sb)-Total	0.00015	<0.0010	0.00133	0.00034	<0.00010	<0.0010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010	<0.00010
Arsenic (As)-Total	0.00075	<0.0010	0.00816	0.00093	<0.00010	0.00121	0.00024	0.00461	0.00499	0.00309	0.00485	0.00493
Barium (Ba)-Total	0.0369	0.0998	0.328	0.0237	<0.00010	0.0069	0.0104	0.00641	0.00525	0.0180	0.00526	0.00490
Beryllium (Be)-Total	<0.00010	<0.0010	0.00038	<0.00010	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Total	<0.000050	<0.00050	0.00014	<0.000050	<0.000050	<0.00050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	0.013	<0.10	0.023	<0.010	<0.010	2.89	0.011	0.015	0.017	0.026	0.016	0.015
Cadmium (Cd)-Total	0.000127	<0.000050	0.000389	0.0000471	<0.000050	0.000057	0.0000123	0.0000429	0.0000229	0.0000073	<0.000050	<0.000050
Calcium (Ca)-Total	15.3	19.7	47.4	6.62	<0.050	297	21.7	25.6	26.5	31.5	27.5	27.1
Cesium (Cs)-Total	0.000013	0.00012	0.00109	0.000095	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Chromium (Cr)-Total	0.00053	0.0017	0.0242	0.00232	0.00011	<0.00050	0.00216	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Total	0.00042	<0.0010	0.0103	0.00091	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	0.00392	<0.0050	0.0508	0.00627	<0.00050	0.00106	<0.00050	<0.00050	<0.00050	0.00056	<0.00050	<0.00050
Gallium (Ga)-Total	-	-	-	-	-	<0.00050	-	-	-	-	-	-
Iron (Fe)-Total	2.04	1.93	25.3	1.95	<0.010	0.043	0.222	0.023	0.010	0.048	<0.010	<0.010
Lead (Pb)-Total	0.00250	0.00140	0.0167	0.00242	<0.000050	0.000124	0.000265	0.000058	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Total	<0.0010	<0.010	0.0182	0.0013	<0.0010	0.125	0.0010	0.0012	0.0012	<0.0010	0.0013	0.0013
Magnesium (Mg)-Total	2.16	4.02	12.7	1.13	<0.0050	885	6.16	8.91	9.75	7.66	9.13	9.38
Manganese (Mn)-Total	0.154	0.0592	0.728	0.0549	<0.00010	0.00414	0.0200	0.00940	0.00824	0.00884	0.00674	0.00820
Mercury (Hg)-Total	-	-	-	-	<0.0000050	-	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Molybdenum (Mo)-Total	0.000062	<0.00050	0.00199	0.000246	<0.000050	0.00804	0.000093	0.000866	0.000868	0.00101	0.000920	0.000891
Nickel (Ni)-Total	0.00161	<0.0050	0.0183	0.00190	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Total	0.053	<0.50	0.77	0.075	<0.050	0.051	<0.050	0.086	0.082	0.071	0.070	0.089
Potassium (K)-Total	2.52	2.59	6.49	0.908	<0.050	293	0.730	2.61	2.90	3.43	2.83	2.98
Rhenium (Re)-Total	-	-	-	-	-	<0.00050	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00162	<0.0020	0.0147	0.00150	<0.00020	0.0797	0.00031	0.00072	0.00074	0.00144	0.00079	0.00080
Selenium (Se)-Total	<0.000050	<0.00050	0.00030	0.000053	<0.000050	<0.00050	0.000072	<0.000050	0.000056	0.000173	<0.000050	<0.000050
Silicon (Si)-Total	6.40	4.8	44.9	3.87	<0.10	<1.0	11.9	10.0	10.5	8.42	11.2	10.9
Silver (Ag)-Total	<0.000010	<0.00010	0.000144	0.000014	<0.000010	<0.00010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	8.69	151	895	13.0	<0.050	7490	16.2	10.7	10.8	10.3	10.4	10.2
Strontium (Sr)-Total	0.0951	0.135	0.248	0.0289	<0.00020	5.18	0.154	0.0903	0.0898	0.116	0.0959	0.0987
Sulfur (S)-Total	2.06	<5.0	11.9	<0.50	<0.50	748	3.70	4.74	4.46	4.86	4.91	4.34
Tellurium (Te)-Total	<0.00020	<0.0020	<0.00040	<0.00020	<0.00020	<0.00050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	<0.000010	<0.00010	0.000081	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Thorium (Th)-Total	<0.00010	<0.0010	0.00058	<0.00010	<0.00010	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	0.00012	<0.0010	0.00115	0.00012	<0.00010	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	0.0104	0.0635	0.907	0.0711	<0.00030	<0.0050	<0.0018	0.00103	0.00031	0.00089	0.00033	<0.00030
Tungsten (W)-Total	<0.00010	<0.0010	0.00033	<0.00010	<0.00010	<0.0010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	0.000010	<0.00010	0.000571	0.000062	<0.000010	0.00218	0.000059	0.000087	0.000084	0.000096	0.000094	0.000091
Vanadium (V)-Total	0.00105	0.0052	0.0508	0.00442	<0.00050	0.00145	0.00111	0.00052	0.00055	0.00086	<0.00050	<0.00050
Yttrium (Y)-Total	-	-	-	-	-	<0.00050	-	-	-	-	-	-
Zinc (Zn)-Total	0.0440	0.042	0.292	0.0382	<0.0030	<0.0030	<0.0030	0.0057	<0.0030	0.0340	<0.0030	<0.0030
Zirconium (Zr)-Total	0.000130	<0.00060	0.00103	0.000139	<0.000060	<0.00050	<0.000060	<0.000060	<0.000020	<0.00020	<0.00020	<0.00020

Table A1-5: Field Duplicate Relative Percent Differences

	MDL WT4 7-Feb-2018 16:35 L2054174-4 Water	Parent WT4 7-Feb-2018 16:35 L2054174-4 Water	Duplicate FIELD DUP 7-Feb-2018 0:00 L2054174-9 Water	RPD	MDL WT3 28-Feb-2018 15:03 L2062216-3 Water	Parent WT3 28-Feb-2018 15:03 L2062216-3 Water	Duplicate FIELD-DUP 28-Feb-2018 0:00 L2062216-6 Water	RPD
Physical Tests (Water)								
Conductivity	2.0	154	156	1.29	2.0	1020	1070	4.78
Hardness (as CaCO3)	0.50	52.1	44.9	14.85	0.50	62.3	62.9	0.96
pH	0.10	7.27	7.28	0.14	0.10	7.56	7.55	0.13
Total Suspended Solids	3.0	80.8	41.0	65.35	3.0	53.1	41.7	24.05
Turbidity	0.10	24.1	14.6	49.10	0.10	48.4	41.9	14.40
Anions and Nutrients (Water)								
Ammonia, Total (as N)	0.0050	0.0106	<0.0050	nc	-	-	-	-
Nitrate (as N)	0.0050	2.20	2.21	0.45	-	-	-	-
Nitrite (as N)	0.0010	<0.0010	<0.0010	nc	-	-	-	-
Phosphorus (P)-Total	0.0020	0.0505	0.0384	27.22	-	-	-	-
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	0.50	7.83	6.99	11.34	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0030	3.36	0.330	164.23	0.0030	1.91	1.64	15.21
Antimony (Sb)-Total	0.00010	0.00034	0.00015	nc	0.00010	0.00023	<0.0010	nc
Arsenic (As)-Total	0.00010	0.00534	0.00075	150.74	0.00010	0.00123	<0.0010	nc
Barium (Ba)-Total	0.000050	0.166	0.0369	127.25	0.000050	0.0954	0.0998	4.51
Beryllium (Be)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.0010	nc
Bismuth (Bi)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.00050	nc
Boron (B)-Total	0.010	0.016	0.013	nc	0.010	<0.010	<0.10	nc
Cadmium (Cd)-Total	0.0000050	0.001490	0.000127	168.58	0.0000050	0.000060	<0.000050	nc
Calcium (Ca)-Total	0.050	22.7	15.3	38.95	0.050	20.1	19.7	2.01
Cesium (Cs)-Total	0.000010	0.000095	0.000013	nc	0.000010	0.000154	0.00012	24.82
Chromium (Cr)-Total	0.00010	0.00410	0.00053	154.21	0.00010	0.00237	0.0017	32.92
Cobalt (Co)-Total	0.00010	0.00468	0.00042	nc	0.00010	0.00086	<0.0010	nc
Copper (Cu)-Total	0.00050	0.0323	0.00392	156.71	0.00050	0.00549	<0.0050	nc
Gallium (Ga)-Total	-	-	-	-	-	-	-	-
Iron (Fe)-Total	0.010	21.3	2.04	165.04	0.010	2.19	1.93	12.62
Lead (Pb)-Total	0.000050	0.0313	0.00250	170.41	0.000050	0.00165	0.00140	16.39
Lithium (Li)-Total	0.0010	<0.0010	<0.0010	nc	0.0010	0.0022	<0.010	nc
Magnesium (Mg)-Total	0.0050	3.32	2.16	42.34	0.0050	3.91	4.02	2.77
Manganese (Mn)-Total	0.00010	2.48	0.154	176.61	0.00010	0.0721	0.0592	19.65
Mercury (Hg)-Total	-	-	-	-	-	-	-	-
Molybdenum (Mo)-Total	0.000050	0.000283	0.000062	nc	0.000050	0.000319	<0.00050	nc
Nickel (Ni)-Total	0.00050	0.0146	0.00161	nc	0.00050	0.00220	<0.0050	nc
Phosphorus (P)-Total	0.050	0.419	0.053	nc	0.050	0.068	<0.50	nc
Potassium (K)-Total	0.050	2.63	2.52	4.27	0.050	2.31	2.59	11.43
Rhenium (Re)-Total	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00020	0.00236	0.00162	37.19	0.00020	0.00243	<0.0020	nc
Selenium (Se)-Total	0.000050	0.000186	<0.000050	nc	0.000050	0.000065	<0.00050	nc
Silicon (Si)-Total	0.10	8.87	6.40	32.35	0.10	5.42	4.8	12.13
Silver (Ag)-Total	0.000010	0.000098	<0.000010	nc	0.000010	0.000020	<0.00010	nc
Sodium (Na)-Total	0.050	9.48	8.69	8.70	0.050	148	151	2.01
Strontium (Sr)-Total	0.00020	0.136	0.0951	35.40	0.00020	0.131	0.135	3.01
Sulfur (S)-Total	0.50	2.18	2.06	nc	0.50	1.47	<5.0	nc
Tellurium (Te)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.0020	nc
Thallium (Tl)-Total	0.000010	0.000028	<0.000010	nc	0.000010	<0.000010	<0.00010	nc
Thorium (Th)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.0010	nc
Tin (Sn)-Total	0.00010	0.00045	0.00012	nc	0.00010	0.00015	<0.0010	nc
Titanium (Ti)-Total	0.00030	0.0827	0.0104	155.32	0.00030	0.0743	0.0635	15.67
Tungsten (W)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.0010	nc
Uranium (U)-Total	0.000010	0.000101	0.000010	nc	0.000010	0.000044	<0.00010	nc
Vanadium (V)-Total	0.00050	0.00863	0.00105	nc	0.00050	0.00492	0.0052	5.53
Yttrium (Y)-Total	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	0.0030	0.351	0.0440	155.44	0.0030	0.0476	0.042	12.50
Zirconium (Zr)-Total	0.000060	0.000312	0.000130	nc	0.00036	<0.00036	<0.00060	nc

Table A1-5: Field Duplicate Relative Percent Differences

	MDL WT4 7-Feb-2018 16:35 L2054174-4 Water	Parent WT4 7-Feb-2018 16:35 L2054174-4 Water	Duplicate FIELD DUP 7-Feb-2018 0:00 L2054174-9 Water	RPD	MDL WT3 28-Feb-2018 15:03 L2062216-3 Water	Parent WT3 28-Feb-2018 15:03 L2062216-3 Water	Duplicate FIELD-DUP 28-Feb-2018 0:00 L2062216-6 Water	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		LAB	LAB			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0160	0.0185	14.49	0.0010	0.0469	0.0470	0.21
Antimony (Sb)-Dissolved	0.00010	0.00010	0.00011	nc	0.00010	0.00010	0.00011	nc
Arsenic (As)-Dissolved	0.00010	0.00015	0.00015	nc	0.00010	0.00022	0.00023	nc
Barium (Ba)-Dissolved	0.000050	0.0285	0.0258	9.94	0.000050	0.0772	0.0807	4.43
Beryllium (Be)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	0.013	0.011	nc	0.010	<0.010	<0.010	nc
Cadmium (Cd)-Dissolved	0.0000050	0.0000273	0.0000292	6.73	0.0000050	0.0000302	0.0000325	7.34
Calcium (Ca)-Dissolved	0.050	16.4	14.0	15.79	0.050	19.4	19.7	1.53
Cesium (Cs)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	0.000012	0.000014	nc
Chromium (Cr)-Dissolved	0.00010	0.00022	0.00013	nc	0.00010	0.00011	0.00011	nc
Cobalt (Co)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	0.00176	0.00143	20.69	0.00020	0.00137	0.00140	2.17
Gallium (Ga)-Dissolved	-	-	-	nc	-	-	-	nc
Iron (Fe)-Dissolved	0.010	0.041	0.030	nc	0.010	0.033	0.034	nc
Lead (Pb)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	0.000052	nc
Lithium (Li)-Dissolved	0.0010	<0.0010	<0.0010	nc	0.0010	<0.0010	<0.0010	nc
Magnesium (Mg)-Dissolved	0.0050	2.72	2.44	10.85	0.0050	3.35	3.35	0.00
Manganese (Mn)-Dissolved	0.00010	0.00064	0.00145	77.51	0.00010	0.0100	0.0102	1.98
Mercury (Hg)-Dissolved	-	-	-	nc	-	-	-	nc
Molybdenum (Mo)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	0.000171	0.000188	nc
Nickel (Ni)-Dissolved	0.00050	0.00074	0.00058	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	<0.050	<0.050	nc	0.050	<0.050	<0.050	nc
Potassium (K)-Dissolved	0.050	2.50	2.41	3.67	0.050	2.41	2.42	0.41
Rhenium (Re)-Dissolved	-	-	-	nc	-	-	-	nc
Rubidium (Rb)-Dissolved	0.00020	0.00158	0.00140	12.08	0.00020	0.00166	0.00169	1.79
Selenium (Se)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	0.000061	<0.000050	nc
Silicon (Si)-Dissolved	0.050	6.16	5.71	7.58	0.050	2.42	2.53	4.44
Silver (Ag)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	9.87	8.65	13.17	0.050	169	174	2.92
Strontium (Sr)-Dissolved	0.00020	0.0878	0.0870	0.92	0.00020	0.126	0.127	0.79
Sulfur (S)-Dissolved	0.50	2.21	1.86	nc	0.50	1.55	1.48	nc
Tellurium (Te)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Dissolved	0.00030	<0.00030	<0.00030	nc	0.00030	0.00083	<0.00090	nc
Tungsten (W)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Vanadium (V)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Yttrium (Y)-Dissolved	-	-	-	nc	-	-	-	nc
Zinc (Zn)-Dissolved	0.0010	0.0153	0.0166	8.15	0.0010	0.0199	0.0213	6.80
Zirconium (Zr)-Dissolved	0.000060	<0.000060	0.000065	nc	0.000060	0.000184	0.000144	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	-	-	-	-	-	-	-	-
Hydrocarbons (Water)								
F2 (C10-C16)	-	-	-	-	-	-	-	-
F3 (C16-C34)	-	-	-	-	-	-	-	-
F4 (C34-C50)	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride, F2-F4	-	-	-	-	-	-	-	-
EPH10-19	0.25	<0.25	<0.25	nc	0.25	<0.25	<0.25	nc
EPH19-32	0.25	<0.25	<0.25	nc	0.25	<0.25	<0.25	nc
2-Bromobenzotrifluoride	-	85.9	88.8	3.32	-	97	91.1	6.27

Notes:

Orange fill indicates value greater than CCME WQG

Blue fill indicates value greater than BC MOE WQG (working or approved)

Green fill indicates value greater than CCME WQG and BC MOE WQG (working or approved)

° Temperature and pH dependent.

† value is chloride-based but chloride was not measured so most conservative possible guideline value was used

‡ guideline is based on guidance framework

- : not analyzed

Table A1-5: Field Duplicate Relative Percent Di

	MDL FIELD-DUP 13-Mar-2018 0:00 L2067173-7 Water	Parent WT2 13-Mar-2018 17:08 L2067173-1 Water	Duplicate FIELD-DUP 13-Mar-2018 0:00 L2067173-7 Water	RPD	MDL WT2 22-Mar-2018 13:00 L2071339-1 Water	Parent WT2 22-Mar-2018 13:00 L2071339-1 Water	Duplicate FIELD-DUP 22-Mar-2018 0:00 L2071339-8 Water	RPD
Physical Tests (Water)								
Conductivity	2.0	5160	5010	2.95	2.0	122	99.1	20.71
Hardness (as CaCO ₃)	0.50	89.3	87.9	1.58	0.50	30.6	15.1	67.83
pH	0.10	7.55	7.58	0.40	0.10	7.62	7.44	2.39
Total Suspended Solids	3.0	631	652	3.27	3.0	27	98.0	113.60
Turbidity	0.10	601	580	3.56	0.10	25.6	61.6	82.57
Anions and Nutrients (Water)								
Ammonia, Total (as N)	-	-	-	-	-	-	-	-
Nitrate (as N)	-	-	-	-	-	-	-	-
Nitrite (as N)	-	-	-	-	-	-	-	-
Phosphorus (P)-Total	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	-	-	-	-	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0060	28.9	27.4	5.33	0.0030	1.30	2.27	54.34
Antimony (Sb)-Total	0.00020	0.00131	0.00133	1.52	0.00010	0.00039	0.00034	nc
Arsenic (As)-Total	0.00020	0.00869	0.00816	6.29	0.00010	0.00125	0.00093	29.36
Barium (Ba)-Total	0.00010	0.319	0.328	2.78	0.00010	0.0175	0.0237	30.10
Beryllium (Be)-Total	0.00020	0.00042	0.00038	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Total	0.00010	0.00014	0.00014	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Total	0.020	0.023	0.023	nc	0.010	0.011	<0.010	nc
Cadmium (Cd)-Total	0.000010	0.000427	0.000389	9.31	0.0000050	0.0000334	0.0000471	34.04
Calcium (Ca)-Total	0.10	41.2	47.4	14.00	0.050	10.9	6.62	48.86
Cesium (Cs)-Total	0.000020	0.00114	0.00109	4.48	0.000010	0.000052	0.000095	58.50
Chromium (Cr)-Total	0.00020	0.0264	0.0242	8.70	0.00010	0.00144	0.00232	46.81
Cobalt (Co)-Total	0.00020	0.0113	0.0103	9.26	0.00010	0.00052	0.00091	54.55
Copper (Cu)-Total	0.0010	0.0558	0.0508	9.38	0.00050	0.00385	0.00627	47.83
Gallium (Ga)-Total	-	-	-	-	-	-	-	-
Iron (Fe)-Total	0.020	27.2	25.3	7.24	0.010	1.26	1.95	42.99
Lead (Pb)-Total	0.00010	0.0187	0.0167	11.30	0.000050	0.00126	0.00242	63.04
Lithium (Li)-Total	0.0020	0.0189	0.0182	3.77	0.0010	<0.0010	0.0013	nc
Magnesium (Mg)-Total	0.010	12.7	12.7	0.00	0.0050	1.69	1.13	39.72
Manganese (Mn)-Total	0.00020	0.757	0.728	3.91	0.00010	0.0365	0.0549	40.26
Mercury (Hg)-Total	-	-	-	-	-	-	-	-
Molybdenum (Mo)-Total	0.00010	0.00190	0.00199	4.63	0.000050	0.000411	0.000246	nc
Nickel (Ni)-Total	0.0010	0.0199	0.0183	8.38	0.00050	0.00104	0.00190	nc
Phosphorus (P)-Total	0.10	0.81	0.77	5.06	0.050	0.067	0.075	nc
Potassium (K)-Total	0.10	5.77	6.49	11.75	0.050	1.32	0.908	36.98
Rhenium (Re)-Total	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00040	0.0145	0.0147	1.37	0.00020	0.00133	0.00150	12.01
Selenium (Se)-Total	0.00010	0.00034	0.00030	nc	0.000050	<0.000050	0.000053	nc
Silicon (Si)-Total	0.20	46.8	44.9	4.14	0.10	3.91	3.87	1.03
Silver (Ag)-Total	0.000020	0.000143	0.000144	0.70	0.000010	<0.000010	0.000014	nc
Sodium (Na)-Total	0.10	684	895	26.73	0.050	14.9	13.0	13.62
Strontium (Sr)-Total	0.00040	0.218	0.248	12.88	0.00020	0.0405	0.0289	33.43
Sulfur (S)-Total	1.0	9.7	11.9	20.37	0.50	0.58	<0.50	nc
Tellurium (Te)-Total	0.00040	<0.00040	<0.00040	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Total	0.000020	0.000081	0.000081	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Total	0.00020	0.00050	0.00058	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Total	0.00020	0.00107	0.00115	7.21	0.00010	<0.00010	0.00012	nc
Titanium (Ti)-Total	0.00060	0.934	0.907	2.93	0.00030	0.0413	0.0711	53.02
Tungsten (W)-Total	0.00020	0.00028	0.00033	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Total	0.000020	0.000577	0.000571	1.05	0.000010	0.000061	0.000062	1.63
Vanadium (V)-Total	0.0010	0.0542	0.0508	6.48	0.00050	0.00278	0.00442	45.56
Yttrium (Y)-Total	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	0.0060	0.315	0.292	7.58	0.0030	0.033	0.0382	14.61
Zirconium (Zr)-Total	0.00012	0.00114	0.00103	10.14	0.000060	0.000097	0.000139	nc

Table A1-5: Field Duplicate Relative Percent Di

	MDL FIELD-DUP 13-Mar-2018 0:00 L2067173-7 Water	Parent WT2 13-Mar-2018 17:08 L2067173-1 Water	Duplicate FIELD-DUP 13-Mar-2018 0:00 L2067173-7 Water	RPD	MDL WT2 22-Mar-2018 13:00 L2071339-1 Water	Parent WT2 22-Mar-2018 13:00 L2071339-1 Water	Duplicate FIELD-DUP 22-Mar-2018 0:00 L2071339-8 Water	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		FIELD	FIELD			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0486	0.0593	19.83	0.0010	0.0406	0.0470	14.61
Antimony (Sb)-Dissolved	0.00010	<0.00050	0.00048	nc	0.00010	0.00027	0.00021	nc
Arsenic (As)-Dissolved	0.00010	0.00078	0.00079	1.27	0.00010	0.00061	0.00053	14.04
Barium (Ba)-Dissolved	0.000050	0.0788	0.0698	12.11	0.00010	0.00749	0.00497	40.45
Beryllium (Be)-Dissolved	0.00010	<0.00050	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Dissolved	0.000050	<0.00025	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	<0.050	0.015	nc	0.010	<0.010	<0.010	nc
Cadmium (Cd)-Dissolved	0.0000050	0.000078	0.0000727	7.03	0.0000050	0.0000125	0.0000109	nc
Calcium (Ca)-Dissolved	0.050	31.9	31.4	1.58	0.050	10.3	5.43	61.92
Cesium (Cs)-Dissolved	0.000010	<0.000050	0.000029	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Dissolved	0.00010	0.00053	0.00080	40.60	0.00010	0.00032	0.00017	nc
Cobalt (Co)-Dissolved	0.00010	<0.00050	0.00015	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	0.0054	0.00544	0.74	0.00020	0.00133	0.00143	7.25
Gallium (Ga)-Dissolved	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	0.010	<0.050	0.028	nc	0.010	0.023	0.025	nc
Lead (Pb)-Dissolved	0.000050	<0.00025	0.000101	nc	0.000050	0.000076	0.000089	nc
Lithium (Li)-Dissolved	0.0050	<0.0050	<0.0050	nc	0.0010	<0.0010	<0.0010	nc
Magnesium (Mg)-Dissolved	0.0050	2.35	2.33	0.85	0.0050	1.22	0.384	104.24
Manganese (Mn)-Dissolved	0.00010	0.0521	0.0515	1.16	0.00010	0.00655	0.00641	2.16
Mercury (Hg)-Dissolved	-	-	-	-	-	-	-	-
Molybdenum (Mo)-Dissolved	0.000050	0.00111	0.000915	19.26	0.000050	0.000344	0.000171	nc
Nickel (Ni)-Dissolved	0.00050	<0.0025	0.00075	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	<0.25	<0.050	nc	0.050	<0.050	<0.050	nc
Potassium (K)-Dissolved	0.050	3.83	4.04	5.34	0.050	1.17	0.650	57.14
Rhenium (Re)-Dissolved	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	0.00020	0.0028	0.00297	5.89	0.00020	0.00070	0.00041	nc
Selenium (Se)-Dissolved	0.000050	<0.00025	0.000180	nc	0.000050	<0.000050	<0.000050	nc
Silicon (Si)-Dissolved	0.050	1.34	1.42	5.80	0.050	1.69	0.538	103.41
Silver (Ag)-Dissolved	0.000010	<0.000050	0.000011	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	868	887	2.17	0.050	15.1	12.2	21.25
Strontium (Sr)-Dissolved	0.00020	0.157	0.148	5.90	0.00020	0.0344	0.0197	54.34
Sulfur (S)-Dissolved	0.50	9.0	10.1	11.52	0.50	<0.50	<0.50	nc
Tellurium (Te)-Dissolved	0.00020	<0.0010	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Dissolved	0.000010	<0.000050	0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Dissolved	0.00010	<0.00050	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Dissolved	0.00010	<0.00050	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Dissolved	0.00030	<0.0015	0.00065	nc	0.00030	0.00064	0.00074	nc
Tungsten (W)-Dissolved	0.00010	<0.00050	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Dissolved	0.000010	0.000122	0.000136	10.85	0.000010	0.000029	0.000012	nc
Vanadium (V)-Dissolved	0.00050	<0.0025	0.00059	nc	0.00050	<0.00050	<0.00050	nc
Yttrium (Y)-Dissolved	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.0010	0.0162	0.0141	13.86	0.0010	0.0123	0.0082	40.00
Zirconium (Zr)-Dissolved	0.000060	<0.00030	<0.000060	nc	0.000060	<0.000060	<0.000060	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	0.10	<0.10	<0.10	nc	0.10	<0.10	<0.10	nc
Hydrocarbons (Water)								
F2 (C10-C16)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F3 (C16-C34)	0.30	1.06	1.18	nc	0.30	<0.30	<0.30	nc
F4 (C34-C50)	0.30	1.97	2.20	11.03	0.30	<0.30	<0.30	nc
2-Bromobenzotrifluoride, F2-F4	-	78.2	75	4.18	-	82.5	87.6	6.00
EPH10-19	-	-	-	-	-	-	-	-
EPH19-32	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride	-	-	-	-	-	-	-	-

Notes:

Orange fill indicates value greater than CCME WQ

Blue fill indicates value greater than BC MOE WQ

Green fill indicates value greater than CCME WQ

^a Temperature and pH dependent.^f value is chloride-based but chloride was not mea^g guideline is based on guidance framework

- : not analyzed

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3 3-May-2019 15:55 L2267589-7 Water	Parent WT3 3-May-19 15:55 L2267589-7 Water	Duplicate DUP 3-May-19 0:00 L2267589-9 Water	RPD	MDL WT5 - DEEP 9-May-2019 10:45 L2270780-2 Seawater	Parent WT5-deep 9-May-19 9:00 L2270780-2 Seawater	Duplicate FIELD DUP 9-May-2019 0:00 L2270780-9 Seawater	RPD
Physical Tests (Water)								
Conductivity	2.0	265	264	0.38	2.0	36500	35500	2.78
Hardness (as CaCO3)	0.50	100	103	2.96	4.8	4650	4800	3.17
pH	0.10	8.23	8.25	0.24	0.10	8.03	8.06	0.37
Total Suspended Solids	3.0	6.9	3.3	nc	2.0	2.7	2.9	nc
Turbidity	-	-	-	-	-	-	-	-
Anions and Nutrients (Water)								
Ammonia, Total (as N)	0.0050	<0.0050	<0.0050	nc	0.0050	0.0108	<0.0050	nc
Nitrate (as N)	0.0050	0.0536	0.0538	0.37	0.50	<0.50	<0.50	nc
Nitrite (as N)	0.0010	<0.0010	<0.0010	nc	0.10	<0.10	<0.10	nc
Phosphorus (P)-Total	0.0020	0.0699	0.0682	2.46	0.0040	0.0328	0.0223	38.11
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	-	-	-	-	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0030	0.0121	<0.0030	nc	0.0050	0.0330	0.0373	12.23
Antimony (Sb)-Total	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Arsenic (As)-Total	0.00010	0.00477	<0.00010	nc	0.00040	0.00127	0.00121	nc
Barium (Ba)-Total	0.00010	0.00577	<0.00010	nc	0.0010	0.0073	0.0069	5.63
Beryllium (Be)-Total	0.00010	<0.00010	<0.00010	nc	0.00050	<0.00050	<0.00050	nc
Bismuth (Bi)-Total	0.000050	<0.000050	<0.000050	nc	0.00050	<0.00050	<0.00050	nc
Boron (B)-Total	0.010	0.015	<0.010	nc	0.30	2.61	2.89	10.18
Cadmium (Cd)-Total	0.0000050	<0.0000050	<0.0000050	nc	0.000010	0.000068	0.000057	17.60
Calcium (Ca)-Total	0.050	27.2	<0.050	nc	1.0	300	297	1.01
Cesium (Cs)-Total	0.000010	<0.000010	<0.000010	nc	0.00050	<0.00050	<0.00050	nc
Chromium (Cr)-Total	0.00010	0.00100	0.00011	nc	0.00050	<0.00050	<0.00050	nc
Cobalt (Co)-Total	0.00010	<0.00010	<0.00010	nc	0.000050	0.000058	<0.000050	nc
Copper (Cu)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	0.00077	0.00106	nc
Gallium (Ga)-Total	-	-	-	-	0.00050	<0.00050	<0.00050	nc
Iron (Fe)-Total	0.010	0.012	<0.010	nc	0.010	0.039	0.043	nc
Lead (Pb)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	0.000068	0.000124	nc
Lithium (Li)-Total	0.0010	0.0011	<0.0010	nc	0.020	0.124	0.125	0.80
Magnesium (Mg)-Total	0.0050	8.83	<0.0050	nc	1.0	1040	885	16.10
Manganese (Mn)-Total	0.00010	0.00545	<0.00010	nc	0.00020	0.00417	0.00414	0.72
Mercury (Hg)-Total	0.0000050	<0.0000050	<0.0000050	nc	-	-	-	-
Molybdenum (Mo)-Total	0.000050	0.000917	<0.000050	nc	0.00010	0.00809	0.00804	0.62
Nickel (Ni)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Total	0.050	0.099	<0.050	nc	0.050	<0.050	0.051	nc
Potassium (K)-Total	0.050	2.96	<0.050	nc	1.0	328	293	11.27
Rhenium (Re)-Total	-	-	-	-	0.00050	<0.00050	<0.00050	nc
Rubidium (Rb)-Total	0.00020	0.00075	<0.00020	nc	0.0050	0.0919	0.0797	14.22
Selenium (Se)-Total	0.000050	0.000057	<0.000050	nc	0.00050	<0.00050	<0.00050	nc
Silicon (Si)-Total	0.10	10.2	<0.10	nc	1.0	<1.0	<1.0	nc
Silver (Ag)-Total	0.000010	<0.000010	<0.000010	nc	0.00010	<0.00010	<0.00010	nc
Sodium (Na)-Total	0.050	11.6	<0.050	nc	2.5	8330	7490	10.62
Strontium (Sr)-Total	0.00020	0.0925	<0.00020	nc	0.010	5.35	5.18	3.23
Sulfur (S)-Total	0.50	4.38	<0.50	nc	5.0	782	748	4.44
Tellurium (Te)-Total	0.00020	<0.00020	<0.00020	nc	0.00050	<0.00050	<0.00050	nc
Thallium (Tl)-Total	0.000010	<0.000010	<0.000010	nc	0.000050	<0.000050	<0.000050	nc
Thorium (Th)-Total	0.00010	<0.00010	<0.00010	nc	0.00050	<0.00050	<0.00050	nc
Tin (Sn)-Total	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Titanium (Ti)-Total	0.00030	0.00033	<0.00030	nc	0.0050	<0.0050	<0.0050	nc
Tungsten (W)-Total	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Uranium (U)-Total	0.000010	0.000090	<0.000010	nc	0.000050	0.00219	0.00218	0.46
Vanadium (V)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	0.00173	0.00145	nc
Yttrium (Y)-Total	-	-	-	-	0.00050	<0.00050	<0.00050	nc
Zinc (Zn)-Total	0.0030	0.0040	<0.0030	nc	0.0030	<0.0030	<0.0030	nc
Zirconium (Zr)-Total	0.000060	<0.000060	<0.000060	nc	0.00050	<0.00050	<0.00050	nc

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3 3-May-2019 15:55 L2267589-7 Water	Parent WT3 3-May-19 15:55 L2267589-7 Water	Duplicate DUP 3-May-19 0:00 L2267589-9 Water	RPD	MDL WT5 - DEEP 9-May-2019 10:45 L2270780-2 Seawater	Parent WT5-deep 9-May-19 9:00 L2270780-2 Seawater	Duplicate FIELD DUP 9-May-2019 0:00 L2270780-9 Seawater	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		FIELD	FIELD			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0044	<0.0010	nc	0.0050	0.0056	0.0052	nc
Antimony (Sb)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Arsenic (As)-Dissolved	0.00010	0.00457	<0.00010	nc	0.00040	0.00126	0.00116	nc
Barium (Ba)-Dissolved	0.00010	0.00574	<0.00010	nc	0.0010	0.0062	0.0051	19.47
Beryllium (Be)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00050	<0.00050	<0.00050	nc
Bismuth (Bi)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.00050	<0.00050	<0.00050	nc
Boron (B)-Dissolved	0.010	0.014	<0.010	nc	0.30	2.85	2.40	17.14
Cadmium (Cd)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.000010	0.000058	0.000053	9.01
Calcium (Ca)-Dissolved	0.050	25.5	<0.050	nc	1.0	296	267	10.30
Cesium (Cs)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.00050	<0.00050	<0.00050	nc
Chromium (Cr)-Dissolved	0.00010	0.00019	<0.00010	nc	0.00050	<0.00050	<0.00050	nc
Cobalt (Co)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.000050	<0.000050	<0.000050	nc
Copper (Cu)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	0.00068	0.00064	nc
Gallium (Ga)-Dissolved		-	-	-	0.00050	<0.00050	<0.00050	nc
Iron (Fe)-Dissolved	0.010	<0.010	<0.010	nc	0.010	<0.010	<0.010	nc
Lead (Pb)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Lithium (Li)-Dissolved	0.0010	0.0011	<0.0010	nc	0.020	0.136	0.118	14.17
Magnesium (Mg)-Dissolved	0.0050	8.94	<0.0050	nc	1.0	949	1000	5.23
Manganese (Mn)-Dissolved	0.00010	0.00272	<0.00010	nc	0.00010	0.00226	0.00217	4.06
Mercury (Hg)-Dissolved	0.0000050	0.0000051	<0.0000050	nc	-	-	-	-
Molybdenum (Mo)-Dissolved	0.000050	0.000932	<0.000050	nc	0.00010	0.00790	0.00776	1.79
Nickel (Ni)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	0.074	<0.050	nc	0.050	<0.050	<0.050	nc
Potassium (K)-Dissolved	0.050	2.81	<0.050	nc	1.0	315	325	3.13
Rhenium (Re)-Dissolved	-	-	-	-	0.00050	<0.00050	<0.00050	nc
Rubidium (Rb)-Dissolved	0.00020	0.00076	<0.00020	nc	0.0050	0.0837	0.0891	6.25
Selenium (Se)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.00050	<0.00050	<0.00050	nc
Silicon (Si)-Dissolved	0.050	9.72	<0.050	nc	1.0	<1.0	<1.0	nc
Silver (Ag)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.00010	<0.00010	<0.00010	nc
Sodium (Na)-Dissolved	0.050	11.5	<0.050	nc	2.5	7750	7470	3.68
Strontium (Sr)-Dissolved	0.00020	0.0952	<0.00020	nc	0.010	5.22	5.06	3.11
Sulfur (S)-Dissolved	0.50	4.12	<0.50	nc	5.0	732	747	2.03
Tellurium (Te)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00050	<0.00050	<0.00050	nc
Thallium (Tl)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000050	<0.000050	<0.000050	nc
Thorium (Th)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00050	<0.00050	<0.00050	nc
Tin (Sn)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Titanium (Ti)-Dissolved	0.00030	<0.00030	<0.00030	nc	0.0050	<0.0050	<0.0050	nc
Tungsten (W)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.0010	<0.0010	<0.0010	nc
Uranium (U)-Dissolved	0.000010	0.000087	<0.000010	nc	0.000050	0.00225	0.00220	2.25
Vanadium (V)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	0.00143	0.00156	nc
Yttrium (Y)-Dissolved	-	-	-	-	0.00050	<0.00050	<0.00050	nc
Zinc (Zn)-Dissolved	0.0010	0.0040	<0.0010	nc	0.0010	0.0014	<0.0010	nc
Zirconium (Zr)-Dissolved	0.000060	<0.000060	<0.000060	nc	0.00050	<0.00050	<0.00050	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	0.10	<0.10	<0.10	nc	0.10	<0.10	<0.10	nc
Hydrocarbons (Water)								
F2 (C10-C16)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F3 (C16-C34)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F4 (C34-C50)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
2-Bromobenzotrifluoride, F2-F4	-	82.5	86.7	4.96	-	85.2	76.4	10.89
EPH10-19	-	-	-	-	-	-	-	-
EPH19-32	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride	-	-	-	-	-	-	-	-

Notes:

Orange fill indicates value greater than CCME WQ

Blue fill indicates value greater than BC MOE WQ

Green fill indicates value greater than CCME WQ¹⁰ Temperature and pH dependent.¹ value is chloride-based but chloride was not mea⁹ guideline is based on guidance framework

- : not analyzed

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT8 16-May-2019 12:30 L2274937-2 Water	Parent WT8 16-May-19 12:30 L2274937-2 Water	Duplicate DUP 16-May-2019 0:00 L2274937-10 Water		MDL WT3/DUP 29-May-2019 12:00 L2281691-2 Water	Parent WT3 29-May-19 12:00 L2281691-2 Water	Duplicate DUP 29-May-2019 0:00 L2281691-10 Water	
				RPD				RPD
Physical Tests (Water)								
Conductivity	2.0	240	243	1.24	2.0	276	277	0.36
Hardness (as CaCO3)	0.50	83.5	80.3	3.91	0.50	104	114	9.17
pH	0.10	7.96	8.05	1.12	0.10	8.25	8.25	0.00
Total Suspended Solids	3.0	28.6	15.2	61.19	3.0	<3.0	<3.0	nc
Turbidity	-		-	-	-	-	-	-
Anions and Nutrients (Water)								
Ammonia, Total (as N)	0.0050	<0.0050	<0.0050	nc	0.0050	<0.0050	<0.0050	nc
Nitrate (as N)	0.0050	1.43	1.43	0.00	0.0050	0.0586	0.0578	1.37
Nitrite (as N)	0.0010	<0.0010	0.0022	nc	0.0010	<0.0010	<0.0010	nc
Phosphorus (P)-Total	0.0020	0.0108	0.0106	1.87	0.0020	0.0668	0.0683	2.22
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	-	-	-	-	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0030	0.0897	0.0483	60.00	0.0030	0.0249	0.0258	3.55
Antimony (Sb)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Arsenic (As)-Total	0.00010	0.00026	0.00024	nc	0.00010	0.00468	0.00461	1.51
Barium (Ba)-Total	0.00010	0.0108	0.0104	3.77	0.00010	0.00650	0.00641	1.39
Beryllium (Be)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Total	0.010	0.011	0.011	nc	0.010	0.015	0.015	nc
Cadmium (Cd)-Total	0.0000050	0.0000082	0.0000123	nc	0.0000050	<0.0000050	0.0000429	nc
Calcium (Ca)-Total	0.050	21.4	21.7	1.39	0.050	26.3	25.6	2.70
Cesium (Cs)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Total	0.00010	0.00206	0.00216	4.74	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Total	0.00050	0.00051	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Gallium (Ga)-Total	-	-	-	-	-	-	-	-
Iron (Fe)-Total	0.010	0.248	0.222	11.06	0.010	0.021	0.023	nc
Lead (Pb)-Total	0.000050	0.000278	0.000265	4.79	0.000050	0.000067	0.000058	nc
Lithium (Li)-Total	0.0010	0.0010	0.0010	nc	0.0010	0.0012	0.0012	nc
Magnesium (Mg)-Total	0.0050	6.19	6.16	0.49	0.0050	9.54	8.91	6.83
Manganese (Mn)-Total	0.00010	0.0203	0.0200	1.49	0.00010	0.00874	0.00940	7.28
Mercury (Hg)-Total	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Total	0.000050	0.000105	0.000093	nc	0.000050	0.000877	0.000866	1.26
Nickel (Ni)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Total	0.050	<0.050	<0.050	nc	0.050	0.076	0.086	nc
Potassium (K)-Total	0.050	0.751	0.730	2.84	0.050	2.85	2.61	8.79
Rhenium (Re)-Total	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00020	0.00041	0.00031	nc	0.00020	0.00076	0.00072	nc
Selenium (Se)-Total	0.000050	0.000128	0.000072	nc	0.000050	<0.000050	<0.000050	nc
Silicon (Si)-Total	0.10	12.3	11.9	3.31	0.10	10.3	10.0	2.96
Silver (Ag)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Total	0.050	16.8	16.2	3.64	0.050	11.5	10.7	7.21
Strontium (Sr)-Total	0.00020	0.149	0.154	3.30	0.00020	0.0908	0.0903	0.55
Sulfur (S)-Total	0.50	3.99	3.70	7.54	0.50	4.94	4.74	4.13
Tellurium (Te)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Total	0.0033	<0.0033	<0.0018	nc	0.00030	0.00101	0.00103	nc
Tungsten (W)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	0.00010	nc
Uranium (U)-Total	0.000010	0.000060	0.000059	1.68	0.000010	0.000083	0.000087	4.71
Vanadium (V)-Total	0.00050	0.00113	0.00111	nc	0.00050	<0.00050	0.00052	nc
Yttrium (Y)-Total	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	0.0030	<0.0030	<0.0030	nc	0.0030	0.0056	0.0057	nc
Zirconium (Zr)-Total	0.000060	<0.000060	<0.000060	nc	0.000060	<0.000060	<0.000060	nc

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT8 16-May-2019 12:30 L2274937-2 Water	Parent WT8 16-May-19 12:30 L2274937-2 Water	Duplicate DUP 16-May-2019 0:00 L2274937-10 Water	RPD	MDL WT3/DUP 29-May-2019 12:00 L2281691-2 Water	Parent WT3 29-May-19 12:00 L2281691-2 Water	Duplicate DUP 29-May-2019 0:00 L2281691-10 Water	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		FIELD	FIELD			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0098	0.0096	2.06	0.0010	0.0046	0.0040	nc
Antimony (Sb)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Arsenic (As)-Dissolved	0.00010	0.00018	0.00017	nc	0.00010	0.00485	0.00478	1.45
Barium (Ba)-Dissolved	0.00010	0.00908	0.00910	0.22	0.00010	0.00612	0.00607	0.82
Beryllium (Be)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	0.011	0.011	nc	0.010	0.015	0.014	nc
Cadmium (Cd)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Calcium (Ca)-Dissolved	0.050	22.9	22.1	3.56	0.050	26.2	30.2	14.18
Cesium (Cs)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Dissolved	0.00010	0.00122	0.00121	0.82	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	0.00021	0.00022	nc	0.00020	<0.00020	<0.00020	nc
Gallium (Ga)-Dissolved	-	-	-	nc	-	-	-	nc
Iron (Fe)-Dissolved	0.010	0.013	0.012	nc	0.010	<0.010	<0.010	nc
Lead (Pb)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Lithium (Li)-Dissolved	0.0010	<0.0010	<0.0010	nc	0.0010	0.0012	0.0012	nc
Magnesium (Mg)-Dissolved	0.0050	6.36	6.09	4.34	0.0050	9.44	9.25	2.03
Manganese (Mn)-Dissolved	0.00010	0.00050	0.00043	nc	0.00010	0.00280	0.00283	1.07
Mercury (Hg)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Dissolved	0.000050	0.000110	0.000111	nc	0.000050	0.000906	0.000863	4.86
Nickel (Ni)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	<0.050	<0.050	nc	0.050	<0.050	0.064	nc
Potassium (K)-Dissolved	0.050	0.768	0.748	2.64	0.050	2.93	2.94	0.34
Rhenium (Re)-Dissolved	-	-	-	nc	-	-	-	nc
Rubidium (Rb)-Dissolved	0.00020	0.00035	0.00031	nc	0.00020	0.00077	0.00078	nc
Selenium (Se)-Dissolved	0.000050	0.000074	0.000061	nc	0.000050	0.000051	<0.000050	nc
Silicon (Si)-Dissolved	0.050	11.1	11.2	0.90	0.050	9.84	9.81	0.31
Silver (Ag)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	17.4	16.2	7.14	0.050	10.6	10.8	1.87
Strontium (Sr)-Dissolved	0.00020	0.169	0.162	4.23	0.00020	0.0949	0.0949	0.00
Sulfur (S)-Dissolved	0.50	3.76	3.72	1.07	0.50	4.41	4.34	1.60
Tellurium (Te)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Dissolved	0.00030	<0.00030	<0.00030	nc	0.00030	<0.00030	<0.00030	nc
Tungsten (W)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Dissolved	0.000010	0.000042	0.000042	nc	0.000010	0.000084	0.000085	1.18
Vanadium (V)-Dissolved	0.00050	0.00071	0.00071	nc	0.00050	<0.00050	<0.00050	nc
Yttrium (Y)-Dissolved	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.0010	<0.0010	<0.0010	nc	0.0010	0.0036	0.0031	nc
Zirconium (Zr)-Dissolved	0.000060	<0.000060	<0.000060	nc	0.000060	<0.000060	<0.000060	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	0.10	<0.10	<0.10	nc	0.10	<0.10	<0.10	nc
Hydrocarbons (Water)								
F2 (C10-C16)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F3 (C16-C34)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F4 (C34-C50)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
2-Bromobenzotrifluoride, F2-F4	-	98.5	95.1	3.51	74.4	64.6	-	nc
EPH10-19	-	-	-	-	-	-	-	-
EPH19-32	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride	-	-	-	-	-	-	-	-

Notes:

Orange fill indicates value greater than CCME WQ

Blue fill indicates value greater than BC MOE WQ

Green fill indicates value greater than CCME WQ

° Temperature and pH dependent.

† value is chloride-based but chloride was not mea

° guideline is based on guidance framework

- : not analyzed

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3 25-Jul-2019 11:55 L2317366-2 Water	Parent WT3/DUP 25-Jul-2019 11:55 L2317366-2 Water	Duplicate DUP 25-Jul-2019 11:56 L2317366-10 Water	RPD	MDL WT11/DUP 1-Aug-2019 11:15 L2321653-5 Water	Parent WT11 1-Aug-2019 11:15 L2321653-5 Water	Duplicate DUP 1-Aug-2019 11:15 L2321653-8 Water	RPD
Physical Tests (Water)								
Conductivity	2.0	254	267	4.99	2.0	244	246	0.82
Hardness (as CaCO ₃)	0.50	103	105	1.92	0.50	107	107	0.00
pH	0.10	8.23	8.33	1.21	0.10	7.73	7.74	0.13
Total Suspended Solids	3.0	<3.0	<3.0	nc	3.0	<3.0	<3.0	nc
Turbidity	-	-	-	-	-	-	-	-
Anions and Nutrients (Water)								
Ammonia, Total (as N)	0.0050	<0.0050	0.0468	nc	0.0050	0.0059	0.0166	nc
Nitrate (as N)	0.0050	0.0163	0.0510	nc	0.0050	0.198	0.207	4.44
Nitrite (as N)	0.0010	0.0020	<0.0010	nc	0.0010	0.0012	<0.0010	nc
Phosphorus (P)-Total	0.0020	0.0670	0.0687	2.51	0.0020	0.0391	0.0732	60.73
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	-	-	-	-	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0030	0.0174	0.0099	nc	0.0030	0.0261	0.0208	22.60
Antimony (Sb)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	0.00016	0.00016	nc
Arsenic (As)-Total	0.00010	0.00501	0.00499	0.40	0.00010	0.00303	0.00309	1.96
Barium (Ba)-Total	0.00010	0.00535	0.00525	1.89	0.00010	0.0173	0.0180	3.97
Beryllium (Be)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Total	0.010	0.016	0.017	nc	0.010	0.025	0.026	nc
Cadmium (Cd)-Total	0.0000050	<0.0000050	0.0000229	nc	0.0000050	0.0000075	0.0000073	nc
Calcium (Ca)-Total	0.050	28.1	26.5	5.86	0.050	29.3	31.5	7.24
Cesium (Cs)-Total	0.000010	0.000013	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	0.00057	0.00056	nc
Gallium (Ga)-Total	-	-	-	-	-	-	-	-
Iron (Fe)-Total	0.010	0.015	0.010	nc	0.010	0.049	0.048	nc
Lead (Pb)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Lithium (Li)-Total	0.0010	0.0014	0.0012	nc	0.0010	<0.0010	<0.0010	nc
Magnesium (Mg)-Total	0.0050	9.60	9.75	1.55	0.0050	7.52	7.66	1.84
Manganese (Mn)-Total	0.00010	0.0132	0.00824	46.27	0.00010	0.00880	0.00884	0.45
Mercury (Hg)-Total	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Total	0.000050	0.000952	0.000868	9.23	0.000050	0.00101	0.00101	0.00
Nickel (Ni)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Total	0.050	0.069	0.082	nc	0.050	0.057	0.071	nc
Potassium (K)-Total	0.050	3.08	2.90	6.02	0.050	3.46	3.43	0.87
Rhenium (Re)-Total	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00020	0.00081	0.00074	nc	0.00020	0.00141	0.00144	2.11
Selenium (Se)-Total	0.000050	<0.000050	0.000056	nc	0.000050	0.000208	0.000173	nc
Silicon (Si)-Total	0.10	10.7	10.5	1.89	0.10	8.13	8.42	3.50
Silver (Ag)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Total	0.050	10.7	10.8	0.93	0.050	10.5	10.3	1.92
Strontium (Sr)-Total	0.00020	0.0974	0.0898	8.12	0.00020	0.113	0.116	2.62
Sulfur (S)-Total	0.50	4.34	4.46	2.73	0.50	4.72	4.86	2.92
Tellurium (Te)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Total	0.00030	0.00070	0.00031	nc	0.00030	0.00101	0.00089	nc
Tungsten (W)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Total	0.000010	0.000092	0.000084	9.09	0.000010	0.000098	0.000096	2.06
Vanadium (V)-Total	0.00050	<0.00050	0.00055	nc	0.00050	0.00091	0.00086	nc
Yttrium (Y)-Total	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	0.0030	<0.0030	<0.0030	nc	0.0030	0.0335	0.0340	1.48
Zirconium (Zr)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3 25-Jul-2019 11:55 L2317366-2 Water	Parent WT3/DUP 25-Jul-2019 11:55 L2317366-2 Water	Duplicate DUP 25-Jul-2019 11:56 L2317366-10 Water	RPD	MDL WT11/DUP 1-Aug-2019 11:15 L2321653-5 Water	Parent WT11 1-Aug-2019 11:15 L2321653-5 Water	Duplicate DUP 1-Aug-2019 11:15 L2321653-8 Water	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		LAB	FIELD			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0030	0.0036	nc	0.0010	0.0031	0.0045	nc
Antimony (Sb)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	0.00014	0.00014	nc
Arsenic (As)-Dissolved	0.00010	0.00521	0.00483	7.57	0.00010	0.00286	0.00287	0.35
Barium (Ba)-Dissolved	0.00010	0.00530	0.00511	3.65	0.00010	0.0169	0.0169	0.00
Beryllium (Be)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	0.015	0.015	nc	0.010	0.026	0.025	nc
Cadmium (Cd)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	0.0000077	0.0000115	nc
Calcium (Ca)-Dissolved	0.050	25.5	26.8	4.97	0.050	30.0	29.6	1.34
Cesium (Cs)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	0.00050	0.00366	nc
Gallium (Ga)-Dissolved	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	0.010	<0.010	0.047	nc	0.010	0.016	0.023	nc
Lead (Pb)-Dissolved	0.000050	<0.000050	0.000052	nc	0.000050	<0.000050	0.000125	nc
Lithium (Li)-Dissolved	0.0010	0.0012	0.0012	nc	0.0010	<0.0010	<0.0010	nc
Magnesium (Mg)-Dissolved	0.0050	9.62	9.31	3.28	0.0050	7.69	7.95	3.32
Manganese (Mn)-Dissolved	0.00010	0.00129	0.00228	55.46	0.00010	0.00774	0.00791	2.17
Mercury (Hg)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Dissolved	0.000050	0.000897	0.000931	3.72	0.000050	0.000999	0.000965	3.46
Nickel (Ni)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	0.069	0.066	nc	0.050	<0.050	<0.050	nc
Potassium (K)-Dissolved	0.050	2.91	3.02	3.71	0.050	3.29	3.30	0.30
Rhenium (Re)-Dissolved	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	0.00020	0.00073	0.00080	nc	0.00020	0.00137	0.00136	0.73
Selenium (Se)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	0.000197	0.000161	nc
Silicon (Si)-Dissolved	0.050	10.4	10.5	0.96	0.050	8.32	8.36	0.48
Silver (Ag)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	11.1	10.6	4.61	0.050	10.2	10.3	0.98
Strontium (Sr)-Dissolved	0.00020	0.0996	0.0935	6.32	0.00020	0.110	0.109	0.91
Sulfur (S)-Dissolved	0.50	4.78	4.41	8.05	0.50	4.90	4.80	2.06
Tellurium (Te)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Dissolved	0.00010	<0.00010	0.00011	nc	0.00010	<0.00010	0.00077	nc
Titanium (Ti)-Dissolved	0.00030	<0.00030	<0.00030	nc	0.00030	<0.00030	<0.00030	nc
Tungsten (W)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Dissolved	0.000010	0.000092	0.000086	6.74	0.000010	0.000095	0.000095	0.00
Vanadium (V)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	0.00075	0.00077	nc
Yttrium (Y)-Dissolved	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.0010	0.0055	0.0028	nc	0.0010	0.0340	0.0355	4.32
Zirconium (Zr)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	0.10	<0.10	<0.10	nc	0.10	<0.10	<0.10	nc
Hydrocarbons (Water)								
F2 (C10-C16)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F3 (C16-C34)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F4 (C34-C50)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
2-Bromobenzotrifluoride, F2-F4	90.5	118.3	-	nc	91.6	93.3	-	nc
EPH10-19	-	-	-	-	-	-	-	-
EPH19-32	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride	-	-	-	-	-	-	-	-

Notes:

Orange fill indicates value greater than CCME WC

Blue fill indicates value greater than BC MOE WQ

Green fill indicates value greater than CCME WQ

^a Temperature and pH dependent.^f value is chloride-based but chloride was not mea^g guideline is based on guidance framework

- : not analyzed

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3/DUP 23-Aug-2019 11:00 L2335149-2 Water	Parent WT3 23-Aug-2019 11:00 L2335149-2 Water	Duplicate DUP 23-Aug-2019 0:00 L2335149-10 Water	RPD	MDL WT3/DUP 29-Aug-2019 11:15 L2338676-2 Water	Parent WT3 29-Aug-2019 11:15 L2338676-2 Water	Duplicate DUP 29-Aug-2019 0:00 L2338676-10 Water	RPD
Physical Tests (Water)								
Conductivity	2.0	260	269	3.40	2.0	269	270	0.37
Hardness (as CaCO ₃)	0.50	107	109	1.85	0.50	107	107	0.00
pH	0.10	8.11	8.20	1.10	0.10	8.15	8.00	1.86
Total Suspended Solids	3.0	<3.0	<3.0	nc	3.0	<3.0	3.8	nc
Turbidity	-	-	-	-	-	-	-	-
Anions and Nutrients (Water)								
Ammonia, Total (as N)	0.0050	0.0065	<0.0050	nc	0.0050	0.0202	<0.0050	nc
Nitrate (as N)	0.0050	0.0765	0.0702	8.59	0.0050	0.0520	0.0505	2.93
Nitrite (as N)	0.0010	<0.0010	<0.0010	nc	0.0010	<0.0010	<0.0010	nc
Phosphorus (P)-Total	0.0020	0.0668	0.0681	1.93	0.0020	0.0672	0.0672	0.00
Organic / Inorganic Carbon (Water)								
Total Organic Carbon	-	-	-	-	-	-	-	-
Total Metals (Water)								
Aluminum (Al)-Total	0.0030	0.0076	0.0139	nc	0.0030	0.0128	0.0072	nc
Antimony (Sb)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Arsenic (As)-Total	0.00010	0.00489	0.00485	0.82	0.00010	0.00506	0.00493	2.60
Barium (Ba)-Total	0.00010	0.00529	0.00526	0.57	0.00010	0.00497	0.00490	1.42
Beryllium (Be)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Total	0.010	0.016	0.016	nc	0.010	0.016	0.015	nc
Cadmium (Cd)-Total	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Calcium (Ca)-Total	0.050	26.6	27.5	3.33	0.050	26.7	27.1	1.49
Cesium (Cs)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Gallium (Ga)-Total	-	-	-	-	-	-	-	-
Iron (Fe)-Total	0.010	<0.010	<0.010	nc	0.010	<0.010	<0.010	nc
Lead (Pb)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Lithium (Li)-Total	0.0010	0.0013	0.0013	nc	0.0010	0.0013	0.0013	nc
Magnesium (Mg)-Total	0.0050	9.56	9.13	4.60	0.0050	9.29	9.38	0.96
Manganese (Mn)-Total	0.00010	0.00787	0.00674	15.47	0.00010	0.00808	0.00820	1.47
Mercury (Hg)-Total	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Total	0.000050	0.000908	0.000920	1.31	0.000050	0.000901	0.000891	1.12
Nickel (Ni)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Total	0.050	0.087	0.070	nc	0.050	0.084	0.089	nc
Potassium (K)-Total	0.050	2.89	2.83	2.10	0.050	2.95	2.98	1.01
Rhenium (Re)-Total	-	-	-	-	-	-	-	-
Rubidium (Rb)-Total	0.00020	0.00083	0.00079	nc	0.00020	0.00074	0.00080	nc
Selenium (Se)-Total	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Silicon (Si)-Total	0.10	11.1	11.2	0.90	0.10	10.9	10.9	0.00
Silver (Ag)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Total	0.050	10.5	10.4	0.96	0.050	10.2	10.2	0.00
Strontium (Sr)-Total	0.00020	0.0951	0.0959	0.84	0.00020	0.0972	0.0987	1.53
Sulfur (S)-Total	0.50	4.54	4.91	7.83	0.50	4.39	4.34	1.15
Tellurium (Te)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Total	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Total	0.00030	<0.00030	0.00033	nc	0.00030	<0.00030	<0.00030	nc
Tungsten (W)-Total	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Total	0.000010	0.000090	0.000094	4.35	0.000010	0.000095	0.000091	4.30
Vanadium (V)-Total	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Yttrium (Y)-Total	-	-	-	-	-	-	-	-
Zinc (Zn)-Total	0.0030	<0.0030	<0.0030	nc	0.0030	<0.0030	<0.0030	nc
Zirconium (Zr)-Total	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc

Table A1-5: Field Duplicate Relative Percent Di

	MDL WT3/DUP 23-Aug-2019 11:00 L2335149-2 Water	Parent WT3 23-Aug-2019 11:00 L2335149-2 Water	Duplicate DUP 23-Aug-2019 0:00 L2335149-10 Water	RPD	MDL WT3/DUP 29-Aug-2019 11:15 L2338676-2 Water	Parent WT3 29-Aug-2019 11:15 L2338676-2 Water	Duplicate DUP 29-Aug-2019 0:00 L2338676-10 Water	RPD
Dissolved Metals (Water)								
Dissolved Metals Filtration Location		FIELD	FIELD			FIELD	FIELD	
Aluminum (Al)-Dissolved	0.0010	0.0026	0.0027	nc	0.0010	0.0035	0.0032	nc
Antimony (Sb)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Arsenic (As)-Dissolved	0.00010	0.00520	0.00507	2.53	0.00010	0.00524	0.00525	0.19
Barium (Ba)-Dissolved	0.00010	0.00526	0.00516	1.92	0.00010	0.00535	0.00525	1.89
Beryllium (Be)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Bismuth (Bi)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Boron (B)-Dissolved	0.010	0.016	0.016	nc	0.010	0.016	0.016	nc
Cadmium (Cd)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Calcium (Ca)-Dissolved	0.050	27.4	28.1	2.52	0.050	26.7	27.2	1.86
Cesium (Cs)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Chromium (Cr)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Cobalt (Co)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Copper (Cu)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Gallium (Ga)-Dissolved	-	-	-	-	-	-	-	-
Iron (Fe)-Dissolved	0.010	<0.010	<0.010	nc	0.010	<0.010	-	nc
Lead (Pb)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Lithium (Li)-Dissolved	0.0010	0.0013	0.0013	nc	0.0010	0.0012	0.0012	nc
Magnesium (Mg)-Dissolved	0.0050	9.46	9.35	1.17	0.0050	9.76	9.50	2.70
Manganese (Mn)-Dissolved	0.00010	0.00181	0.00175	3.37	0.00010	0.00167	0.00180	7.49
Mercury (Hg)-Dissolved	0.0000050	<0.0000050	<0.0000050	nc	0.0000050	<0.0000050	<0.0000050	nc
Molybdenum (Mo)-Dissolved	0.000050	0.000962	0.000989	2.77	0.000050	0.000905	0.000905	0.00
Nickel (Ni)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Phosphorus (P)-Dissolved	0.050	0.068	0.068	nc	0.050	0.064	0.076	nc
Potassium (K)-Dissolved	0.050	3.09	3.01	2.62	0.050	3.05	3.04	0.33
Rhenium (Re)-Dissolved	-	-	-	-	-	-	-	-
Rubidium (Rb)-Dissolved	0.00020	0.00074	0.00076	nc	0.00020	0.00080	0.00082	nc
Selenium (Se)-Dissolved	0.000050	<0.000050	<0.000050	nc	0.000050	<0.000050	<0.000050	nc
Silicon (Si)-Dissolved	0.050	11.0	10.8	1.83	0.050	10.5	10.5	0.00
Silver (Ag)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Sodium (Na)-Dissolved	0.050	11.1	10.8	2.74	0.050	10.8	10.5	2.82
Strontium (Sr)-Dissolved	0.00020	0.0980	0.0978	0.20	0.00020	0.0972	0.0957	1.56
Sulfur (S)-Dissolved	0.50	4.67	4.45	4.82	0.50	4.28	4.35	1.62
Tellurium (Te)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Thallium (Tl)-Dissolved	0.000010	<0.000010	<0.000010	nc	0.000010	<0.000010	<0.000010	nc
Thorium (Th)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Tin (Sn)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Titanium (Ti)-Dissolved	0.00030	<0.00030	<0.00030	nc	0.00030	<0.00030	<0.00030	nc
Tungsten (W)-Dissolved	0.00010	<0.00010	<0.00010	nc	0.00010	<0.00010	<0.00010	nc
Uranium (U)-Dissolved	0.000010	0.000094	0.000093	1.07	0.000010	0.000085	0.000087	2.33
Vanadium (V)-Dissolved	0.00050	<0.00050	<0.00050	nc	0.00050	<0.00050	<0.00050	nc
Yttrium (Y)-Dissolved	-	-	-	-	-	-	-	-
Zinc (Zn)-Dissolved	0.0010	0.0021	0.0022	nc	0.0010	0.0014	0.0019	nc
Zirconium (Zr)-Dissolved	0.00020	<0.00020	<0.00020	nc	0.00020	<0.00020	<0.00020	nc
Volatile Organic Compounds (Water)								
F1 (C6-C10)	0.10	<0.10	<0.10	nc	0.10	<0.10	<0.10	nc
Hydrocarbons (Water)								
F2 (C10-C16)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F3 (C16-C34)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
F4 (C34-C50)	0.30	<0.30	<0.30	nc	0.30	<0.30	<0.30	nc
2-Bromobenzotrifluoride, F2-F4	79.1	93.8	-	nc	95.4	93	-	nc
EPH10-19	-	-	-	-	-	-	-	-
EPH19-32	-	-	-	-	-	-	-	-
2-Bromobenzotrifluoride	-	-	-	-	-	-	-	-

Notes:

Orange fill indicates value greater than CCME WQ

Blue fill indicates value greater than BC MOE WQ

Green fill indicates value greater than CCME WQ

^a Temperature and pH dependent.^f value is chloride-based but chloride was not mea^g guideline is based on guidance framework

- : not analyzed

**WESTRIDGE MARINE TERMINAL—WATER QUALITY RESULTS: FEBRUARY AND MARCH 2018
AND MAY, JULY AND AUGUST 2019**

Appendix A Water Quality Data
October 2, 2019

A.2 LABORATORY WATER QUALITY DATA ANALYTICAL REPORTS





STANTEC CONSULTING LTD.
ATTN: Barrie Tuite
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 07-FEB-18
Report Date: 20-FEB-18 18:08 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2054174
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431
C of C Numbers: 17-665243
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-5 GRAB 07-FEB-18 12:44 WT5	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7		
Grouping	Analyte						
SEAWATER							
Physical Tests	Conductivity (uS/cm)	21500	21600	21900			
	Hardness (as CaCO3) (mg/L)	2250	2160	2150			
	pH (pH)	7.73	7.76	7.78			
	Total Suspended Solids (mg/L)	<2.0	<2.0	<2.0			
	Turbidity (NTU)	0.65	0.68	0.44			
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0116	0.0097	0.0074			
	Nitrate (as N) (mg/L)	0.263 ^{HTD}	0.266 ^{HTD}	0.265 ^{HTD}			
	Nitrite (as N) (mg/L)	<0.010	<0.010	<0.010			
	Phosphorus (P)-Total (mg/L)	0.0354	0.0374	0.0334			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.99	1.61	1.73			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0722	0.0774	0.0669			
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)	<0.0020	<0.0020	<0.0020			
	Barium (Ba)-Total (mg/L)	0.0072	0.0072	0.0068			
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	1.81	1.86	1.90			
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000050	<0.000050			
	Calcium (Ca)-Total (mg/L)	161	152	156			
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050			
	Copper (Cu)-Total (mg/L)	0.00082	0.00079	0.00091			
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)	0.045	0.040	0.027			
	Lead (Pb)-Total (mg/L)	<0.00030	<0.00030	<0.00030			
	Lithium (Li)-Total (mg/L)	0.087	0.087	0.083			
	Magnesium (Mg)-Total (mg/L)	403	452	457			
	Manganese (Mn)-Total (mg/L)	0.00532	0.00579	0.00451			
	Molybdenum (Mo)-Total (mg/L)	0.0046	0.0045	0.0043			
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050	0.051	0.051			
	Potassium (K)-Total (mg/L)	142	135	138			
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Rubidium (Rb)-Total (mg/L)	0.0568	0.0584	0.0523			
	Selenium (Se)-Total (mg/L)	<0.0020	<0.0020	<0.0020			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-5 GRAB 07-FEB-18 12:44 WT5	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7		
Grouping	Analyte						
SEAWATER							
Total Metals	Silicon (Si)-Total (mg/L)	1.9	2.2	2.0			
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Sodium (Na)-Total (mg/L)	3690	3620	3660			
	Strontium (Sr)-Total (mg/L)	2.23	2.12	2.45			
	Sulfur (S)-Total (mg/L)	306	347	359			
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050			
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010			
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050			
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010			
	Uranium (U)-Total (mg/L)	0.00107	0.00110	0.00114			
	Vanadium (V)-Total (mg/L)	0.00067	0.00076	0.00074			
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
	Zinc (Zn)-Total (mg/L)	0.0053	0.0034	0.0047			
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050			
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB			
	Aluminum (Al)-Dissolved (mg/L)	0.0443	0.0396	0.0414			
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Arsenic (As)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020			
	Barium (Ba)-Dissolved (mg/L)	0.0072	0.0072	0.0073			
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Boron (B)-Dissolved (mg/L)	1.89	1.85	1.97			
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	0.000068			
	Calcium (Ca)-Dissolved (mg/L)	157	152	147			
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Copper (Cu)-Dissolved (mg/L)	0.00065	<0.00050	0.00060			
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030			
	Lithium (Li)-Dissolved (mg/L)	0.085	0.086	0.086			
	Magnesium (Mg)-Dissolved (mg/L)	450	432	433			
	Manganese (Mn)-Dissolved (mg/L)	0.00443	0.00387	0.00353			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0048	0.0049	0.0046			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054174-5 GRAB 07-FEB-18 12:44 WT5	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7		
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	137	129	134		
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Rubidium (Rb)-Dissolved (mg/L)	0.0554	0.0574	0.0570		
	Selenium (Se)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020		
	Silicon (Si)-Dissolved (mg/L)	2.1	2.0	1.8		
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Sodium (Na)-Dissolved (mg/L)	3700	3490	3630		
	Strontium (Sr)-Dissolved (mg/L)	2.14	2.19	2.32		
	Sulfur (S)-Dissolved (mg/L)	346	332	330		
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050		
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Uranium (U)-Dissolved (mg/L)	0.00110	0.00115	0.00120		
	Vanadium (V)-Dissolved (mg/L)	0.00070	0.00068	0.00067		
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	0.0033	0.0031		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054174-1 GRAB 07-FEB-18 15:58 WT1	L2054174-2 GRAB 07-FEB-18 15:11 WT2	L2054174-3 GRAB 07-FEB-18 14:52 WT3	L2054174-4 GRAB 07-FEB-18 16:35 WT4	L2054174-5 GRAB 07-FEB-18 12:44 WT5
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	131	81.6	73.9	154	
	Hardness (as CaCO3) (mg/L)	54.1	28.7	19.0	52.1	
	pH (pH)	7.45	7.55	7.41	7.27	
	Total Suspended Solids (mg/L)	58.8	4.0	43.4	80.8	
	Turbidity (NTU)	34.1	2.93	14.1	24.1	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	0.0058	0.0109	0.0106	
	Nitrate (as N) (mg/L)	0.686	0.205	0.441	2.20	
	Nitrite (as N) (mg/L)	0.0011	0.0011	0.0014	<0.0010	
	Phosphorus (P)-Total (mg/L)	0.0186	0.018	0.0155	0.0505 ^{RRV}	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	8.25	1.60	4.04	7.83	
Total Metals	Aluminum (Al)-Total (mg/L)	0.521	0.192	0.483	3.36	
	Antimony (Sb)-Total (mg/L)	0.00014	0.00057	0.00019	0.00034	
	Arsenic (As)-Total (mg/L)	0.00237	0.00071	0.00034	0.00534	
	Barium (Ba)-Total (mg/L)	0.0114	0.00707	0.0110	0.166	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	0.016	
	Cadmium (Cd)-Total (mg/L)	0.0000165	0.0000192	0.0000203	0.00149	
	Calcium (Ca)-Total (mg/L)	13.7	8.88	5.69	22.7	
	Cesium (Cs)-Total (mg/L)	0.000018	0.000011	0.000025	0.000095	
	Chromium (Cr)-Total (mg/L)	0.00246	0.00027	0.00058	0.00410	
	Cobalt (Co)-Total (mg/L)	0.00049	<0.00010	0.00021	0.00468	
	Copper (Cu)-Total (mg/L)	0.00259	0.00145	0.00228	0.0323	
	Iron (Fe)-Total (mg/L)	2.01	0.167	0.455	21.3	
	Lead (Pb)-Total (mg/L)	0.000760	0.000288	0.000854	0.0313	
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Total (mg/L)	3.70	1.09	1.23	3.32	
	Manganese (Mn)-Total (mg/L)	0.0644	0.00579	0.0401	2.48	
	Molybdenum (Mo)-Total (mg/L)	0.000459	0.000495	0.000153	0.000283	
	Nickel (Ni)-Total (mg/L)	0.00130	<0.00050	0.00065	0.0146	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.419	
	Potassium (K)-Total (mg/L)	1.07	1.04	0.670	2.63	
	Rubidium (Rb)-Total (mg/L)	0.00063	0.00075	0.00076	0.00236	
	Selenium (Se)-Total (mg/L)	0.000257	0.000133	<0.000050	0.000186	
	Silicon (Si)-Total (mg/L)	8.08	2.89	2.73	8.87	
	Silver (Ag)-Total (mg/L)	0.000019	<0.000010	<0.000010	0.000098	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7	L2054174-8 GRAB 07-FEB-18 BLANK-F1	L2054174-9 GRAB 07-FEB-18 FIELD DUP	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)				<2.0	156	
	Hardness (as CaCO3) (mg/L)				<0.50	44.9	
	pH (pH)				5.67	7.28	
	Total Suspended Solids (mg/L)				<3.0	41.0	
	Turbidity (NTU)				<0.10	14.6	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)				<0.0050	<0.0050	
	Nitrate (as N) (mg/L)				0.0076	2.21	
	Nitrite (as N) (mg/L)				<0.0010	<0.0010	
	Phosphorus (P)-Total (mg/L)				<0.0020	0.0384 ^{RRV}	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)				<0.50	6.99	
Total Metals	Aluminum (Al)-Total (mg/L)				<0.0030	0.330	
	Antimony (Sb)-Total (mg/L)				<0.00010	0.00015	
	Arsenic (As)-Total (mg/L)				<0.00010	0.00075	
	Barium (Ba)-Total (mg/L)				0.000363 ^{RRV}	0.0369	
	Beryllium (Be)-Total (mg/L)				<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)				<0.000050	<0.000050	
	Boron (B)-Total (mg/L)				<0.010	0.013	
	Cadmium (Cd)-Total (mg/L)				<0.0000050	0.000127	
	Calcium (Ca)-Total (mg/L)				<0.050	15.3	
	Cesium (Cs)-Total (mg/L)				<0.000010	0.000013	
	Chromium (Cr)-Total (mg/L)				<0.00010	0.00053	
	Cobalt (Co)-Total (mg/L)				<0.00010	0.00042	
	Copper (Cu)-Total (mg/L)				<0.00050	0.00392	
	Iron (Fe)-Total (mg/L)				<0.010	2.04	
	Lead (Pb)-Total (mg/L)				<0.000050	0.00250	
	Lithium (Li)-Total (mg/L)				<0.0010	<0.0010	
	Magnesium (Mg)-Total (mg/L)				<0.0050	2.16	
	Manganese (Mn)-Total (mg/L)				<0.00010	0.154	
	Molybdenum (Mo)-Total (mg/L)				<0.000050	0.000062	
	Nickel (Ni)-Total (mg/L)				<0.00050	0.00161	
	Phosphorus (P)-Total (mg/L)				<0.050	0.053	
	Potassium (K)-Total (mg/L)				<0.050	2.52	
	Rubidium (Rb)-Total (mg/L)				<0.00020	0.00162	
	Selenium (Se)-Total (mg/L)				<0.000050	<0.000050	
	Silicon (Si)-Total (mg/L)				<0.10	6.40	
	Silver (Ag)-Total (mg/L)				<0.000010	<0.000010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-1 GRAB 07-FEB-18 15:58 WT1	L2054174-2 GRAB 07-FEB-18 15:11 WT2	L2054174-3 GRAB 07-FEB-18 14:52 WT3	L2054174-4 GRAB 07-FEB-18 16:35 WT4	L2054174-5 GRAB 07-FEB-18 12:44 WT5
Grouping	Analyte						
WATER							
Total Metals	Sodium (Na)-Total (mg/L)	7.07	4.72	7.20	9.48		
	Strontium (Sr)-Total (mg/L)	0.0791	0.0307	0.0313	0.136		
	Sulfur (S)-Total (mg/L)	2.33	1.00	0.80	2.18		
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000028		
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00045		
	Titanium (Ti)-Total (mg/L)	0.0178	0.00697	0.0188	0.0827		
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Total (mg/L)	0.000105	0.000019	0.000017	0.000101		
	Vanadium (V)-Total (mg/L)	0.00363	0.00087	0.00145	0.00863		
	Zinc (Zn)-Total (mg/L)	0.0057	0.0207	0.0212	0.351		
	Zirconium (Zr)-Total (mg/L)	0.000282	0.000127	0.000091	0.000312		
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB	LAB		
	Aluminum (Al)-Dissolved (mg/L)	0.0716	0.0191	0.0256	0.0160		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00051	0.00013	0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00058	0.00059	0.00012	0.00015		
	Barium (Ba)-Dissolved (mg/L)	0.00732	0.00551	0.00747	0.0285		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.013		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000058	0.0000181	<0.0000050	0.0000273		
	Calcium (Ca)-Dissolved (mg/L)	14.0	9.34	5.72	16.4		
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010		
	Chromium (Cr)-Dissolved (mg/L)	0.00109	0.00013	<0.00010	0.00022		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00159	0.00093	0.00095	0.00176		
	Iron (Fe)-Dissolved (mg/L)	0.134	<0.010	<0.010	0.041		
	Lead (Pb)-Dissolved (mg/L)	0.000071	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)	4.66	1.32	1.14	2.72		
	Manganese (Mn)-Dissolved (mg/L)	0.00230	0.00039	0.00018	0.00064		
	Molybdenum (Mo)-Dissolved (mg/L)	0.000396	0.000515	0.000113	<0.000050		
	Nickel (Ni)-Dissolved (mg/L)	0.00065	<0.00050	<0.00050	0.00074		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.04	1.02	0.677	2.50		
	Rubidium (Rb)-Dissolved (mg/L)	0.00047	0.00060	0.00056	0.00158		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7	L2054174-8 GRAB 07-FEB-18 BLANK-F1	L2054174-9 GRAB 07-FEB-18 FIELD DUP	
Grouping	Analyte						
WATER							
Total Metals	Sodium (Na)-Total (mg/L)				<0.050	8.69	
	Strontium (Sr)-Total (mg/L)				<0.00020	0.0951	
	Sulfur (S)-Total (mg/L)				<0.50	2.06	
	Tellurium (Te)-Total (mg/L)				<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)				<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)				<0.00010	<0.00010	
	Tin (Sn)-Total (mg/L)				<0.00010	0.00012	
	Titanium (Ti)-Total (mg/L)				<0.00030	0.0104	
	Tungsten (W)-Total (mg/L)				<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)				<0.000010	0.000010	
	Vanadium (V)-Total (mg/L)				<0.00050	0.00105	
	Zinc (Zn)-Total (mg/L)				<0.0030	0.0440	
	Zirconium (Zr)-Total (mg/L)				<0.000060	0.000130	
Dissolved Metals	Dissolved Metals Filtration Location				LAB	LAB	
	Aluminum (Al)-Dissolved (mg/L)				<0.0010	0.0185	
	Antimony (Sb)-Dissolved (mg/L)				<0.00010	0.00011	
	Arsenic (As)-Dissolved (mg/L)				<0.00010	0.00015	
	Barium (Ba)-Dissolved (mg/L)				<0.000050	0.0258	
	Beryllium (Be)-Dissolved (mg/L)				<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)				<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)				<0.010	0.011	
	Cadmium (Cd)-Dissolved (mg/L)				<0.0000050	0.0000292	
	Calcium (Ca)-Dissolved (mg/L)				<0.050	14.0	
	Cesium (Cs)-Dissolved (mg/L)				<0.000010	<0.000010	
	Chromium (Cr)-Dissolved (mg/L)				<0.00010	0.00013	
	Cobalt (Co)-Dissolved (mg/L)				<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)				<0.00020	0.00143	
	Iron (Fe)-Dissolved (mg/L)				<0.010	0.030	
	Lead (Pb)-Dissolved (mg/L)				<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)				<0.0010	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)				<0.0050	2.44	
	Manganese (Mn)-Dissolved (mg/L)				<0.00010	0.00145	
	Molybdenum (Mo)-Dissolved (mg/L)				<0.000050	<0.000050	
	Nickel (Ni)-Dissolved (mg/L)				<0.00050	0.00058	
	Phosphorus (P)-Dissolved (mg/L)				<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)				<0.050	2.41	
	Rubidium (Rb)-Dissolved (mg/L)				<0.00020	0.00140	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2054174-1 GRAB 07-FEB-18 15:58 WT1	L2054174-2 GRAB 07-FEB-18 15:11 WT2	L2054174-3 GRAB 07-FEB-18 14:52 WT3	L2054174-4 GRAB 07-FEB-18 16:35 WT4	L2054174-5 GRAB 07-FEB-18 12:44 WT5
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	0.000153	<0.000050	<0.000050	<0.000050	
	Silicon (Si)-Dissolved (mg/L)	7.40	2.64	2.25	6.16	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	7.26	4.86	7.59	9.87	
	Strontium (Sr)-Dissolved (mg/L)	0.0697	0.0296	0.0270	0.0878	
	Sulfur (S)-Dissolved (mg/L)	1.97	0.83	0.84	2.21	
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00144	<0.00030	0.00053	<0.00030	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.000046	0.000011	<0.000010	<0.000010	
	Vanadium (V)-Dissolved (mg/L)	0.00071	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0017	0.0156	0.0077	0.0153	
	Zirconium (Zr)-Dissolved (mg/L)	0.000120	<0.000060	<0.000060	<0.000060	
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	89.9	88.4	89.1	85.9	87.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2054174-6 GRAB 07-FEB-18 12:30 WT6	L2054174-7 GRAB 07-FEB-18 12:13 WT7	L2054174-8 GRAB 07-FEB-18 BLANK-F1	L2054174-9 GRAB 07-FEB-18 FIELD DUP	
Grouping	Analyte						
WATER							
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)				<0.000050	<0.000050	
	Silicon (Si)-Dissolved (mg/L)				<0.050	5.71	
	Silver (Ag)-Dissolved (mg/L)				<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)				<0.050	8.65	
	Strontium (Sr)-Dissolved (mg/L)				<0.00020	0.0870	
	Sulfur (S)-Dissolved (mg/L)				<0.50	1.86	
	Tellurium (Te)-Dissolved (mg/L)				<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)				<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)				<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)				<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)				<0.00030	<0.00030	
	Tungsten (W)-Dissolved (mg/L)				<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)				<0.000010	<0.000010	
	Vanadium (V)-Dissolved (mg/L)				<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)				<0.0010	0.0166	
	Zirconium (Zr)-Dissolved (mg/L)				<0.000060	0.000065	
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25	
	Surrogate: 2-Bromobenzotrifluoride (%)	85.7	86.6	82.8	88.8		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Cadmium (Cd)-Total	MB-LOR	L2054174-5, -6, -7
Method Blank	Nickel (Ni)-Total	MB-LOR	L2054174-5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L2054174-1, -2, -3, -8, -9
Matrix Spike	Total Organic Carbon	MS-B	L2054174-4
Matrix Spike	Total Organic Carbon	MS-B	L2054174-4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2054174-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2054174-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2054174-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2054174-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2054174-8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2054174-1, -2, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2054174-4
Matrix Spike	Barium (Ba)-Total	MS-B	L2054174-3, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2054174-4
Matrix Spike	Boron (B)-Total	MS-B	L2054174-3, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054174-1, -2, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054174-3, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054174-4
Matrix Spike	Copper (Cu)-Total	MS-B	L2054174-1, -2, -8, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2054174-4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054174-1, -2, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054174-3, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054174-4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2054174-4
Matrix Spike	Potassium (K)-Total	MS-B	L2054174-3, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2054174-4
Matrix Spike	Sodium (Na)-Total	MS-B	L2054174-3, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2054174-4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054174-1, -2, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054174-3, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054174-4
Matrix Spike	Titanium (Ti)-Total	MS-B	L2054174-4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2054174-5, -6, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2054174-5, -6, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2054174-5, -6, -7
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2054174-5, -6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2054174-5, -6, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2054174-5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Reference Information

MB-LOR

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

RRV Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CARBONS-C-TOC-VA	Seawater	TOC by combustion (seawater)	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-D-L-HRMS-VA	Seawater	Diss. Metals in Seawater by HR-ICPMS	EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration based on APHA Method 3030B.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-L-HRMS-VA	Seawater	Tot. Metals in Seawater by HR-ICPMS	EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion based on APHA Method 3030E.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			

Reference Information

NO2-L-IC-N-VA Seawater Nitrite in Seawater by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Seawater Nitrate in Seawater by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-T-PRES-COL-VA Seawater Total P in Seawater by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

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.

TURBIDITY-C-VA Seawater Turbidity by Meter in Seawater APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

17-665243

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

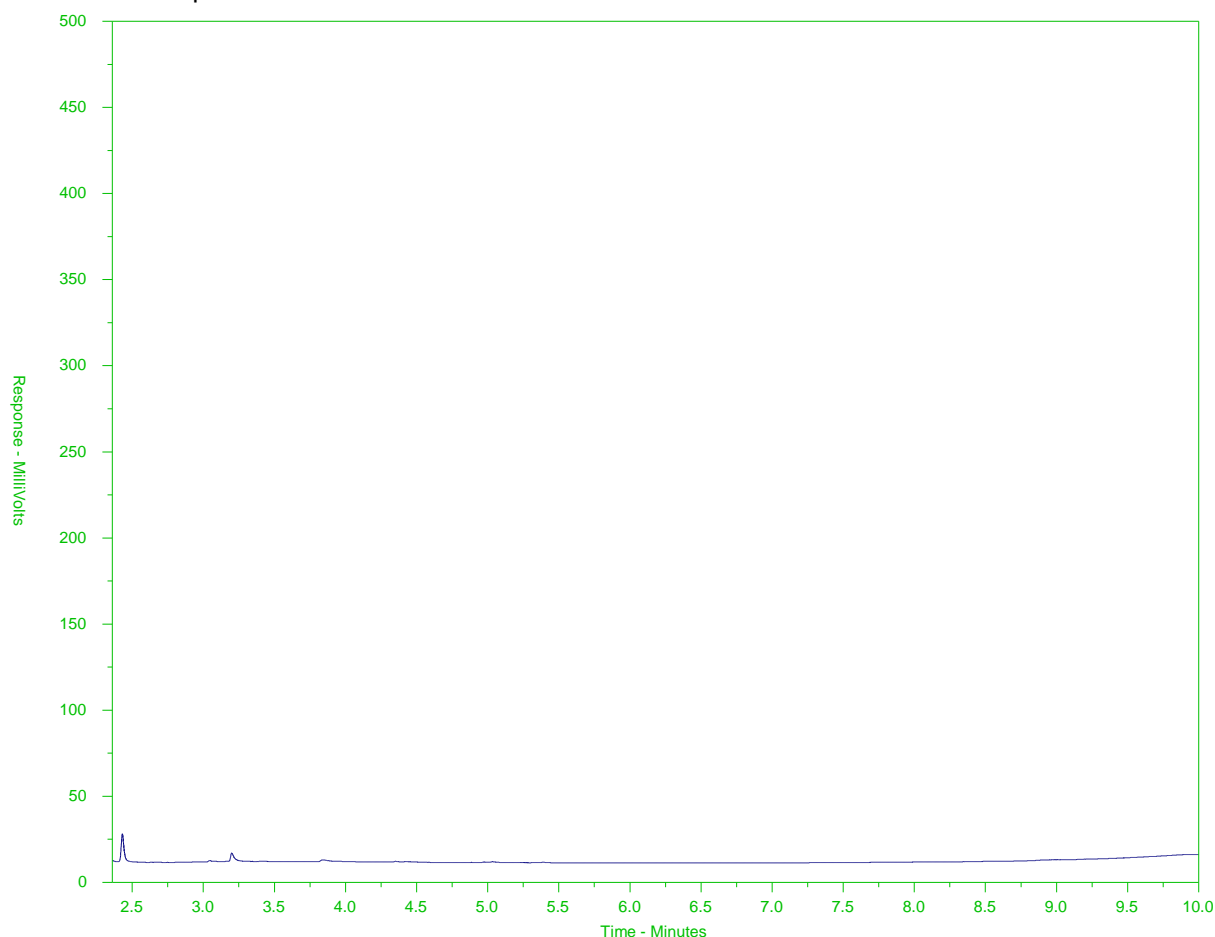
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-1
Client Sample ID: WT1



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

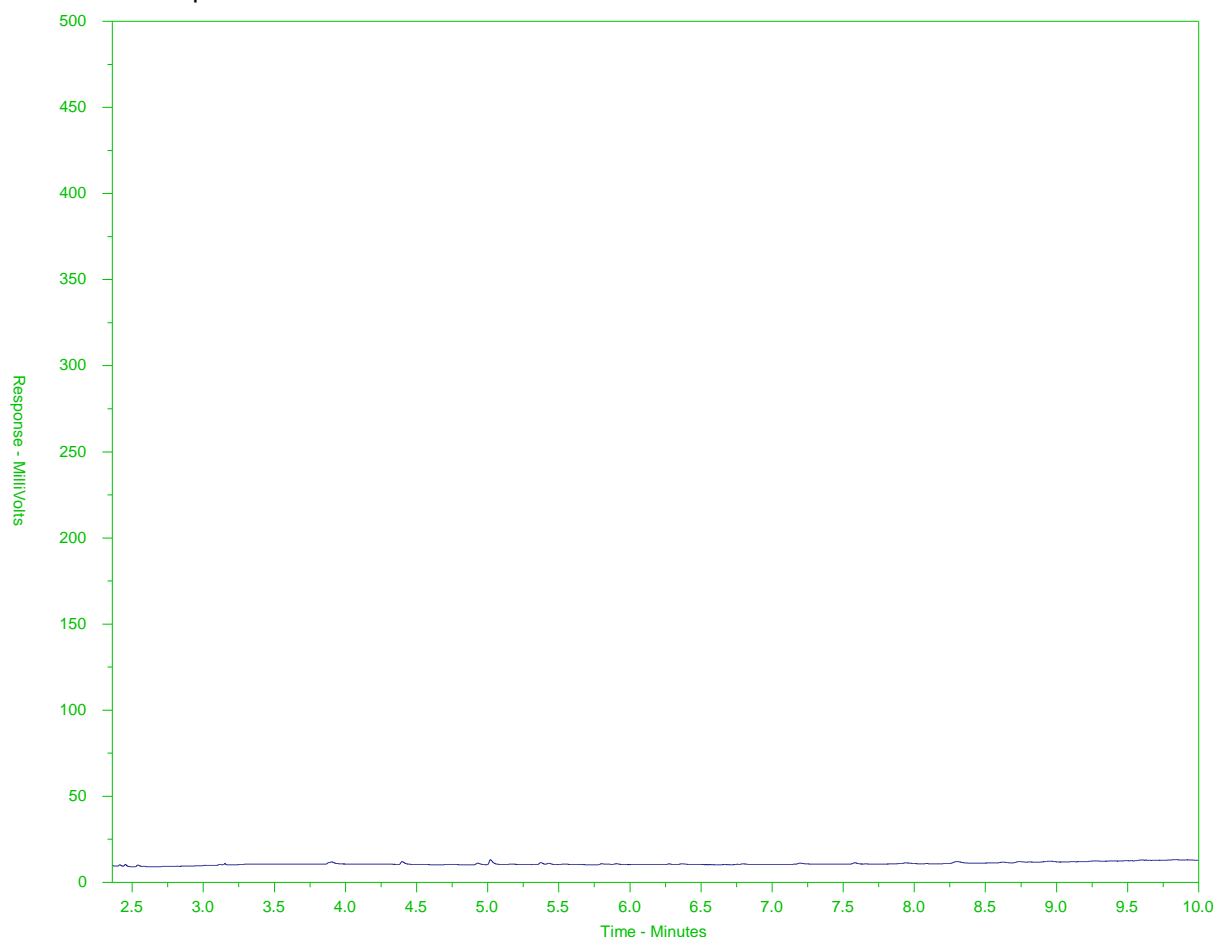
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-2
Client Sample ID: WT2



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale on left.

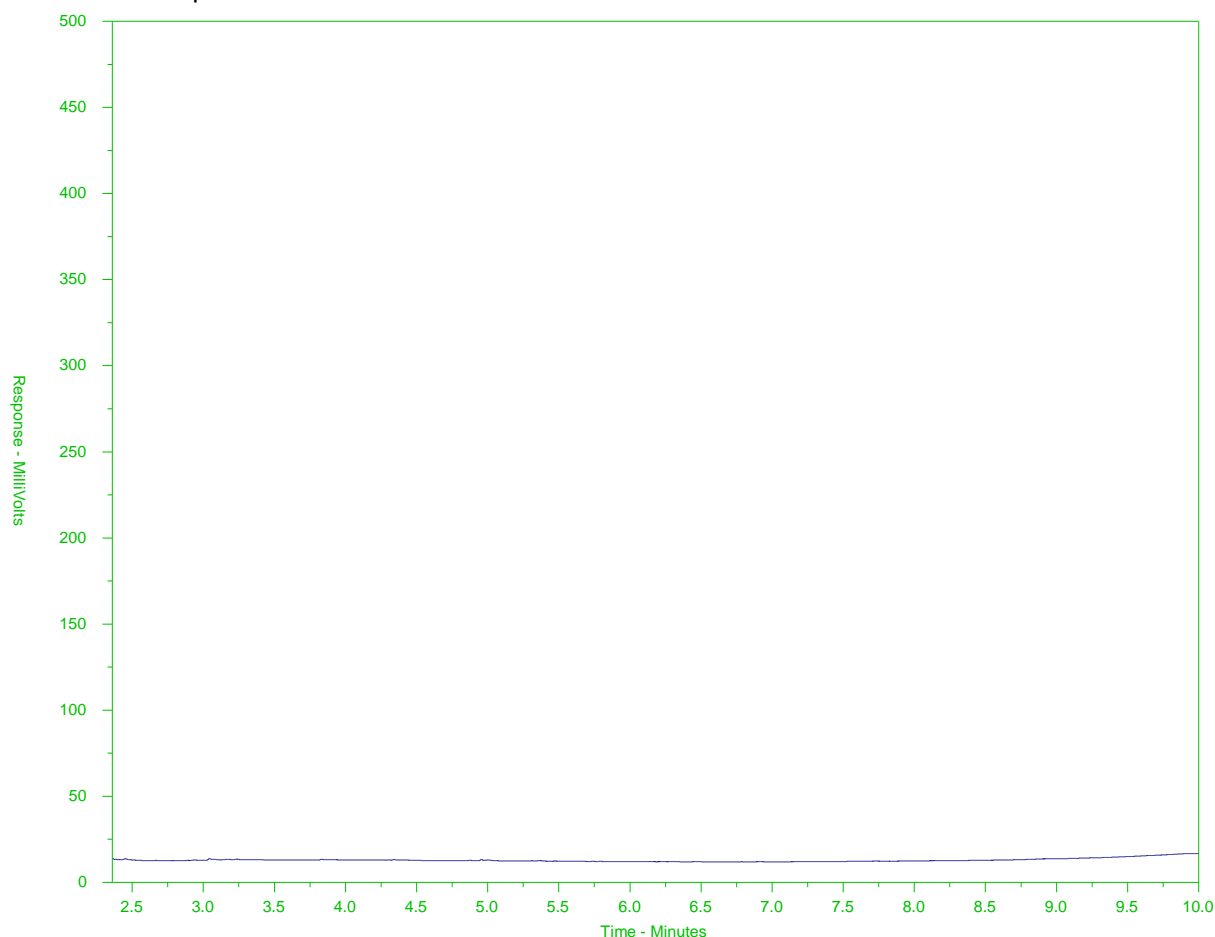
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-3
Client Sample ID: WT3



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

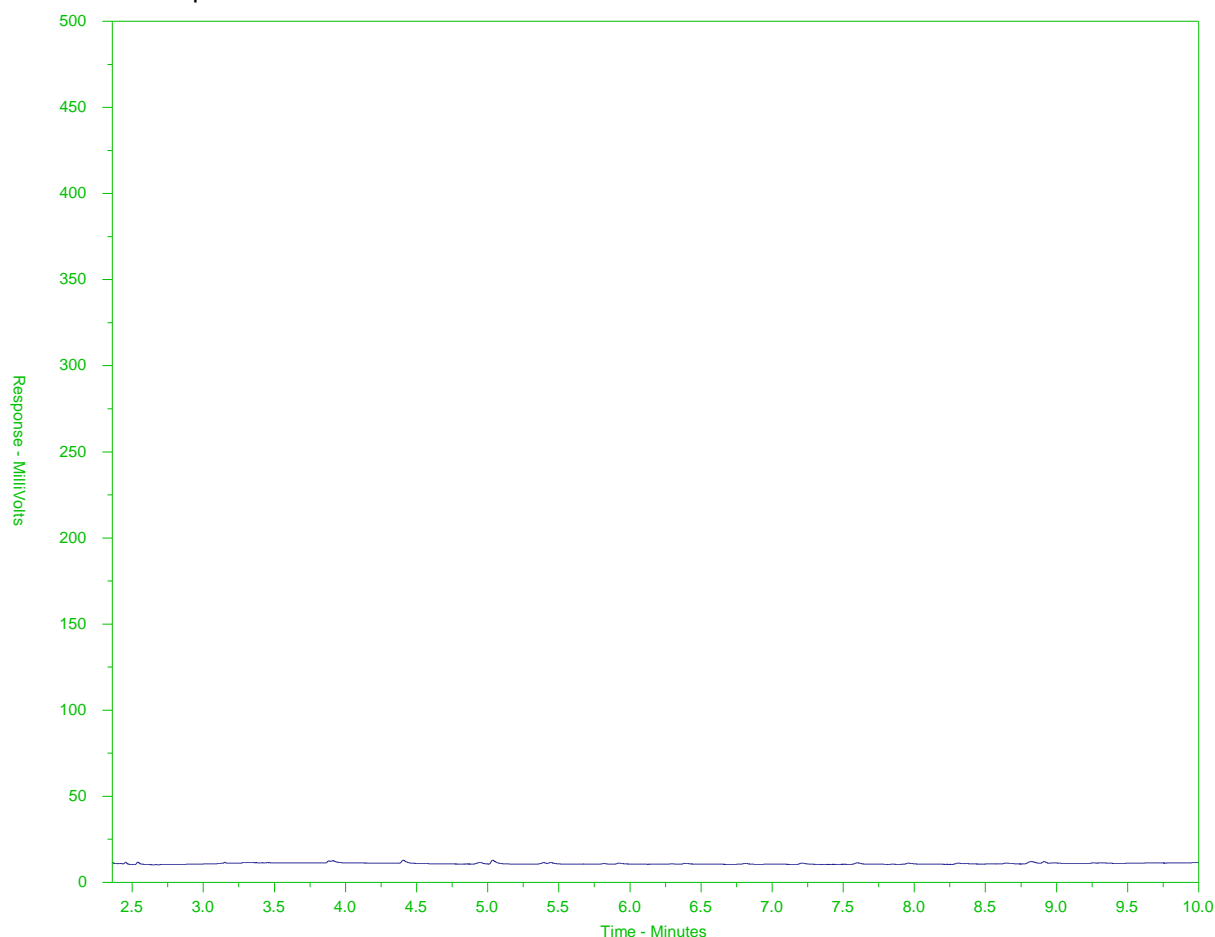
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-4
Client Sample ID: WT4



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

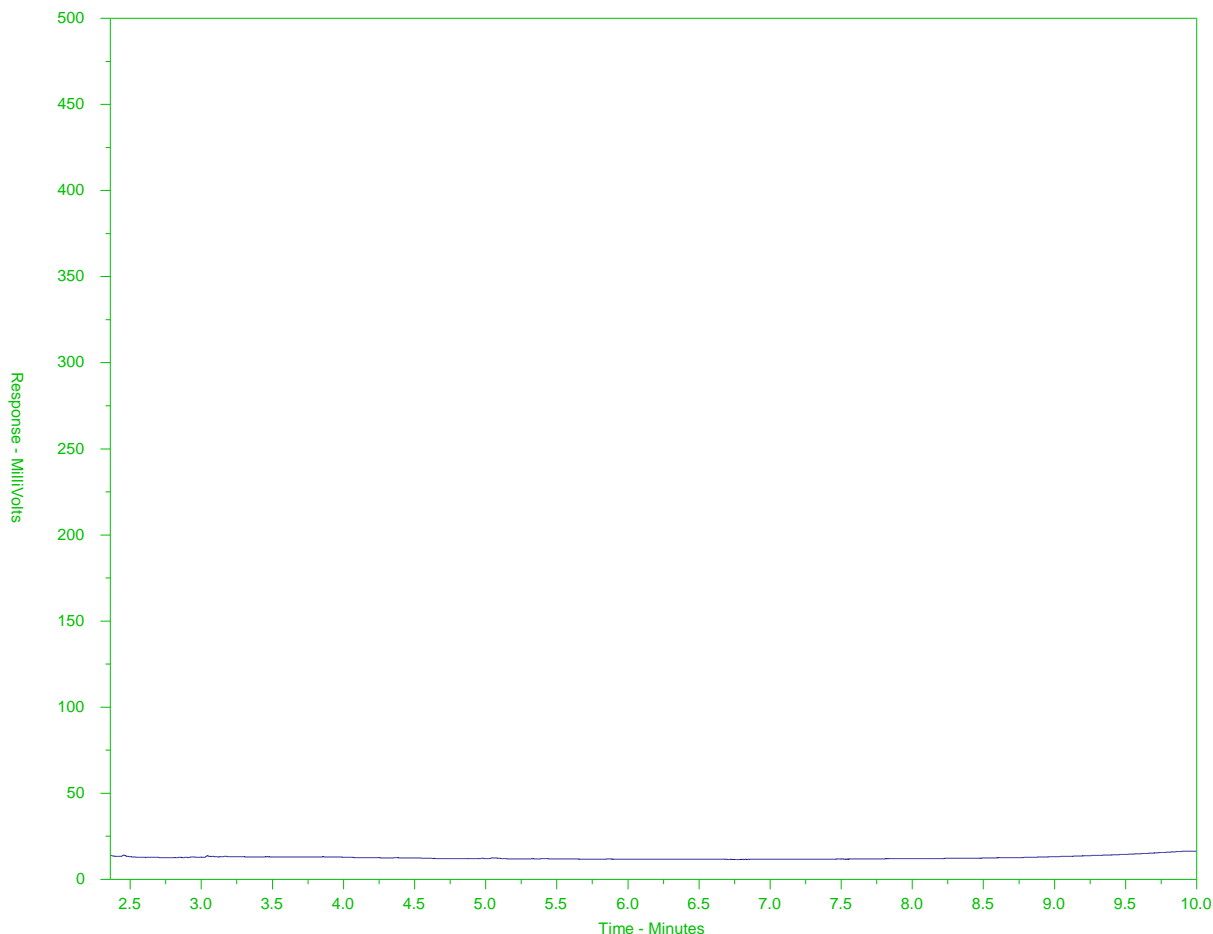
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-5
Client Sample ID: WT5



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

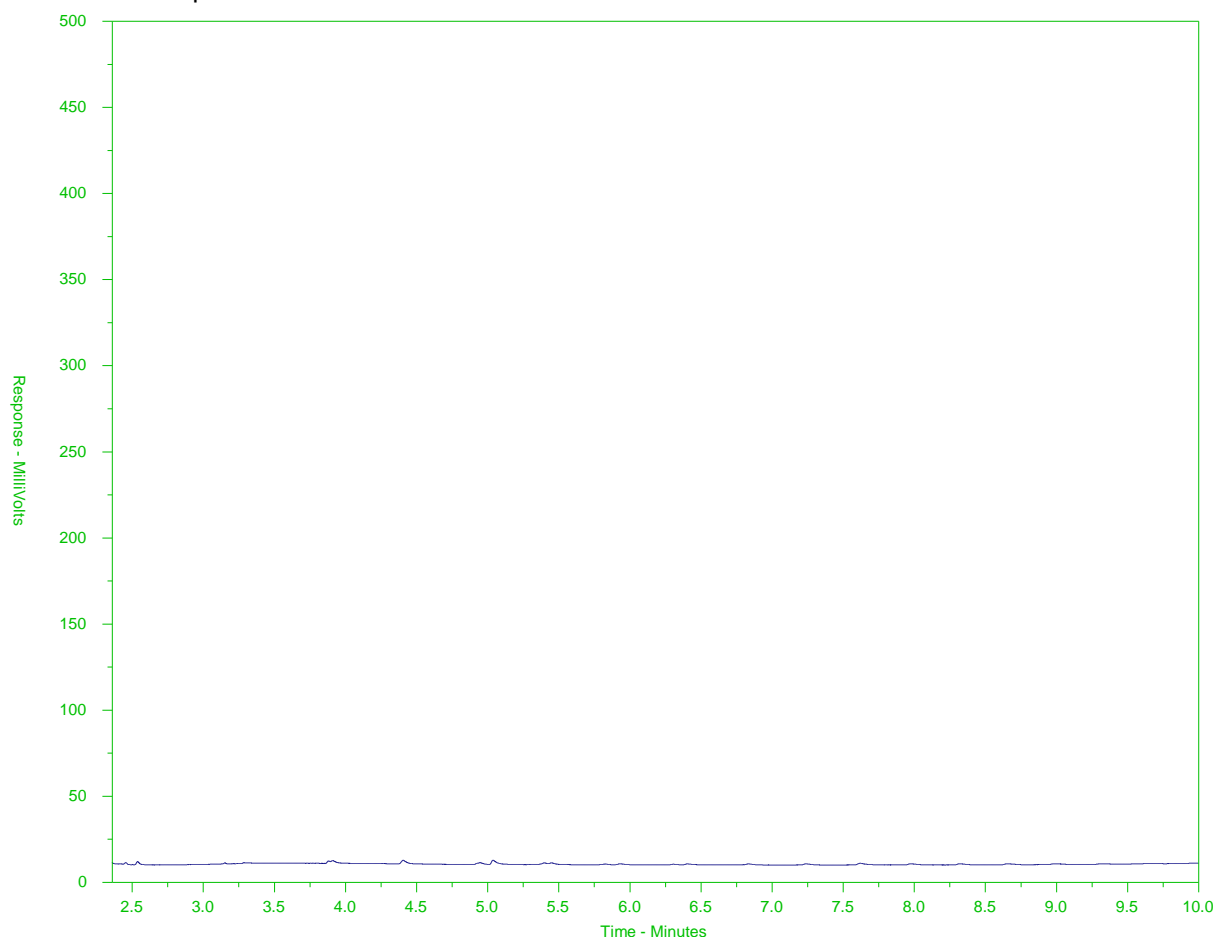
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-6
Client Sample ID: WT6



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale on left.

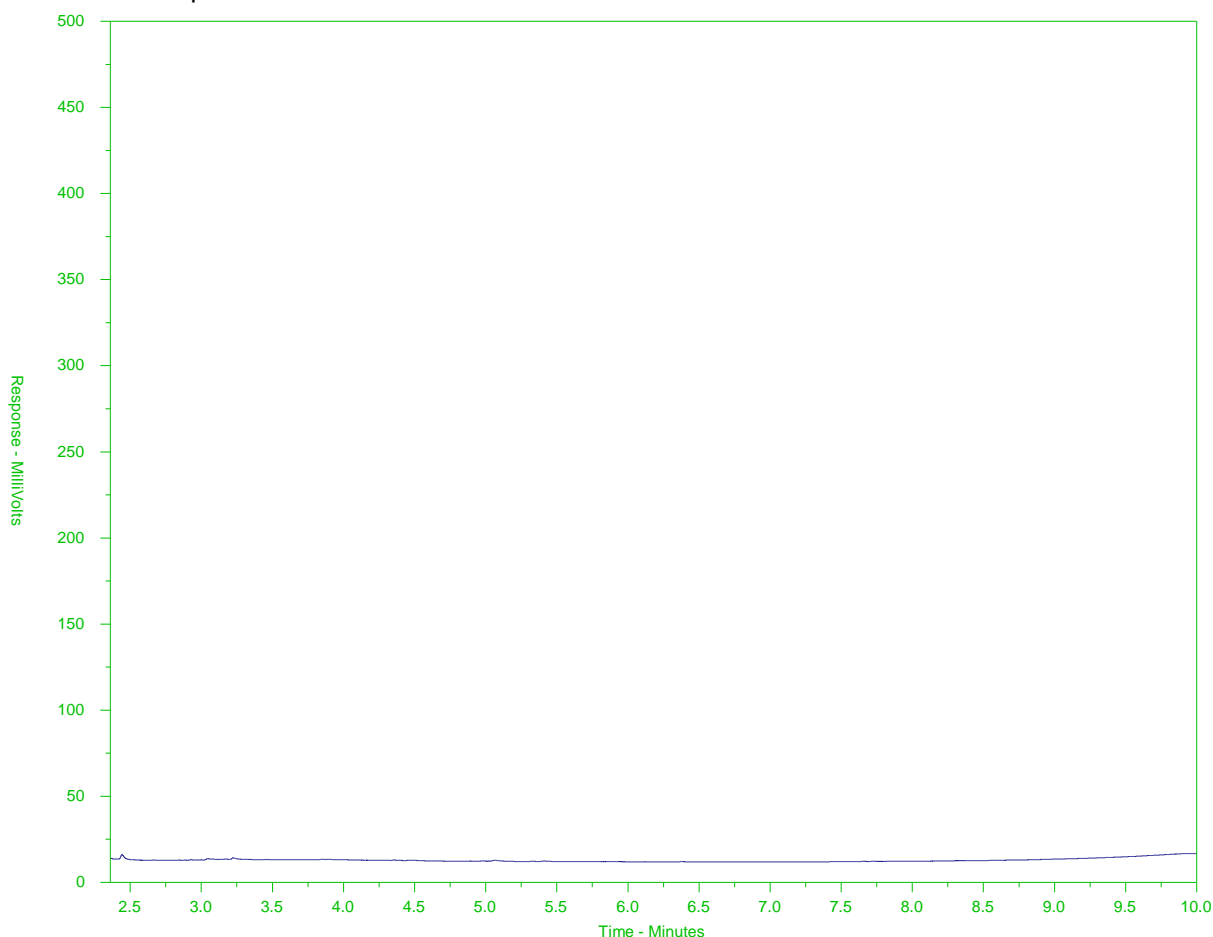
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-7
Client Sample ID: WT7



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale on left.

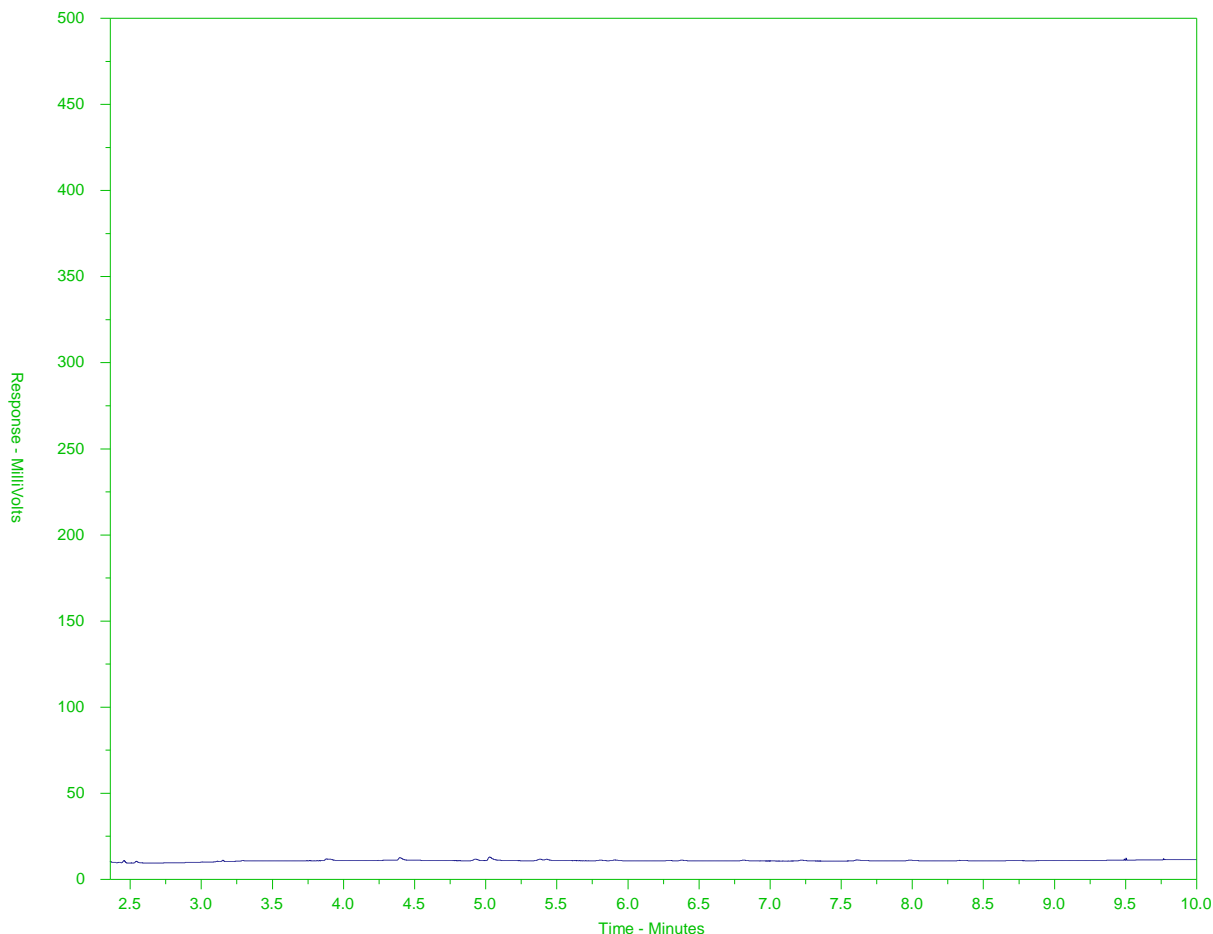
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-8
Client Sample ID: BLANK-F1



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

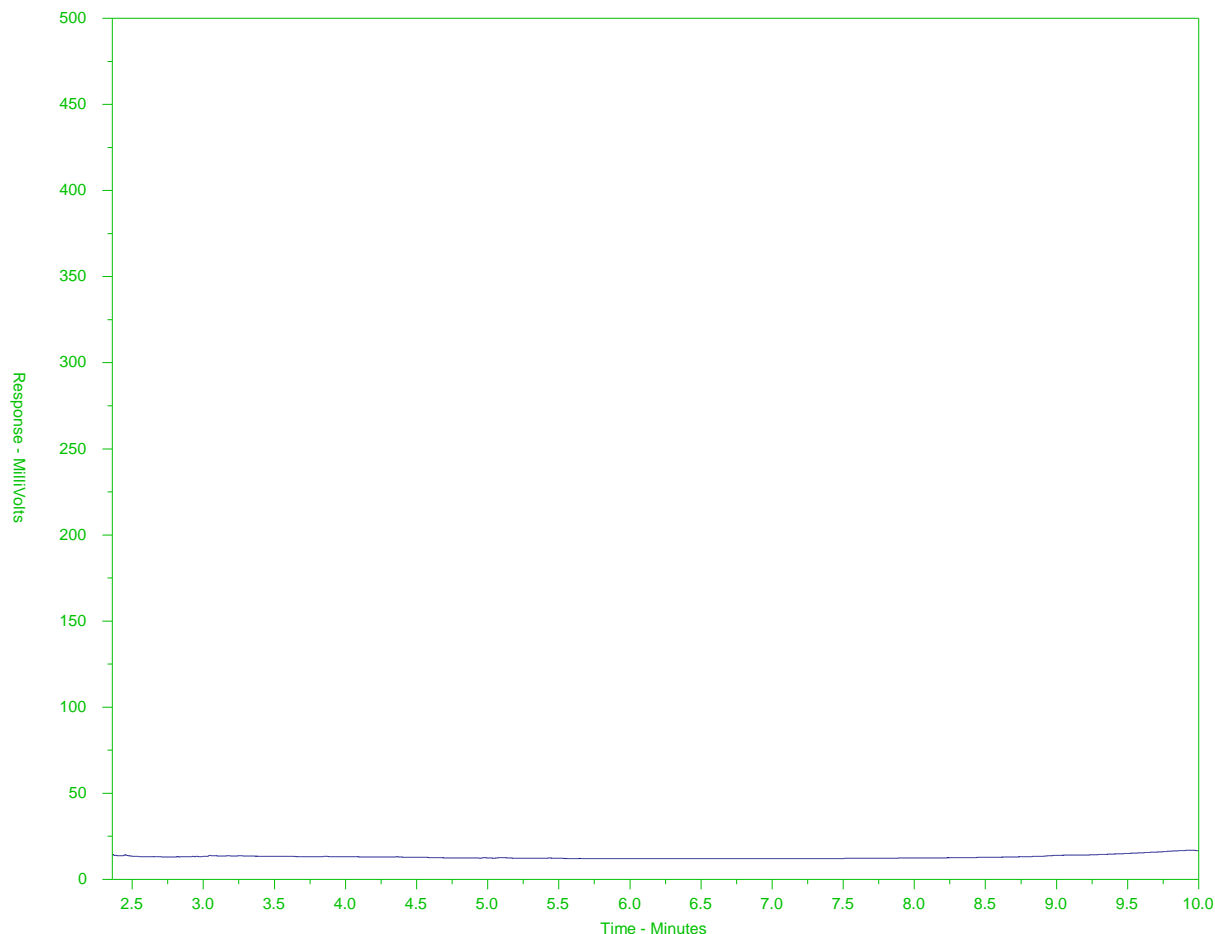
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2054174-9
Client Sample ID: FIELD DUP



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

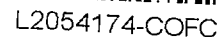
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale on left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



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www.alsglobal.com

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

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

JULY 2017 FROM



STANTEC CONSULTING LTD.
ATTN: Barrie Tuite
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 28-FEB-18
Report Date: 09-MAR-18 17:56 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2062216
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431
C of C Numbers:
Legal Site Desc:

Comments:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062216-1 Grab 28-FEB-18 16:40 WT1	L2062216-2 Grab 28-FEB-18 15:27 WT2	L2062216-3 Grab 28-FEB-18 15:03 WT3	L2062216-4 Grab 28-FEB-18 14:20 WT5	L2062216-5 Grab 28-FEB-18 14:42 WT7
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	161	423	1020	36800	36900
	Hardness (as CaCO3) (mg/L)	59.9	55.5	62.3	4270	4250
	pH (pH)	7.81	7.65	7.56	7.80	7.78
	Total Suspended Solids (mg/L)	22.7	43.1	53.1	30.5	25.1
	Turbidity (NTU)	10.3	51.0	48.4	0.94	1.12
Total Metals	Aluminum (Al)-Total (mg/L)	0.458	2.72	1.91	<0.15 ^{DLA}	<0.060 ^{DLA}
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00034	0.00023	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Arsenic (As)-Total (mg/L)	0.00135	0.00233	0.00123	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Barium (Ba)-Total (mg/L)	0.00998	0.0378	0.0954	0.0109	0.0082
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.0025 ^{DLA}	<0.0010 ^{DLA}
	Boron (B)-Total (mg/L)	0.011	0.010	<0.010	2.69	3.15
	Cadmium (Cd)-Total (mg/L)	0.0000178	0.0000763	0.0000600	<0.00025 ^{DLA}	<0.00010 ^{DLA}
	Calcium (Ca)-Total (mg/L)	15.7	19.0	20.1	256	295
	Cesium (Cs)-Total (mg/L)	0.000014	0.000197	0.000154	<0.00050 ^{DLA}	0.00020 ^{DLA}
	Chromium (Cr)-Total (mg/L)	0.00324	0.00345	0.00237	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Cobalt (Co)-Total (mg/L)	0.00027	0.00124	0.00086	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Copper (Cu)-Total (mg/L)	0.00202	0.00856	0.00549	<0.025 ^{DLA}	<0.010 ^{DLA}
	Iron (Fe)-Total (mg/L)	0.865	2.97	2.19	<0.50 ^{DLA}	<0.20 ^{DLA}
	Lead (Pb)-Total (mg/L)	0.000895	0.00406	0.00165	<0.0025 ^{DLA}	<0.0010 ^{DLA}
	Lithium (Li)-Total (mg/L)	<0.0010	0.0022	0.0022	0.080	0.123
	Magnesium (Mg)-Total (mg/L)	4.64	2.57	3.91	806	911
	Manganese (Mn)-Total (mg/L)	0.0489	0.0719	0.0721	<0.0050 ^{DLA}	0.0072
	Molybdenum (Mo)-Total (mg/L)	0.000341	0.000473	0.000319	0.0076 ^{DLA}	0.0086 ^{DLA}
	Nickel (Ni)-Total (mg/L)	0.00108	0.00247	0.00220	<0.025 ^{DLA}	<0.010 ^{DLA}
	Phosphorus (P)-Total (mg/L)	<0.050	0.087	0.068	<2.5 ^{DLA}	<1.0 ^{DLA}
	Potassium (K)-Total (mg/L)	0.989	1.92	2.31	269	305
	Rubidium (Rb)-Total (mg/L)	0.00054	0.00223	0.00243	0.071	0.0803
	Selenium (Se)-Total (mg/L)	0.000237	0.000086	0.000065	<0.0025 ^{DLA}	<0.0010 ^{DLA}
	Silicon (Si)-Total (mg/L)	8.31	5.57	5.42	<5.0 ^{DLA}	<2.0 ^{DLA}
	Silver (Ag)-Total (mg/L)	<0.000010	0.000026	0.000020	<0.00050 ^{DLA}	<0.00020 ^{DLA}
	Sodium (Na)-Total (mg/L)	7.34	68.6	148	6480	7210
	Strontium (Sr)-Total (mg/L)	0.0816	0.0790	0.131	5.10	5.78
	Sulfur (S)-Total (mg/L)	2.54	1.01	1.47	593	696
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.010 ^{DLA}	<0.0040 ^{DLA}
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000010	<0.000010	<0.00050 ^{DLA}	<0.00020 ^{DLA}
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.0050 ^{DLA}	<0.0020 ^{DLA}

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062216-6 Grab 28-FEB-18 FIELD-DUP	L2062216-7 Grab 28-FEB-18 14:00 FIELD-BLANK	L2062216-8 Grab 28-FEB-18 15:50 WT8	L2062216-9 Grab 28-FEB-18 TRAVEL BLANK	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	1070	<2.0	161	<2.0	
	Hardness (as CaCO3) (mg/L)	62.9	<0.50	56.1	<0.50 ^{HTC}	
	pH (pH)	7.55	5.78	7.80	5.64	
	Total Suspended Solids (mg/L)	41.7	<3.0	25.3	<3.0	
	Turbidity (NTU)	41.9	<0.10	11.7	<0.10	
Total Metals	Aluminum (Al)-Total (mg/L)	1.64	<0.0030	0.522	<0.0030	
	Antimony (Sb)-Total (mg/L)	<0.0010 ^{DLA}	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	<0.0010 ^{DLA}	<0.00010	0.00134	<0.00010	
	Barium (Ba)-Total (mg/L)	0.0998	<0.000050	0.0108	<0.000050	
	Beryllium (Be)-Total (mg/L)	<0.0010 ^{DLA}	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.00050 ^{DLA}	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.10 ^{DLA}	<0.010	0.011	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.000050 ^{DLA}	<0.0000050	0.0000233	<0.0000050	
	Calcium (Ca)-Total (mg/L)	19.7	<0.050	15.8	<0.050	
	Cesium (Cs)-Total (mg/L)	0.00012	<0.000010	0.000015	<0.000010	
	Chromium (Cr)-Total (mg/L)	0.0017	<0.00010	0.00319	<0.00010	
	Cobalt (Co)-Total (mg/L)	<0.0010 ^{DLA}	<0.00010	0.00031	<0.00010	
	Copper (Cu)-Total (mg/L)	<0.0050 ^{DLA}	<0.00050	0.00217	<0.00050	
	Iron (Fe)-Total (mg/L)	1.93	<0.010	0.976	<0.010	
	Lead (Pb)-Total (mg/L)	0.00140	<0.000050	0.00101	<0.000050	
	Lithium (Li)-Total (mg/L)	<0.010 ^{DLA}	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Total (mg/L)	4.02	<0.0050	4.79	<0.0050	
	Manganese (Mn)-Total (mg/L)	0.0592	<0.00010	0.0553	<0.00010	
	Molybdenum (Mo)-Total (mg/L)	<0.00050 ^{DLA}	<0.000050	0.000309	<0.000050	
	Nickel (Ni)-Total (mg/L)	<0.0050 ^{DLA}	<0.00050	0.00106	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.50 ^{DLA}	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	2.59	<0.050	1.01	<0.050	
	Rubidium (Rb)-Total (mg/L)	<0.0020 ^{DLA}	<0.00020	0.00055	<0.00020	
	Selenium (Se)-Total (mg/L)	<0.00050 ^{DLA}	<0.000050	0.000278	<0.000050	
	Silicon (Si)-Total (mg/L)	4.8	<0.10	8.70	<0.10	
	Silver (Ag)-Total (mg/L)	<0.00010 ^{DLA}	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	151	<0.050	7.53	<0.050	
	Strontium (Sr)-Total (mg/L)	0.135	<0.00020	0.0809	<0.00020	
	Sulfur (S)-Total (mg/L)	<5.0 ^{DLA}	<0.50	2.55	<0.50	
	Tellurium (Te)-Total (mg/L)	<0.0020 ^{DLA}	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.00010 ^{DLA}	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.0010 ^{DLA}	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062216-1 Grab 28-FEB-18 16:40 WT1	L2062216-2 Grab 28-FEB-18 15:27 WT2	L2062216-3 Grab 28-FEB-18 15:03 WT3	L2062216-4 Grab 28-FEB-18 14:20 WT5	L2062216-5 Grab 28-FEB-18 14:42 WT7
Grouping	Analyte					
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	0.00016	0.00015	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Titanium (Ti)-Total (mg/L)	0.0152	0.0937	0.0743	<0.015 ^{DLA}	<0.0060 ^{DLA}
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.0050 ^{DLA}	<0.0020 ^{DLA}
	Uranium (U)-Total (mg/L)	0.000125	0.000106	0.000044	0.00208	0.00209
	Vanadium (V)-Total (mg/L)	0.00310	0.00625	0.00492	<0.025 ^{DLA}	<0.010 ^{DLA}
	Zinc (Zn)-Total (mg/L)	0.0072	0.0581	0.0476	<0.15 ^{DLA}	<0.060 ^{DLA}
	Zirconium (Zr)-Total (mg/L)	<0.00018 ^{DLB}	<0.00030 ^{DLB}	<0.00036 ^{DLB}	<0.0030 ^{DLA}	<0.0012 ^{DLA}
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0572	0.0429	0.0469	0.044	0.021
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00023	0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Arsenic (As)-Dissolved (mg/L)	0.00079	0.00048	0.00022	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Barium (Ba)-Dissolved (mg/L)	0.00608	0.0160	0.0772	0.0089	0.0083
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.0010 ^{DLA}	<0.0010 ^{DLA}
	Boron (B)-Dissolved (mg/L)	0.010	<0.010	<0.010	3.52	3.35
	Cadmium (Cd)-Dissolved (mg/L)	0.0000053	0.0000244	0.0000302	<0.00010 ^{DLA}	<0.00010 ^{DLA}
	Calcium (Ca)-Dissolved (mg/L)	16.4	19.1	19.4	292	303
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	0.000012	<0.00020 ^{DLA}	0.00021
	Chromium (Cr)-Dissolved (mg/L)	0.00087	0.00014	0.00011	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Copper (Cu)-Dissolved (mg/L)	0.00090	0.00116	0.00137	<0.0040 ^{DLA}	<0.0040 ^{DLA}
	Iron (Fe)-Dissolved (mg/L)	0.106	0.031	0.033	<0.20 ^{DLA}	<0.20 ^{DLA}
	Lead (Pb)-Dissolved (mg/L)	0.000091	0.000054	<0.000050	<0.0010 ^{DLA}	<0.0010 ^{DLA}
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.119	0.117
	Magnesium (Mg)-Dissolved (mg/L)	4.62	1.89	3.35	860	849
	Manganese (Mn)-Dissolved (mg/L)	0.00719	0.00497	0.0100	0.0048	0.0036
	Molybdenum (Mo)-Dissolved (mg/L)	0.000212	0.000360	0.000171	0.0075	0.0079
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.010 ^{DLA}	<0.010 ^{DLA}
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<1.0 ^{DLA}	<1.0 ^{DLA}
	Potassium (K)-Dissolved (mg/L)	1.05	1.87	2.41	288	275
	Rubidium (Rb)-Dissolved (mg/L)	0.00038	0.00089	0.00166	0.0780	0.0732
	Selenium (Se)-Dissolved (mg/L)	0.000171	0.000051	0.000061	<0.0010 ^{DLA}	<0.0010 ^{DLA}
	Silicon (Si)-Dissolved (mg/L)	7.43	1.87	2.42	2.0	1.8
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.00020 ^{DLA}	<0.00020 ^{DLA}
	Sodium (Na)-Dissolved (mg/L)	7.94	71.3	169	7330	7260
	Strontium (Sr)-Dissolved (mg/L)	0.0768	0.0774	0.126	5.44	5.21
	Sulfur (S)-Dissolved (mg/L)	2.16	1.13	1.55	710	716

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2062216-6 Grab 28-FEB-18 FIELD-DUP	L2062216-7 Grab 28-FEB-18 14:00 FIELD-BLANK	L2062216-8 Grab 28-FEB-18 15:50 WT8	L2062216-9 Grab 28-FEB-18 TRAVEL BLANK	
Grouping	Analyte						
WATER							
Total Metals	Tin (Sn)-Total (mg/L)		<0.0010 ^{DLA}	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)		0.0635	<0.00030	0.0171	<0.00030	
	Tungsten (W)-Total (mg/L)		<0.0010 ^{DLA}	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)		<0.00010 ^{DLA}	<0.000010	0.000136	<0.000010	
	Vanadium (V)-Total (mg/L)		0.0052	<0.00050	0.00350	<0.00050	
	Zinc (Zn)-Total (mg/L)		0.042	<0.0030	0.0052	<0.0030	
	Zirconium (Zr)-Total (mg/L)		<0.00060 ^{DLA}	<0.000060	<0.00018 ^{DLB}	<0.000060	
Dissolved Metals	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)		0.0470	0.0018	0.0581		
	Antimony (Sb)-Dissolved (mg/L)		0.00011	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)		0.00023	<0.00010	0.00078		
	Barium (Ba)-Dissolved (mg/L)		0.0807	<0.000050	0.00679		
	Beryllium (Be)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)		<0.010	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)		0.0000325	<0.0000050	0.0000054		
	Calcium (Ca)-Dissolved (mg/L)		19.7	<0.050	14.4		
	Cesium (Cs)-Dissolved (mg/L)		0.000014	<0.000010	<0.000010		
	Chromium (Cr)-Dissolved (mg/L)		0.00011	<0.00010	0.00098		
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010		
	Copper (Cu)-Dissolved (mg/L)		0.00140	<0.00020	0.00096		
	Iron (Fe)-Dissolved (mg/L)		0.034	<0.010	0.086		
	Lead (Pb)-Dissolved (mg/L)		0.000052	<0.000050	0.000086		
	Lithium (Li)-Dissolved (mg/L)		<0.0010	<0.0010	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)		3.35	<0.0050	4.86		
	Manganese (Mn)-Dissolved (mg/L)		0.0102	<0.00010	0.00643		
	Molybdenum (Mo)-Dissolved (mg/L)		0.000188	<0.000050	0.000209		
	Nickel (Ni)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)		<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)		2.42	<0.050	0.991		
	Rubidium (Rb)-Dissolved (mg/L)		0.00169	<0.00020	0.00036		
	Selenium (Se)-Dissolved (mg/L)		<0.000050	<0.000050	0.000220		
	Silicon (Si)-Dissolved (mg/L)		2.53	<0.050	7.74		
	Silver (Ag)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)		174	<0.050	8.51		
	Strontium (Sr)-Dissolved (mg/L)		0.127	<0.00020	0.0799		
	Sulfur (S)-Dissolved (mg/L)		1.48	<0.50	2.38		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062216-1 Grab 28-FEB-18 16:40 WT1	L2062216-2 Grab 28-FEB-18 15:27 WT2	L2062216-3 Grab 28-FEB-18 15:03 WT3	L2062216-4 Grab 28-FEB-18 14:20 WT5	L2062216-5 Grab 28-FEB-18 14:42 WT7
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.0040 ^{DLA}	<0.0040 ^{DLA}
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.00020 ^{DLA}	<0.00020 ^{DLA}
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Titanium (Ti)-Dissolved (mg/L)	<0.0030 ^{DLM}	<0.00090 ^{DLM}	0.00083	<0.0060 ^{DLA}	<0.0060 ^{DLA}
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.0020 ^{DLA}	<0.0020 ^{DLA}
	Uranium (U)-Dissolved (mg/L)	0.000039	0.000025	<0.000010	0.00221 ^{DLA}	0.00215 ^{DLA}
	Vanadium (V)-Dissolved (mg/L)	0.00115	<0.00050	<0.00050	<0.010 ^{DLA}	<0.010 ^{DLA}
	Zinc (Zn)-Dissolved (mg/L)	0.0018	0.0194	0.0199	<0.020 ^{DLA}	<0.020 ^{DLA}
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	0.000086	0.000184	<0.0012 ^{DLA}	<0.0012 ^{DLA}
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Surrogate: 2-Bromobenzotrifluoride (%)	80.0	82.4	97.0	87.9	92.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2062216-6 Grab 28-FEB-18 FIELD-DUP	L2062216-7 Grab 28-FEB-18 14:00 FIELD-BLANK	L2062216-8 Grab 28-FEB-18 15:50 WT8	L2062216-9 Grab 28-FEB-18 TRAVEL BLANK	
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00090 ^{DLM}	<0.00030	0.00163		
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Dissolved (mg/L)	<0.000010	<0.000010	0.000038		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00128		
	Zinc (Zn)-Dissolved (mg/L)	0.0213	<0.0010	0.0018		
	Zirconium (Zr)-Dissolved (mg/L)	0.000144	<0.000060	0.000116		
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	
	Surrogate: 2-Bromobenzotrifluoride (%)	91.1	95.7	92.5	93.6	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Zirconium (Zr)-Total	MB-LOR	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2062216-7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2062216-7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2062216-7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2062216-7
Matrix Spike	Barium (Ba)-Total	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2062216-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO ₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

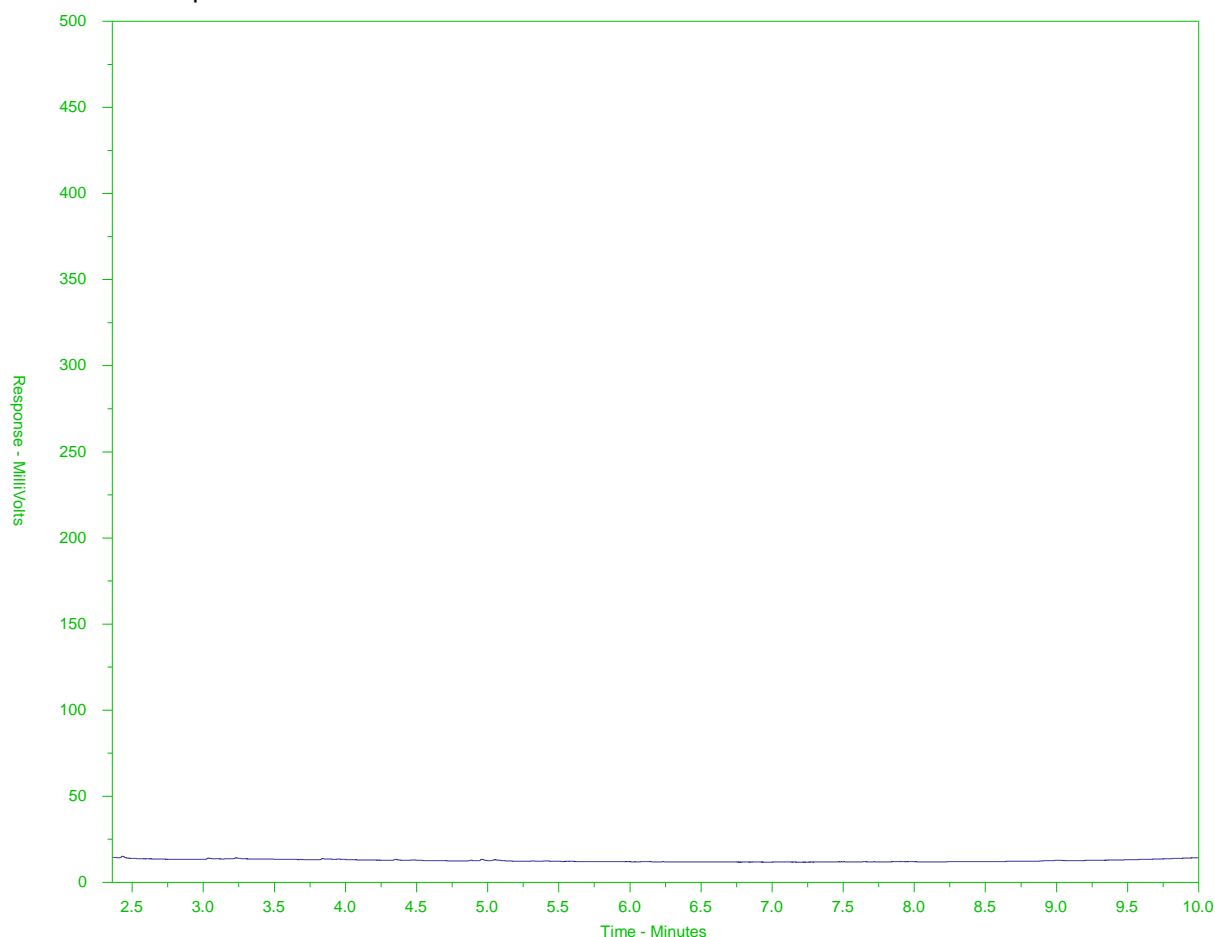
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-1
Client Sample ID: WT1



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

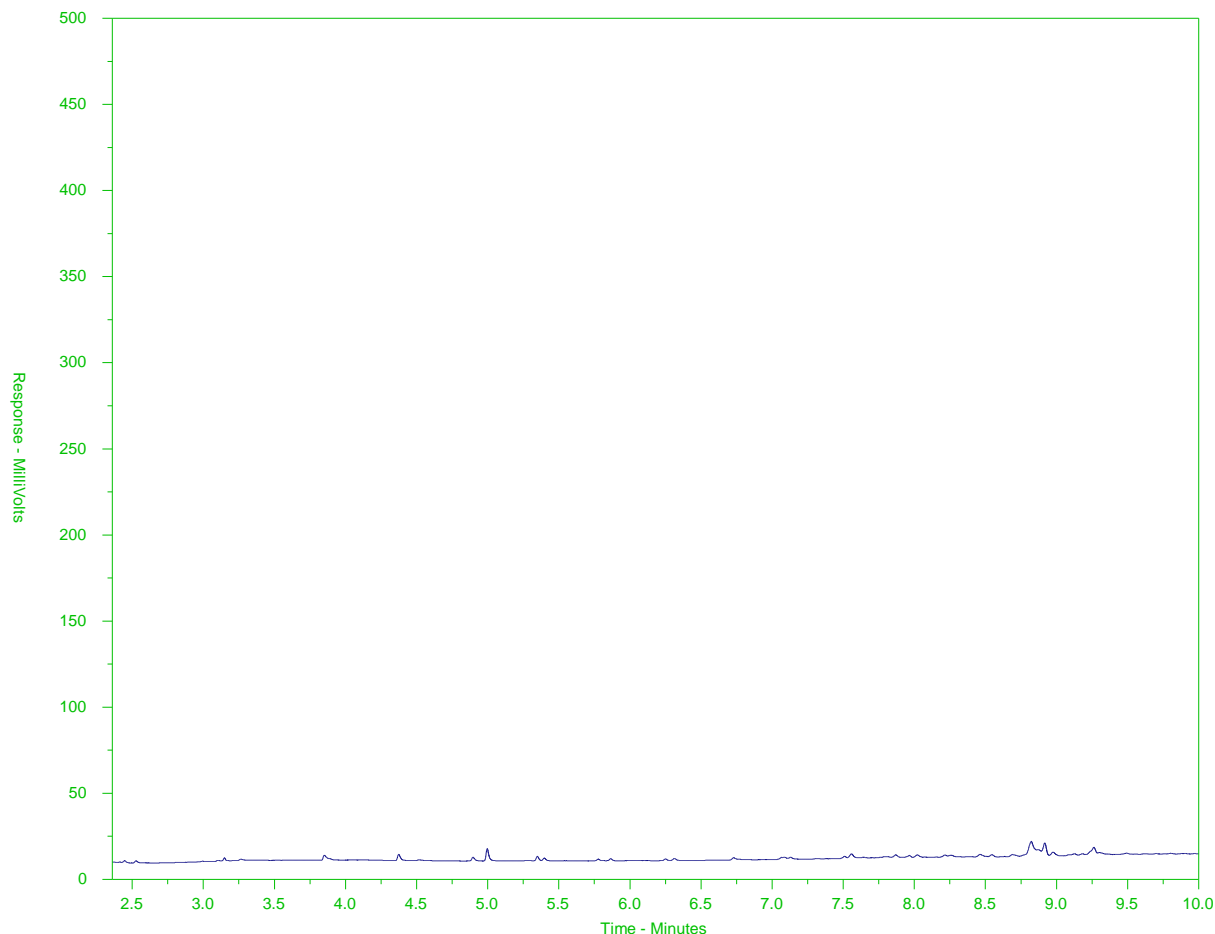
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-2
Client Sample ID: WT2



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale on left.

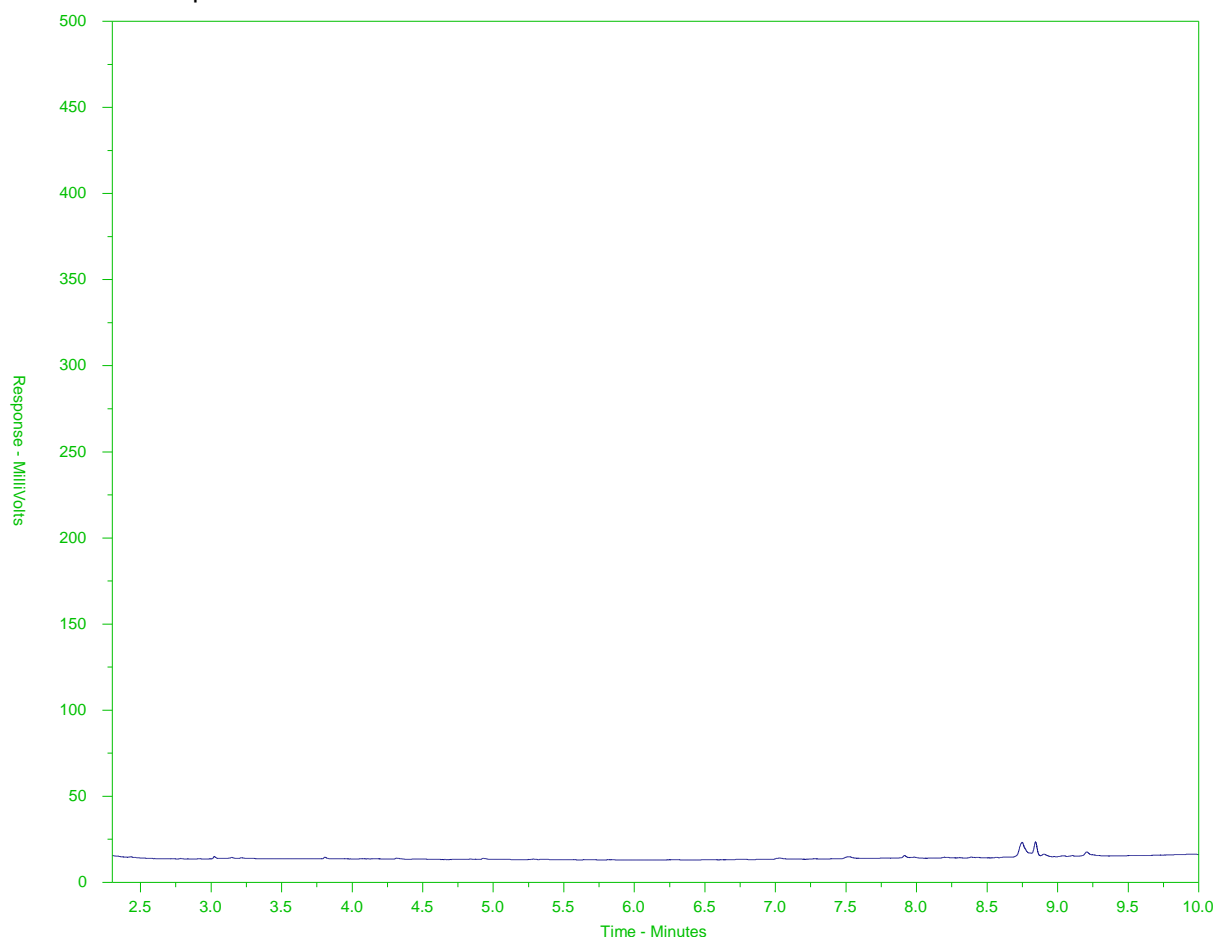
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-3
Client Sample ID: WT3



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

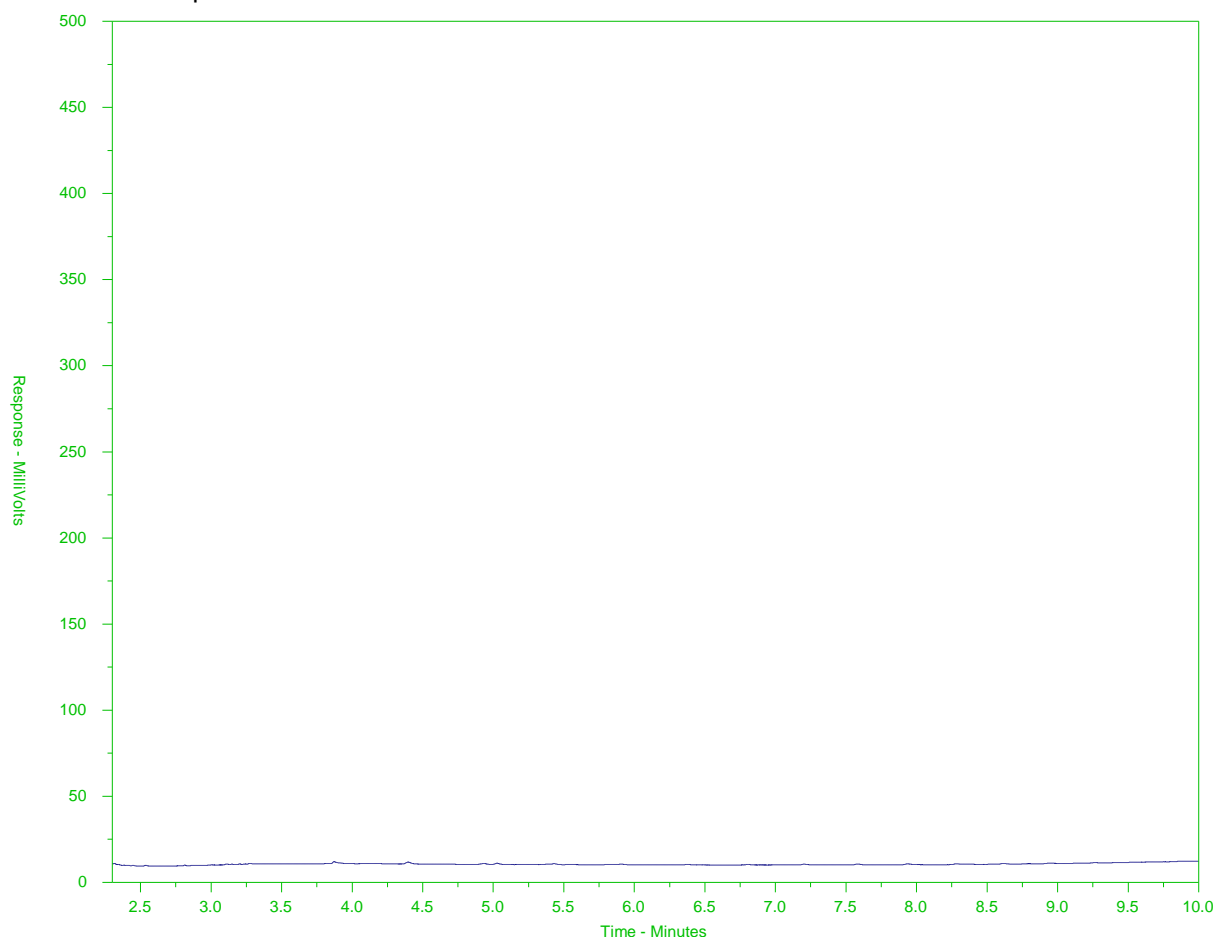
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-4
Client Sample ID: WT5



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

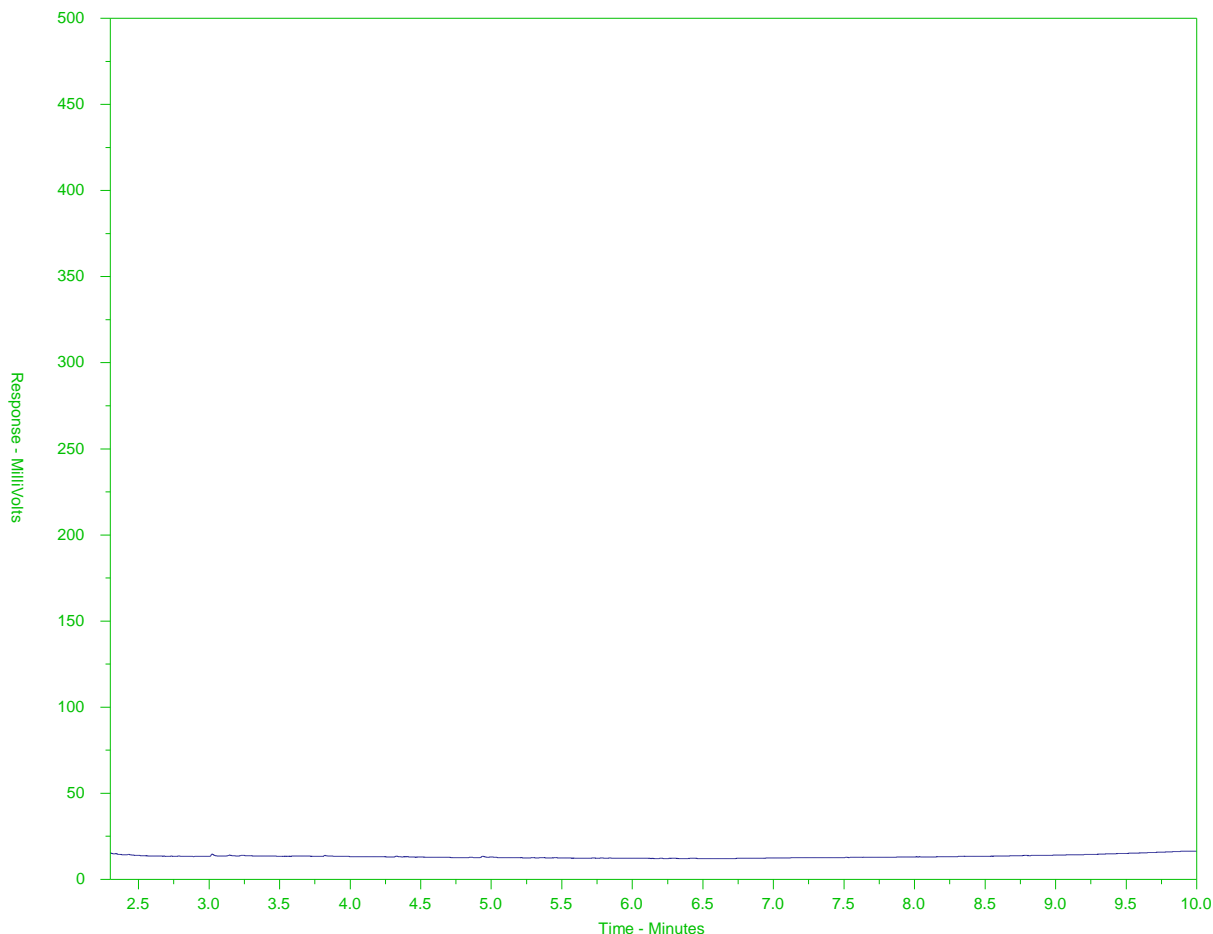
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-5
Client Sample ID: WT7



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

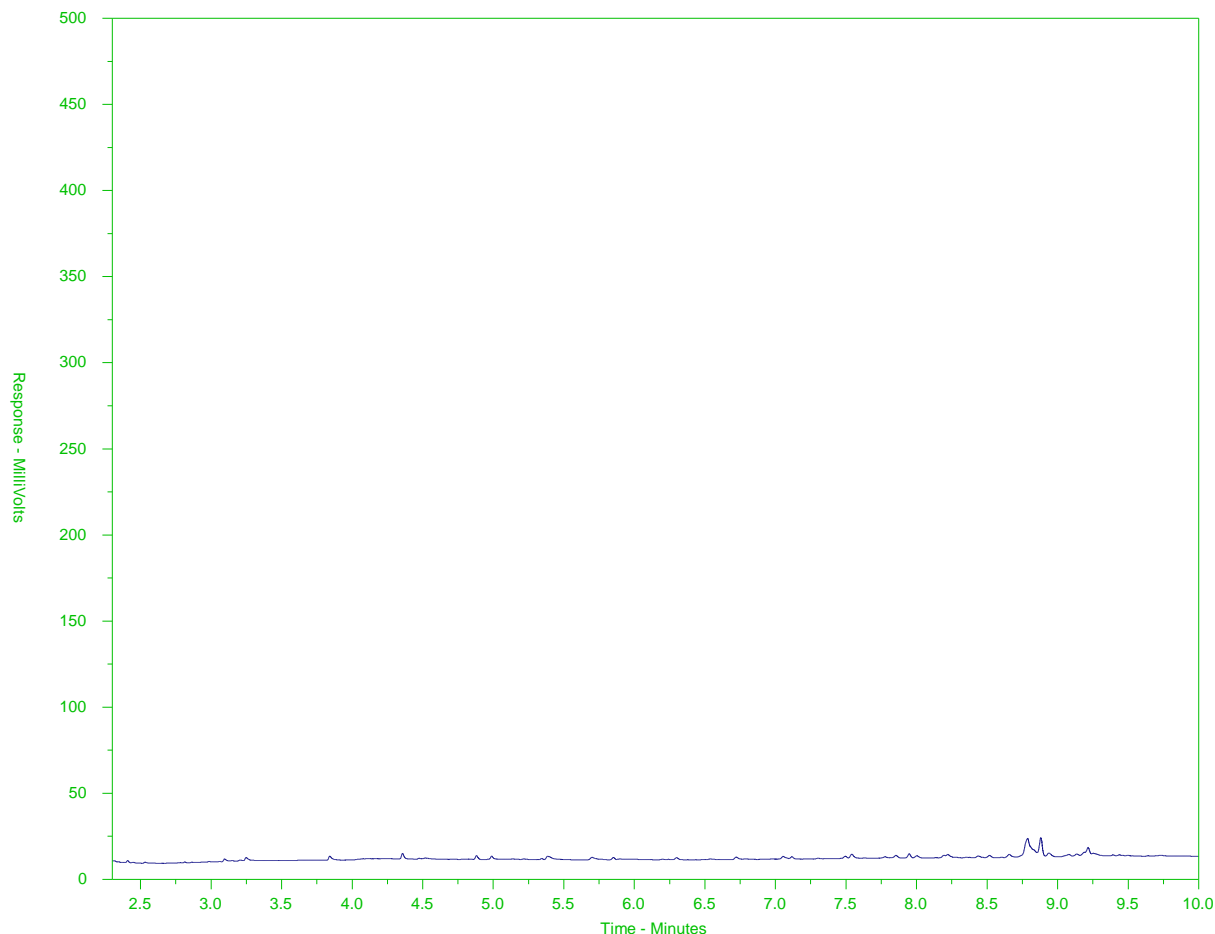
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-6
Client Sample ID: FIELD-DUP



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

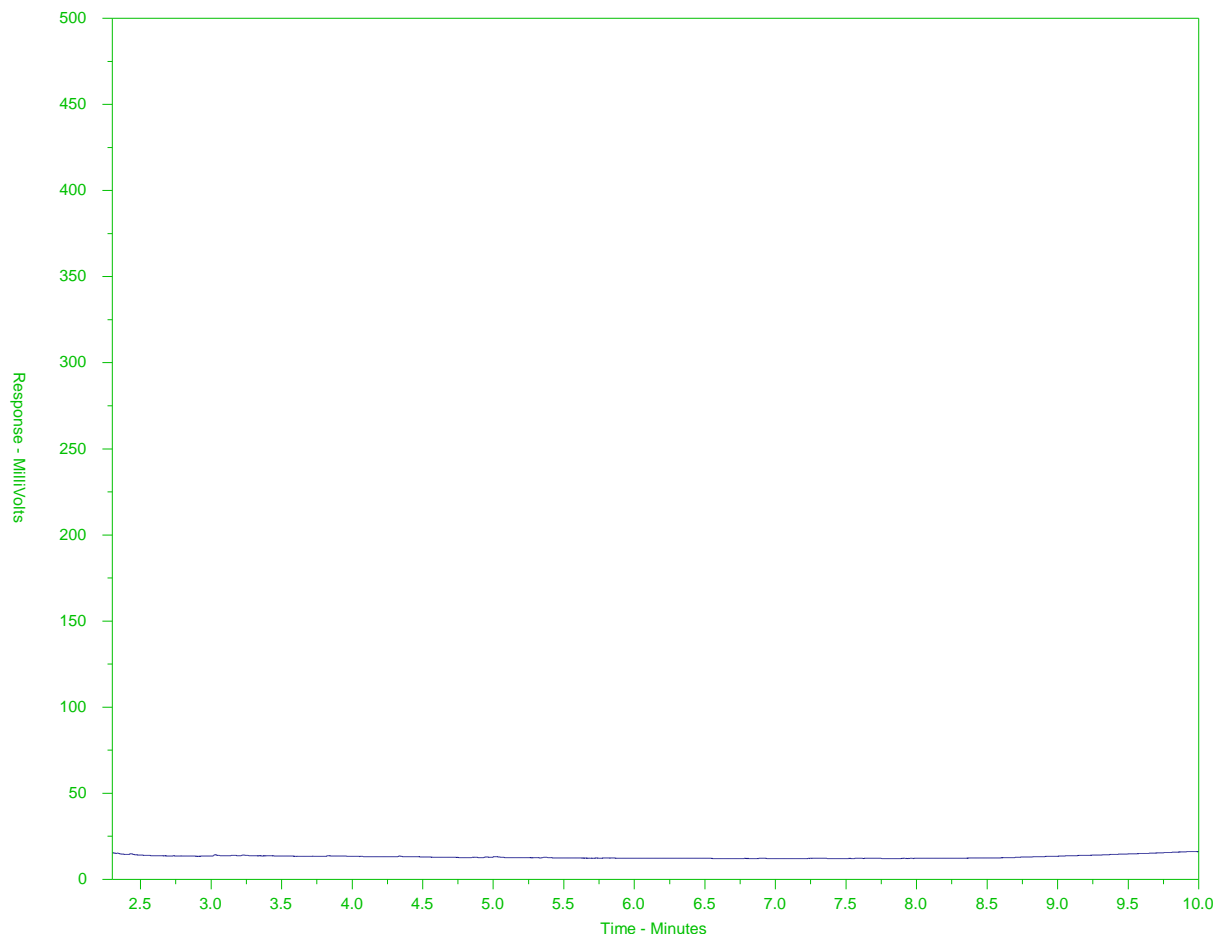
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-7
Client Sample ID: FIELD-BLANK



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

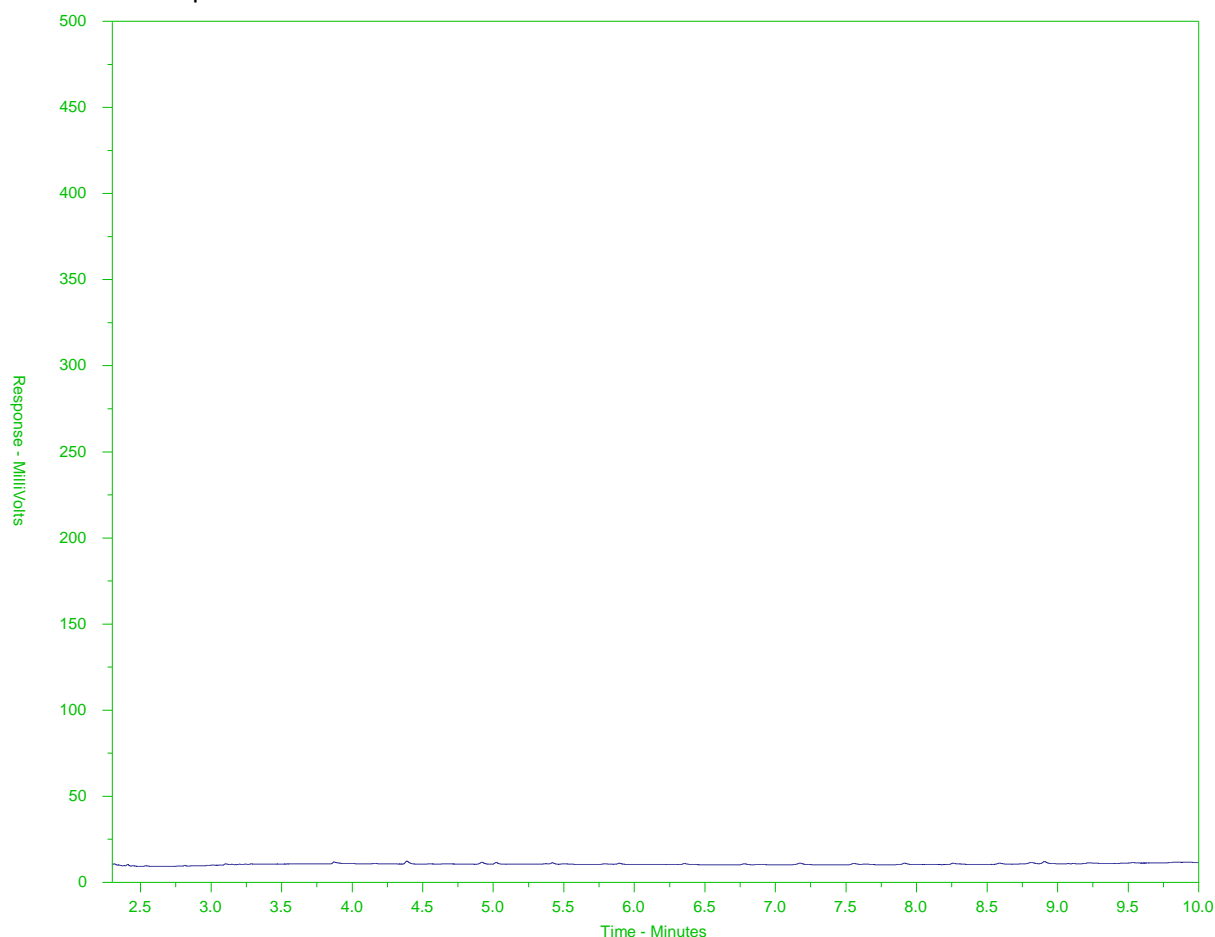
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-8
Client Sample ID: WT8



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

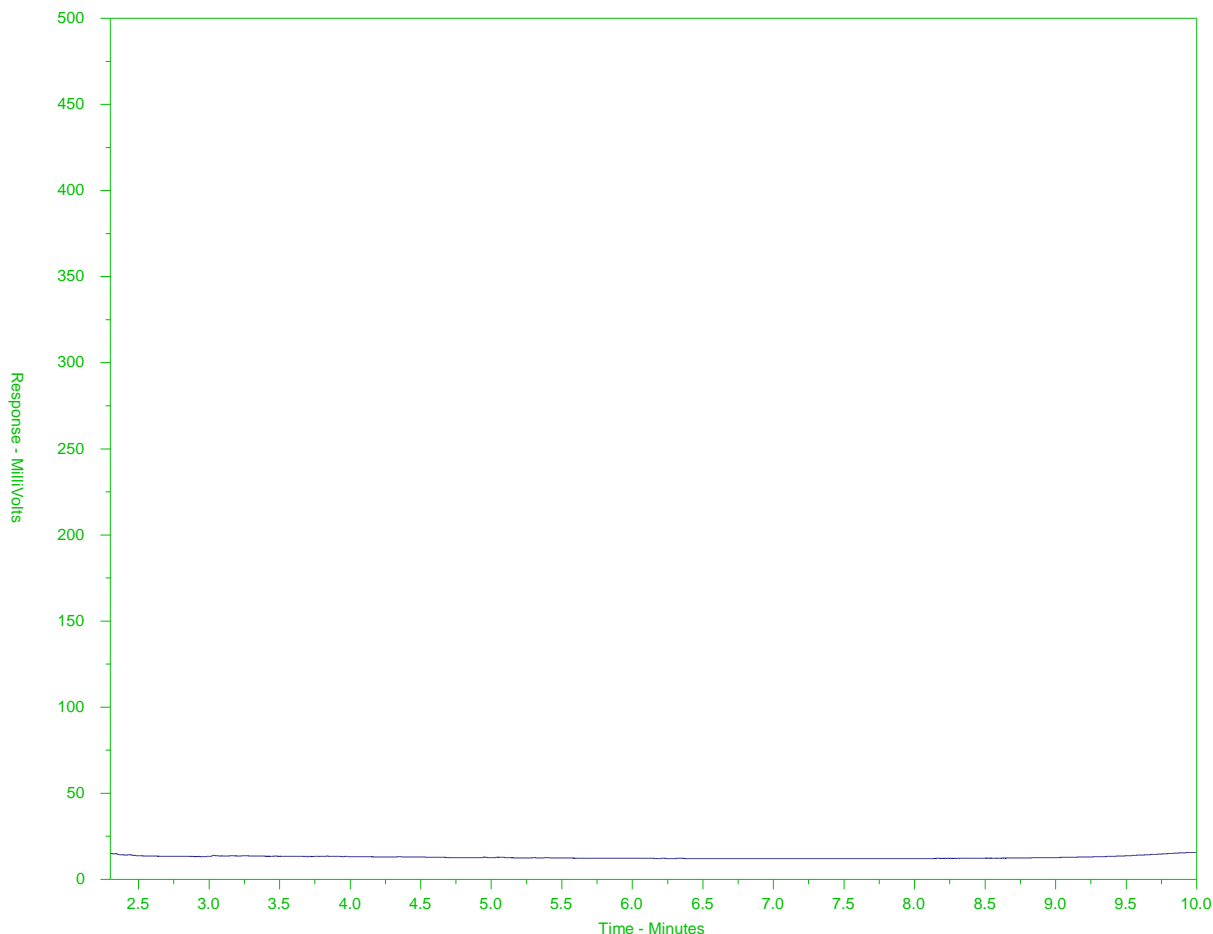
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2062216-9
Client Sample ID: TRAVEL BLANK



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →	← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody (COC) / Analytical Request Form



L2062216-COFC

COC Number: 17 -

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To		Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	STANTEC CONSULTING LTD.	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)	Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	BARRIE TUITE	Quality Control (QC) Report with Report	<input type="checkbox"/> YES <input type="checkbox"/> NO	1 Business day [E1 - 100%] <input type="checkbox"/>	
Phone:	(778) 328-1027	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		Same Day, Weekend or Statutory holiday [E2 - 200%] <input type="checkbox"/>	
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	(Laboratory opening fees may apply) []	
Street:	500-4730 KINGSWAY	Email 1 or Fax	BARRIE.TUITE@STANTEC.COM	Date and Time Required for all E&P TATs:	
City/Province:	BURNABY, BC	Email 2	JACLYN.BOWMAN@STANTEC.COM	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H 0C6	Email 3		Analysis Request	
Invoice To	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
	Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		
Company:	STANTEC CONSULTING LTD.	Email 1 or Fax	BARRIE.TUITE@STANTEC.COM		
Contact:	BARRIE TUITE	Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:		AFE/Cost Center:	PO#		
Job #:	123512431	Major/Minor Code:	Routing Code:		
PO / AFE:		Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only):		ALS Contact:	BRENT MACK	Sampler:	M. TRUDELL J. BOWMAN
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	WT1	28-Feb-18	16:40	Grab	
	WT2	28-Feb-18	15:27	Grab	
	WT3	28-Feb-18	15:03	Grab	
	WT4	28-Feb-18		Grab	
	WT5	28-Feb-18	14:20	Grab	
	WT6	28-Feb-18		Grab	
	WT7	28-Feb-18	14:42	Grab	
	FIELD-DUP	28-Feb-18		Grab	
	FIELD-BLANK	28-Feb-18	14:00	Grab	
	WT8		15:50		
	TRAVEL BLANK				
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		METALS ANALYSIS EXCLUDES MERCURY.		Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Jaclyn Bowman	Date: 28 Feb 18	Time: 16:40	Received by:	Date: 2/28/18	Time: 5:12 PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Barrie Tuite
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 13-MAR-18
Report Date: 23-MAR-18 14:01 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2067173
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7			
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	39900	40200			
	Hardness (as CaCO3) (mg/L)	4110	4010			
	pH (pH)	8.04	8.09			
	Total Suspended Solids (mg/L)	3.5	3.3			
	Turbidity (NTU)	0.84	1.10			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0179	0.0168			
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)	<0.0020	<0.0020			
	Barium (Ba)-Total (mg/L)	0.0102	0.0099			
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	3.31	3.61			
	Cadmium (Cd)-Total (mg/L)	0.000076	0.000061			
	Calcium (Ca)-Total (mg/L)	281	296			
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050			
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050			
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050			
	Copper (Cu)-Total (mg/L)	0.00064	0.00058			
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)	0.021	0.014			
	Lead (Pb)-Total (mg/L)	<0.00030	<0.00030			
	Lithium (Li)-Total (mg/L)	0.142	0.150			
	Magnesium (Mg)-Total (mg/L)	898	809			
	Manganese (Mn)-Total (mg/L)	0.00499	0.00481			
	Molybdenum (Mo)-Total (mg/L)	0.0078	0.0082			
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050			
	Phosphorus (P)-Total (mg/L)	0.059	0.055			
	Potassium (K)-Total (mg/L)	254	262			
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050			
	Rubidium (Rb)-Total (mg/L)	0.0860	0.0910			
	Selenium (Se)-Total (mg/L)	<0.0020	<0.0020			
	Silicon (Si)-Total (mg/L)	<1.0	<1.0			
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010			
	Sodium (Na)-Total (mg/L)	7020	7290			
	Strontium (Sr)-Total (mg/L)	4.56	4.77			
	Sulfur (S)-Total (mg/L)	639	626			
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7			
Grouping	Analyte						
SEAWATER							
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050				
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050				
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010				
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050				
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010				
	Uranium (U)-Total (mg/L)	0.00246	0.00259				
	Vanadium (V)-Total (mg/L)	0.00131	0.00124				
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050				
	Zinc (Zn)-Total (mg/L)	0.0081	0.0056				
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.0020	<0.0020				
	Barium (Ba)-Dissolved (mg/L)	0.0101	0.0097				
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050				
	Boron (B)-Dissolved (mg/L)	3.58	3.34				
	Cadmium (Cd)-Dissolved (mg/L)	0.000092	0.000058				
	Calcium (Ca)-Dissolved (mg/L)	311	296				
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050				
	Copper (Cu)-Dissolved (mg/L)	0.00059	0.00051				
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.00030	<0.00030				
	Lithium (Li)-Dissolved (mg/L)	0.149	0.138				
	Magnesium (Mg)-Dissolved (mg/L)	809	795				
	Manganese (Mn)-Dissolved (mg/L)	0.00380	0.00353				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0084	0.0078				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	273	266				
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050				
	Rubidium (Rb)-Dissolved (mg/L)	0.0883	0.0842				
	Selenium (Se)-Dissolved (mg/L)	0.0039	0.0032				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7			
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0			
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010			
	Sodium (Na)-Dissolved (mg/L)	7590	7100			
	Strontium (Sr)-Dissolved (mg/L)	4.77	4.83			
	Sulfur (S)-Dissolved (mg/L)	629	607			
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050			
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050			
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050			
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050			
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010			
	Uranium (U)-Dissolved (mg/L)	0.00264	0.00253			
	Vanadium (V)-Dissolved (mg/L)	0.00115	0.00118			
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	0.0072	<0.0030			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-1 Water 13-MAR-18 17:08 WT2	L2067173-2 Water 13-MAR-18 15:51 WT3	L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7	L2067173-5 Water 13-MAR-18 14:22 WT8
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	5160	477			235
	Hardness (as CaCO3) (mg/L)	89.3	55.7			74.4
	pH (pH)	7.55	7.79			7.95
	Total Suspended Solids (mg/L)	631	98.1			33.7
	Turbidity (NTU)	601	18.2			11.5
Total Metals	Aluminum (Al)-Total (mg/L)	28.9	0.132			0.252
	Antimony (Sb)-Total (mg/L)	0.00131	0.00018			0.00011
	Arsenic (As)-Total (mg/L)	0.00869	0.00019			0.00032
	Barium (Ba)-Total (mg/L)	0.319	0.0383			0.0126
	Beryllium (Be)-Total (mg/L)	0.00042	<0.00010			<0.00010
	Bismuth (Bi)-Total (mg/L)	0.00014	<0.000050			<0.000050
	Boron (B)-Total (mg/L)	0.023	<0.010			0.012
	Cadmium (Cd)-Total (mg/L)	0.000427	0.0000194			0.0000194
	Calcium (Ca)-Total (mg/L)	41.2	17.2			21.8
	Cesium (Cs)-Total (mg/L)	0.00114	0.000010			0.000010
	Chromium (Cr)-Total (mg/L)	0.0264	0.00023			0.00341
	Cobalt (Co)-Total (mg/L)	0.0113	<0.00010			0.00018
	Copper (Cu)-Total (mg/L)	0.0558	0.00217			0.00093
	Iron (Fe)-Total (mg/L)	27.2	0.106			0.721
	Lead (Pb)-Total (mg/L)	0.0187	0.000150			0.000642
	Lithium (Li)-Total (mg/L)	0.0189	0.0015			0.0015
	Magnesium (Mg)-Total (mg/L)	12.7	3.51			5.89
	Manganese (Mn)-Total (mg/L)	0.757	0.00697			0.0531
	Molybdenum (Mo)-Total (mg/L)	0.00190	0.000149			0.000119
	Nickel (Ni)-Total (mg/L)	0.0199	<0.00050			0.00065
	Phosphorus (P)-Total (mg/L)	0.81	<0.050			<0.050
	Potassium (K)-Total (mg/L)	5.77	1.56			0.831
	Rubidium (Rb)-Total (mg/L)	0.0145	0.00115			0.00044
	Selenium (Se)-Total (mg/L)	0.00034	0.000089			0.000149
	Silicon (Si)-Total (mg/L)	46.8	4.09			11.9
	Silver (Ag)-Total (mg/L)	0.000143	<0.000010			0.000010
	Sodium (Na)-Total (mg/L)	684	68.1			14.9
	Strontium (Sr)-Total (mg/L)	0.218	0.103			0.153
	Sulfur (S)-Total (mg/L)	9.7	2.16			4.16
	Tellurium (Te)-Total (mg/L)	<0.00040 ^{DLA}	<0.00020			<0.00020
	Thallium (Tl)-Total (mg/L)	0.000081	<0.000010			<0.000010
	Thorium (Th)-Total (mg/L)	0.00050	<0.00010			<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-6 Water 13-MAR-18 14:59 WT10	L2067173-7 Water 13-MAR-18 FIELD-DUP	L2067173-8 Water 13-MAR-18 FIELD-BLANK	L2067173-9 Water 13-MAR-18 TRAVEL BLANK	
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	219	5010	<2.0	<2.0	
	Hardness (as CaCO3) (mg/L)	80.3	87.9	<0.50	<0.50 ^{HTC}	
	pH (pH)	8.03	7.58	5.79	5.65	
	Total Suspended Solids (mg/L)	17.1	652	<3.0	<3.0	
	Turbidity (NTU)	7.71	580	<0.10	<0.10	
Total Metals	Aluminum (Al)-Total (mg/L)	0.309	27.4	<0.0030	<0.0030	
	Antimony (Sb)-Total (mg/L)	0.00014	0.00133	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00137	0.00816	<0.00010	<0.00010	
	Barium (Ba)-Total (mg/L)	0.0117	0.328	<0.000050	<0.000050	
	Beryllium (Be)-Total (mg/L)	<0.00010	0.00038	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	0.00014	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.014	0.023	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	0.0000097	0.000389	<0.0000050	<0.0000050	
	Calcium (Ca)-Total (mg/L)	22.2	47.4	<0.050	<0.050	
	Cesium (Cs)-Total (mg/L)	0.000010	0.00109	<0.000010	<0.000010	
	Chromium (Cr)-Total (mg/L)	0.00160	0.0242	<0.00010	<0.00010	
	Cobalt (Co)-Total (mg/L)	0.00019	0.0103	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	0.00111	0.0508	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.532	25.3	<0.010	<0.010	
	Lead (Pb)-Total (mg/L)	0.000331	0.0167	<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	0.0016	0.0182	<0.0010	<0.0010	
	Magnesium (Mg)-Total (mg/L)	6.83	12.7	<0.0050	<0.0050	
	Manganese (Mn)-Total (mg/L)	0.0320	0.728	<0.00010	<0.00010	
	Molybdenum (Mo)-Total (mg/L)	0.000474	0.00199	<0.000050	<0.000050	
	Nickel (Ni)-Total (mg/L)	0.00067	0.0183	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	0.77	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	1.45	6.49	<0.050	<0.050	
	Rubidium (Rb)-Total (mg/L)	0.00066	0.0147	<0.00020	<0.00020	
	Selenium (Se)-Total (mg/L)	0.000229	0.00030	<0.000050	<0.000050	
	Silicon (Si)-Total (mg/L)	10.9	44.9	<0.10	<0.10	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000144	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	10.6	895	<0.050	<0.050	
	Strontium (Sr)-Total (mg/L)	0.113	0.248	<0.00020	<0.00020	
	Sulfur (S)-Total (mg/L)	4.17	11.9	<0.50	<0.50	
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00040 ^{DLA}	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000081	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.00010	0.00058	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-1 Water 13-MAR-18 17:08 WT2	L2067173-2 Water 13-MAR-18 15:51 WT3	L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7	L2067173-5 Water 13-MAR-18 14:22 WT8
Grouping	Analyte					
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	0.00107	<0.00010			<0.00010
	Titanium (Ti)-Total (mg/L)	0.934	0.00375			0.00835
	Tungsten (W)-Total (mg/L)	0.00028	<0.00010			<0.00010
	Uranium (U)-Total (mg/L)	0.000577	0.000010			0.000083
	Vanadium (V)-Total (mg/L)	0.0542	0.00052			0.00180
	Zinc (Zn)-Total (mg/L)	0.315	0.0185			0.0035
	Zirconium (Zr)-Total (mg/L)	0.00114	0.000169			0.00107
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0486	0.0308			0.0126
	Antimony (Sb)-Dissolved (mg/L)	^{DLA} <0.00050	0.00013			<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00078	0.00014			0.00016
	Barium (Ba)-Dissolved (mg/L)	0.0788	0.0394			0.00938
	Beryllium (Be)-Dissolved (mg/L)	^{DLA} <0.00050	<0.00010			<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	^{DLA} <0.00025	<0.000050			<0.000050
	Boron (B)-Dissolved (mg/L)	^{DLA} <0.050	<0.010			0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000078	0.0000243			<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	31.9	16.7			21.1
	Cesium (Cs)-Dissolved (mg/L)	^{DLA} <0.000050	<0.000010			<0.000010
	Chromium (Cr)-Dissolved (mg/L)	0.00053	0.00012			0.00094
	Cobalt (Co)-Dissolved (mg/L)	^{DLA} <0.00050	<0.00010			<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.0054	0.00237			0.00023
	Iron (Fe)-Dissolved (mg/L)	^{DLA} <0.050	0.010			0.020
	Lead (Pb)-Dissolved (mg/L)	^{DLA} <0.00025	^{DTMF} 0.000668			<0.000050
	Lithium (Li)-Dissolved (mg/L)	^{DLA} <0.0050	<0.0010			<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	2.35	3.38			5.27
	Manganese (Mn)-Dissolved (mg/L)	0.0521	0.00063			0.00060
	Molybdenum (Mo)-Dissolved (mg/L)	0.00111	0.000156			0.000126
	Nickel (Ni)-Dissolved (mg/L)	^{DLA} <0.0025	<0.00050			<0.00050
	Phosphorus (P)-Dissolved (mg/L)	^{DLA} <0.25	<0.050			<0.050
	Potassium (K)-Dissolved (mg/L)	3.83	1.62			0.837
	Rubidium (Rb)-Dissolved (mg/L)	0.0028	0.00110			0.00036
	Selenium (Se)-Dissolved (mg/L)	^{DLA} <0.00025	<0.000050			0.000083
	Silicon (Si)-Dissolved (mg/L)	1.34	3.88			10.5
	Silver (Ag)-Dissolved (mg/L)	^{DLA} <0.000050	<0.000010			<0.000010
	Sodium (Na)-Dissolved (mg/L)	868	71.2			15.4
	Strontium (Sr)-Dissolved (mg/L)	0.157	0.102			0.147
	Sulfur (S)-Dissolved (mg/L)	9.0	1.82			3.40

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-6 Water 13-MAR-18 14:59 WT10	L2067173-7 Water 13-MAR-18 FIELD-DUP	L2067173-8 Water 13-MAR-18 FIELD-BLANK	L2067173-9 Water 13-MAR-18 TRAVEL BLANK	
Grouping	Analyte					
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	0.00115	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	0.0111	0.907	<0.00030	<0.00030	
	Tungsten (W)-Total (mg/L)	<0.00010	0.00033	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)	0.000095	0.000571	<0.000010	<0.000010	
	Vanadium (V)-Total (mg/L)	0.00206	0.0508	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	0.0092	0.292	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	0.000070	0.00103	<0.000060	<0.000060	
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0244	0.0593	<0.0010		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00048	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00111	0.00079	<0.00010		
	Barium (Ba)-Dissolved (mg/L)	0.00981	0.0698	0.000085		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.013	0.015	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000052	0.0000727	<0.0000050		
	Calcium (Ca)-Dissolved (mg/L)	21.5	31.4	<0.050		
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	0.000029	<0.000010		
	Chromium (Cr)-Dissolved (mg/L)	0.00063	0.00080	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00015	<0.00010		
	Copper (Cu)-Dissolved (mg/L)	0.00047	0.00544	<0.00020		
	Iron (Fe)-Dissolved (mg/L)	0.083	0.028	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000101	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0050 ^{DLA}	<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)	6.47	2.33	0.0053		
	Manganese (Mn)-Dissolved (mg/L)	0.0157	0.0515	<0.00010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.000496	0.000915	0.000061		
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00075	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	1.45	4.04	<0.050		
	Rubidium (Rb)-Dissolved (mg/L)	0.00050	0.00297	<0.00020		
	Selenium (Se)-Dissolved (mg/L)	0.000175	0.000180	<0.000050		
	Silicon (Si)-Dissolved (mg/L)	9.51	1.42	<0.050		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	0.000011	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	10.6	887	<0.050		
	Strontium (Sr)-Dissolved (mg/L)	0.106	0.148	0.00031		
	Sulfur (S)-Dissolved (mg/L)	3.31	10.1	<0.50		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-1 Water 13-MAR-18 17:08 WT2	L2067173-2 Water 13-MAR-18 15:51 WT3	L2067173-3 Seawater 13-MAR-18 16:27 WT5	L2067173-4 Seawater 13-MAR-18 16:37 WT7	L2067173-5 Water 13-MAR-18 14:22 WT8
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	^{DLA} <0.0010	<0.00020			<0.00020
	Thallium (Tl)-Dissolved (mg/L)	^{DLA} <0.000050	<0.000010			<0.000010
	Thorium (Th)-Dissolved (mg/L)	^{DLA} <0.00050	<0.00010			<0.00010
	Tin (Sn)-Dissolved (mg/L)	^{DLA} <0.00050	<0.00010			<0.00010
	Titanium (Ti)-Dissolved (mg/L)	^{DLA} <0.0015	<0.00030			<0.00030
	Tungsten (W)-Dissolved (mg/L)	^{DLA} <0.00050	<0.00010			<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000122	<0.000010			0.000040
	Vanadium (V)-Dissolved (mg/L)	^{DLA} <0.0025	<0.00050			0.00062
	Zinc (Zn)-Dissolved (mg/L)	0.0162	0.0216			<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	^{DLA} <0.00030	0.000140			<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	1.06	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	1.97	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	78.2	77.9	73.1	76.6	75.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2067173-6 Water 13-MAR-18 14:59 WT10	L2067173-7 Water 13-MAR-18 FIELD-DUP	L2067173-8 Water 13-MAR-18 FIELD-BLANK	L2067173-9 Water 13-MAR-18 TRAVEL BLANK	
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000010	<0.000010		
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.00060 ^{DLM}	0.00065	<0.00030		
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Uranium (U)-Dissolved (mg/L)	0.000075	0.000136	<0.000010		
	Vanadium (V)-Dissolved (mg/L)	0.00106	0.00059	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0069	0.0141	<0.0010		
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	<0.000060		
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10		
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30		
	F3 (C16-C34) (mg/L)	<0.30	1.18	<0.30		
	F4 (C34-C50) (mg/L)	<0.30	2.20	<0.30		
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	78.8	75.0	69.3		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Dissolved	MB-LOR	L2067173-1, -2, -5, -6, -7, -8
Laboratory Control Sample	Phosphorus (P)-Dissolved	MES	L2067173-1, -2, -5, -6, -7, -8
Laboratory Control Sample	Sulfur (S)-Total	MES	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2067173-1, -2, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTMF	Dissolved concentration exceeds total for field-filtered metals sample. Metallic contaminants may have been introduced to dissolved sample during field filtration.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
EC-SCREEN-VA	Seawater	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-D-L-HRMS-VA	Seawater	Diss. Metals in Seawater by HR-ICPMS	EPA 200.8

Reference Information

Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration based on APHA Method 3030B.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-L-HRMS-VA Seawater Tot. Metals in Seawater by HR-ICPMS EPA 200.8

Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion based on APHA Method 3030E.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

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.

TURBIDITY-C-VA Seawater Turbidity by Meter in Seawater APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

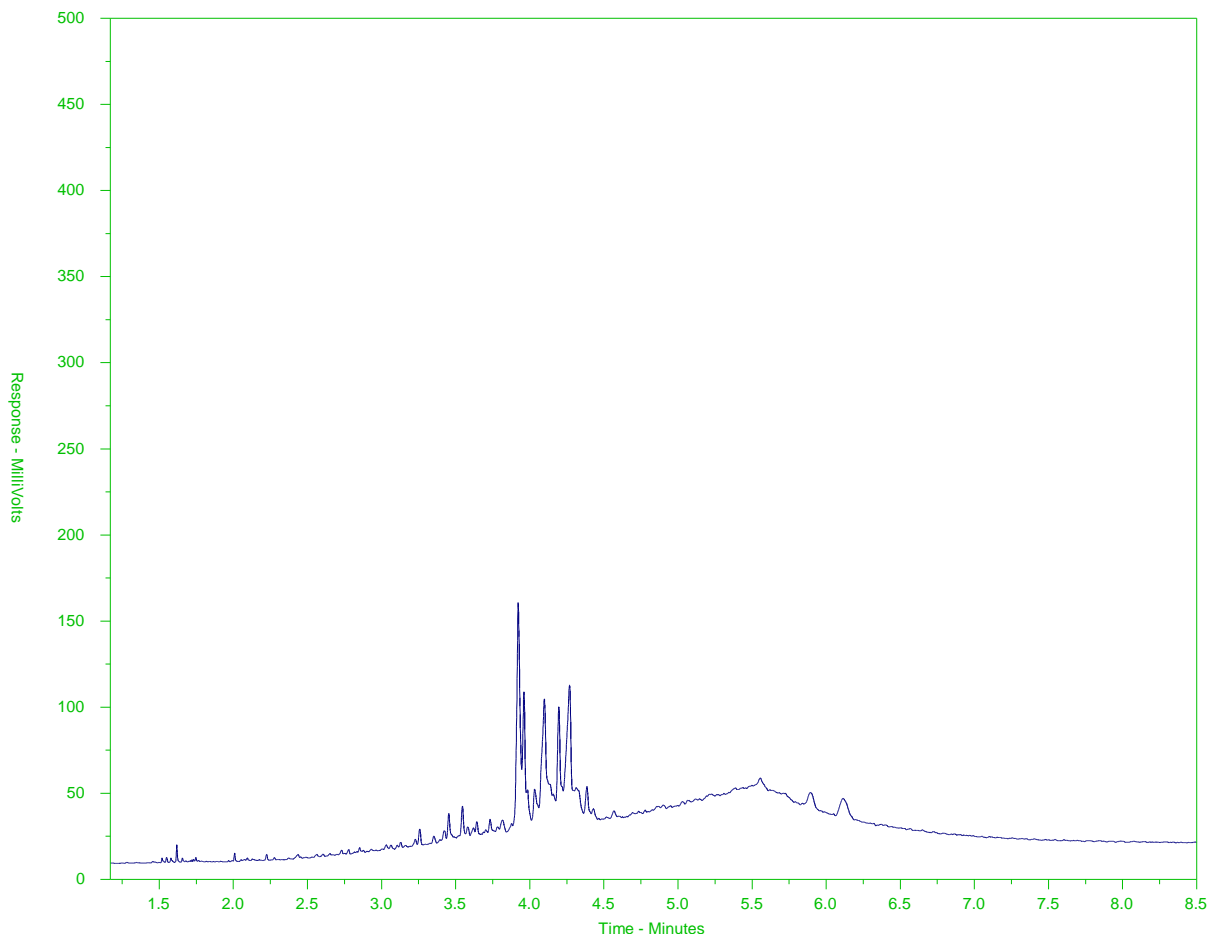
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-1
Client Sample ID: WT2



F2		F3		F4	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

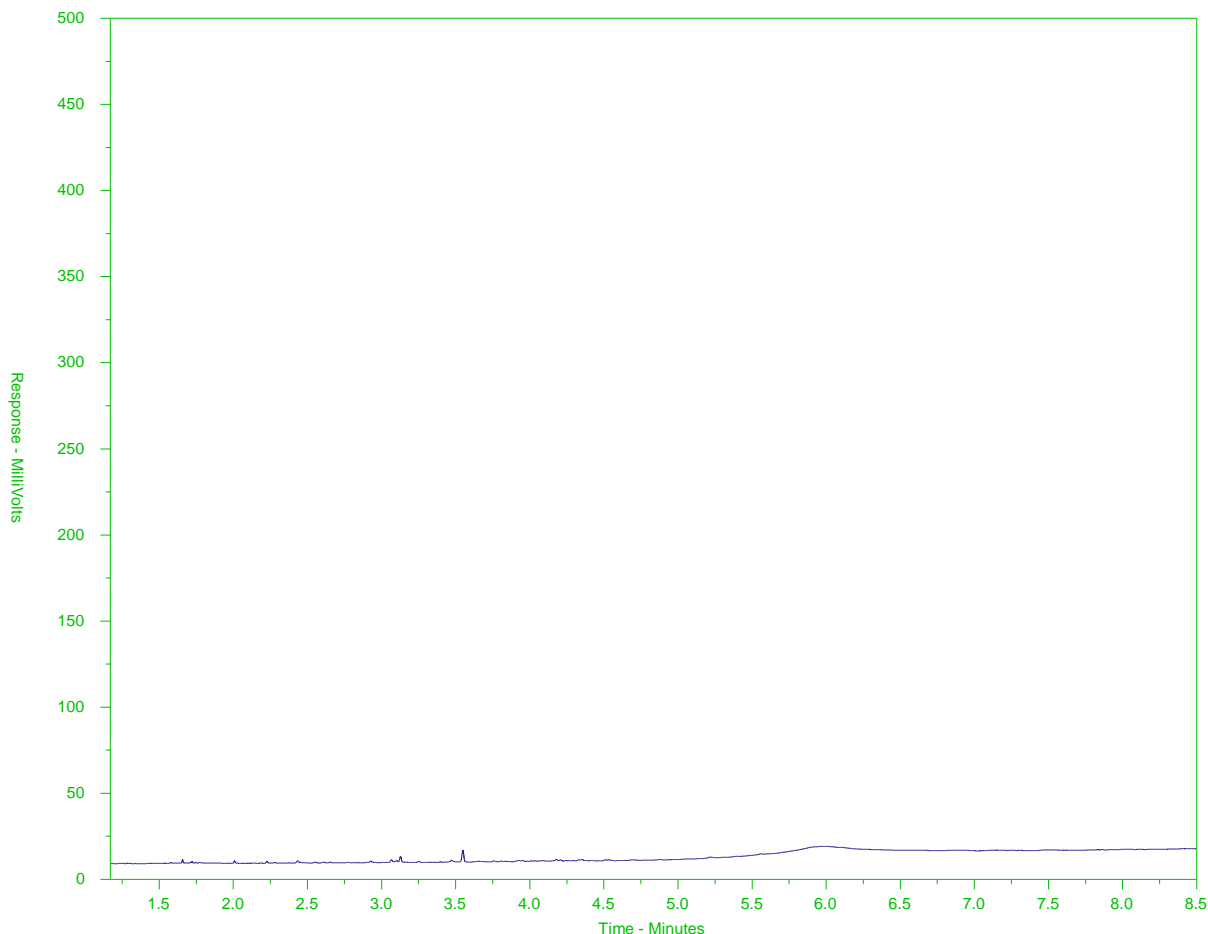
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-2
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

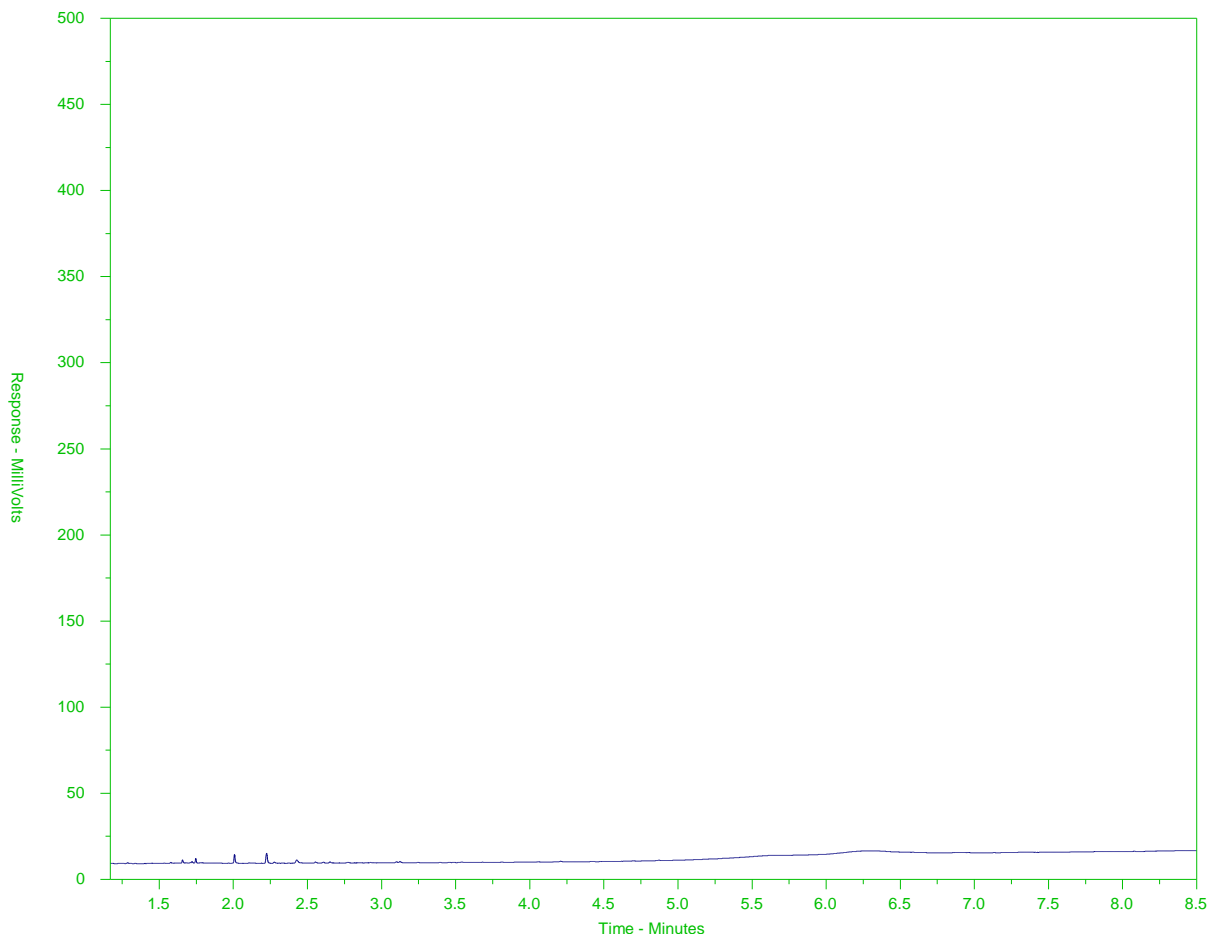
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-3
Client Sample ID: WT5



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

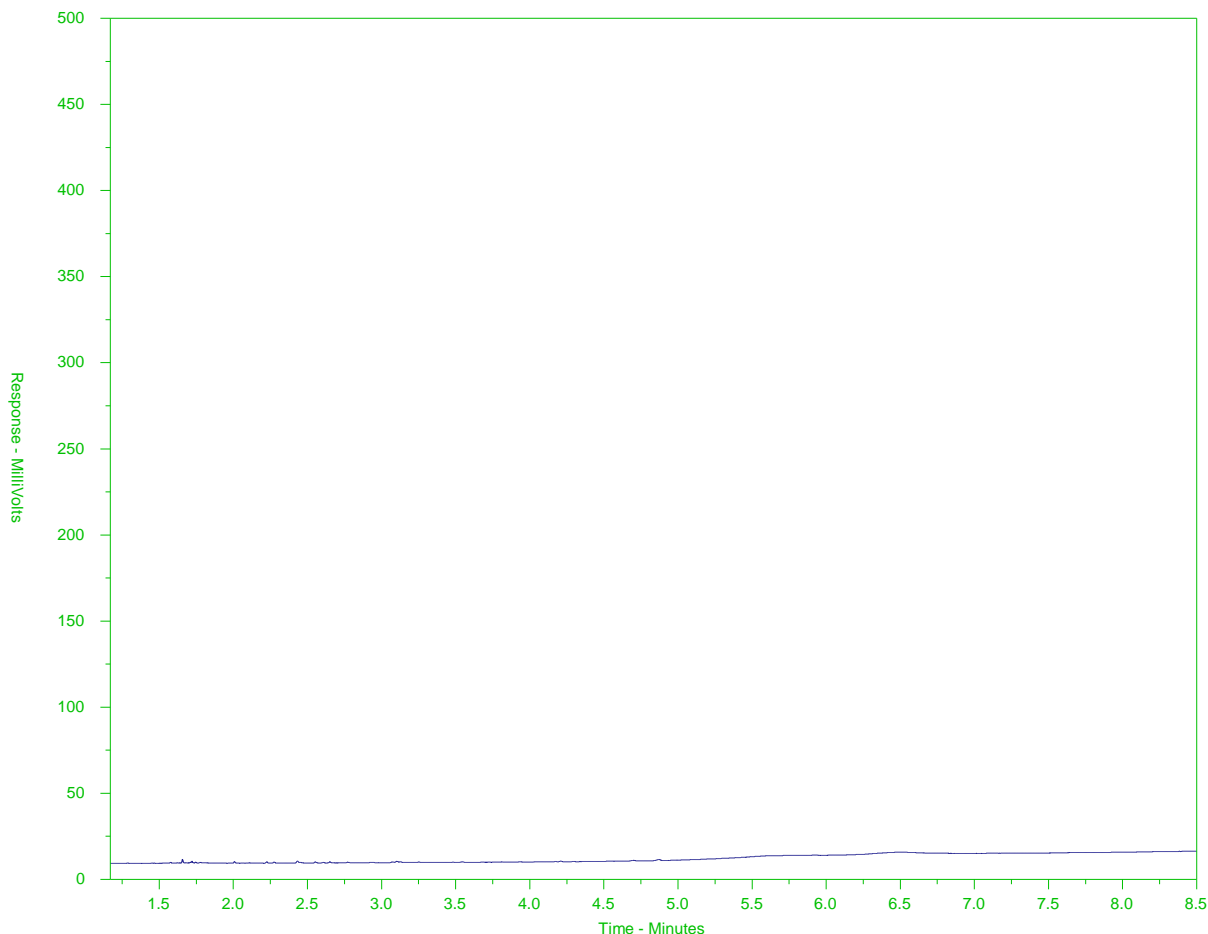
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-4
Client Sample ID: WT7



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

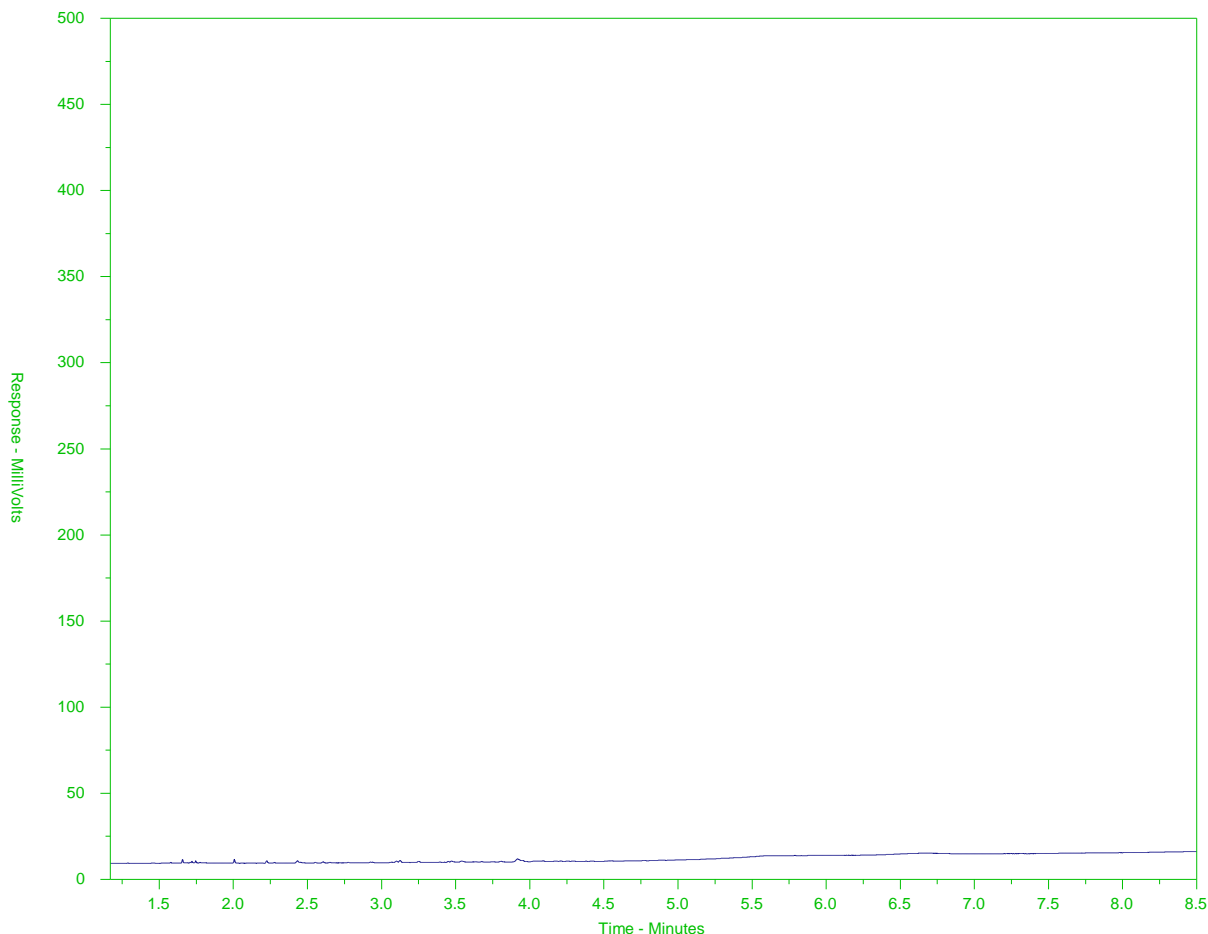
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-5
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

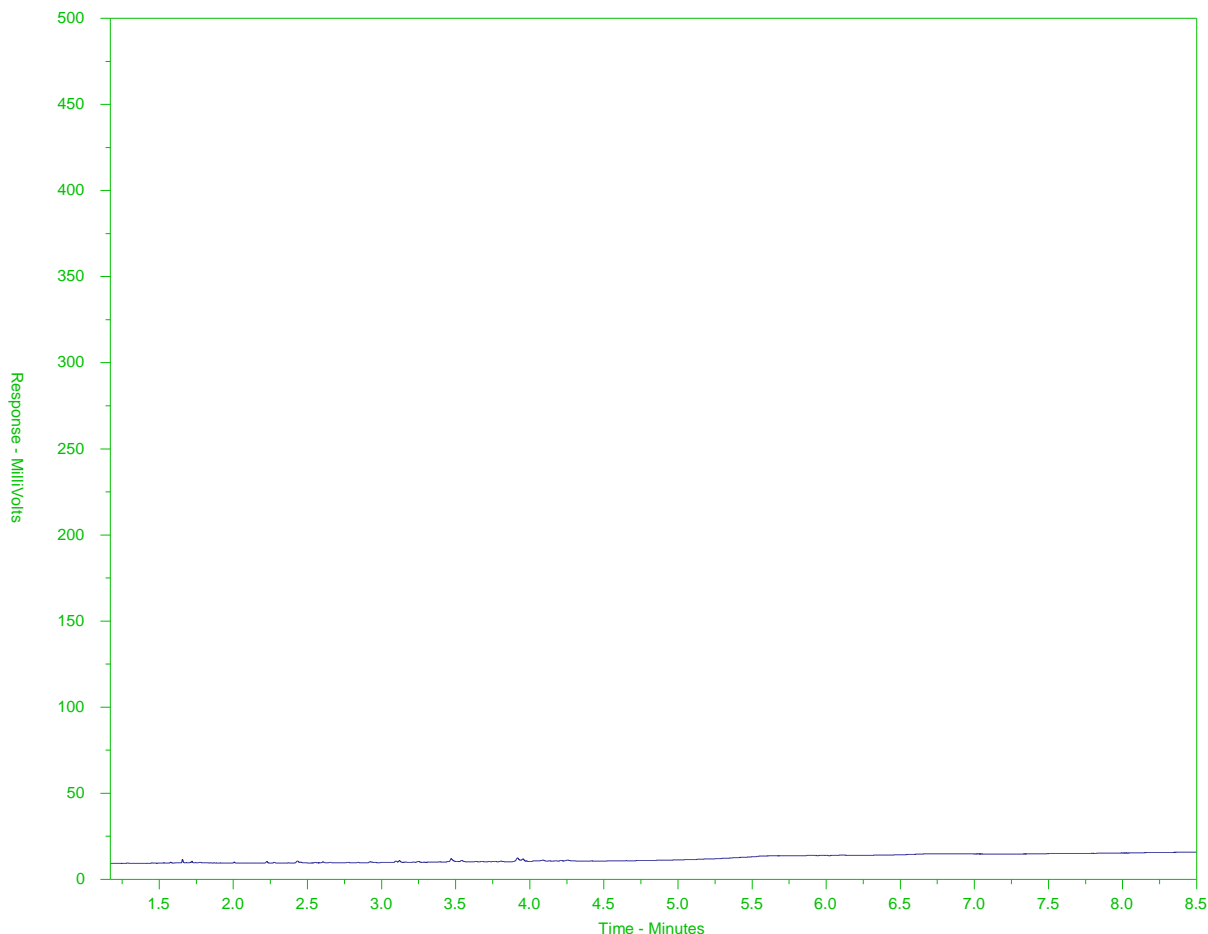
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-6
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

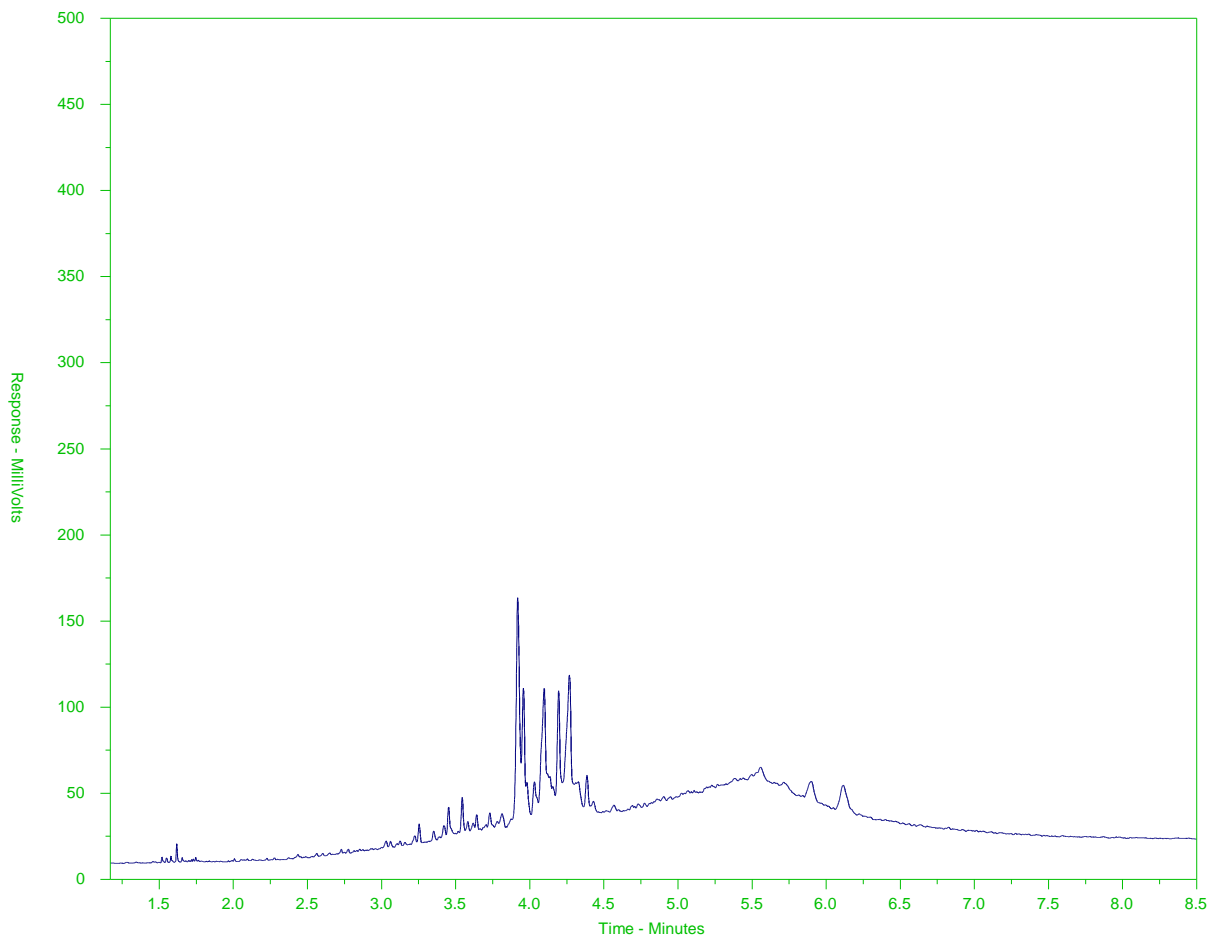
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-7
Client Sample ID: FIELD-DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

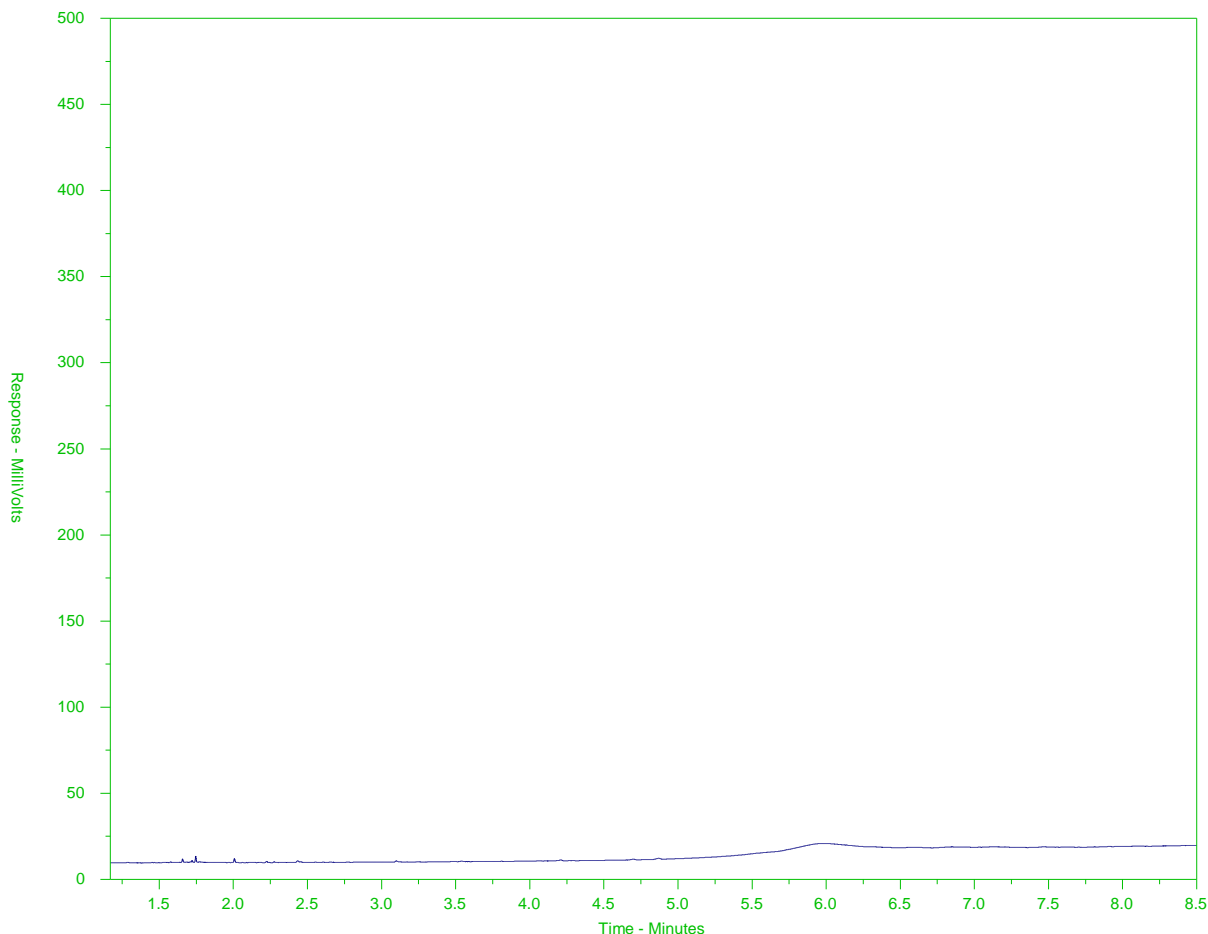
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2067173-C-8
Client Sample ID: FIELD-BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

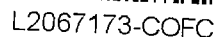
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



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COC Number: 17 -

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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SEPT 2017 FROM

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

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



STANTEC CONSULTING LTD.
ATTN: Barrie Tuite
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 22-MAR-18
Report Date: 17-APR-18 17:46 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2071339
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7			
Grouping	Analyte						
SEAWATER							
Physical Tests	Conductivity (uS/cm)		38700	37100			
	Hardness (as CaCO3) (mg/L)		3880	3910			
	pH (pH)		8.01	8.01			
	Total Suspended Solids (mg/L)		3.9	5.2			
	Turbidity (NTU)		1.05	1.95			
Total Metals	Aluminum (Al)-Total (mg/L)		0.0464	0.0314			
	Antimony (Sb)-Total (mg/L)		<0.00050	<0.00050			
	Arsenic (As)-Total (mg/L)		<0.0020	<0.0020			
	Barium (Ba)-Total (mg/L)		0.0093	0.0096			
	Beryllium (Be)-Total (mg/L)		<0.00050	<0.00050			
	Bismuth (Bi)-Total (mg/L)		<0.00050	<0.00050			
	Boron (B)-Total (mg/L)		3.06	3.16			
	Cadmium (Cd)-Total (mg/L)		0.000054	0.000054			
	Calcium (Ca)-Total (mg/L)		270	264			
	Cesium (Cs)-Total (mg/L)		<0.00050	<0.00050			
	Chromium (Cr)-Total (mg/L)		<0.00050	<0.00050			
	Cobalt (Co)-Total (mg/L)		<0.000050	<0.000050			
	Copper (Cu)-Total (mg/L)		0.00091	0.00085			
	Gallium (Ga)-Total (mg/L)		<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)		0.063	0.036			
	Lead (Pb)-Total (mg/L)		<0.00030	<0.00030			
	Lithium (Li)-Total (mg/L)		0.132	0.129			
	Magnesium (Mg)-Total (mg/L)		772	837			
	Manganese (Mn)-Total (mg/L)		0.00681	0.00580			
	Molybdenum (Mo)-Total (mg/L)		0.0075	0.0074			
	Nickel (Ni)-Total (mg/L)		0.00098	0.00098			
	Phosphorus (P)-Total (mg/L)		0.051	<0.050			
	Potassium (K)-Total (mg/L)		244	231			
	Rhenium (Re)-Total (mg/L)		<0.00050	<0.00050			
	Rubidium (Rb)-Total (mg/L)		0.0832	0.0813			
	Selenium (Se)-Total (mg/L)		<0.0020	<0.0020			
	Silicon (Si)-Total (mg/L)		<1.0	<1.0			
	Silver (Ag)-Total (mg/L)		<0.00010	<0.00010			
	Sodium (Na)-Total (mg/L)		6620	6440			
	Strontium (Sr)-Total (mg/L)		4.73	4.34			
	Sulfur (S)-Total (mg/L)		588	576			
	Tellurium (Te)-Total (mg/L)		<0.00050	<0.00050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7			
Grouping	Analyte						
SEAWATER							
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050				
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050				
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010				
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050				
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010				
	Uranium (U)-Total (mg/L)	0.00238	0.00246				
	Vanadium (V)-Total (mg/L)	0.00123	0.00115				
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.0020	<0.0020				
	Barium (Ba)-Dissolved (mg/L)	0.0089	0.0093				
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050				
	Boron (B)-Dissolved (mg/L)	3.17	3.10				
	Cadmium (Cd)-Dissolved (mg/L)	0.000058	<0.000050				
	Calcium (Ca)-Dissolved (mg/L)	273	263				
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050				
	Copper (Cu)-Dissolved (mg/L)	0.00061	0.00055				
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.00030	<0.00030				
	Lithium (Li)-Dissolved (mg/L)	0.132	0.128				
	Magnesium (Mg)-Dissolved (mg/L)	776	789				
	Manganese (Mn)-Dissolved (mg/L)	0.00484	0.00462				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0080	0.0072				
	Nickel (Ni)-Dissolved (mg/L)	0.00093	0.00094				
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				
	Potassium (K)-Dissolved (mg/L)	239	230				
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050				
	Rubidium (Rb)-Dissolved (mg/L)	0.0830	0.0808				
	Selenium (Se)-Dissolved (mg/L)	<0.0020	<0.0020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7			
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0			
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010			
	Sodium (Na)-Dissolved (mg/L)	6690	6470			
	Strontium (Sr)-Dissolved (mg/L)	4.47	4.41			
	Sulfur (S)-Dissolved (mg/L)	557	541			
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050			
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050			
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050			
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050			
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010			
	Uranium (U)-Dissolved (mg/L)	0.00244	0.00241			
	Vanadium (V)-Dissolved (mg/L)	0.00109	0.00103			
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-1 WATER 22-MAR-18 13:00 WT2	L2071339-2 WATER 22-MAR-18 13:24 WT3	L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7	L2071339-5 WATER 22-MAR-18 14:12 WT8
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	122	159			194
	Hardness (as CaCO3) (mg/L)	30.6	17.9			69.7
	pH (pH)	7.62	7.59			7.84
	Total Suspended Solids (mg/L)	27.0	25.8			23.4
	Turbidity (NTU)	25.6	14.4			11.8
Total Metals	Aluminum (Al)-Total (mg/L)	1.30	0.992			0.408
	Antimony (Sb)-Total (mg/L)	0.00039	0.00017			0.00015
	Arsenic (As)-Total (mg/L)	0.00125	0.00044			0.00052
	Barium (Ba)-Total (mg/L)	0.0175	0.0213			0.0127
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050			<0.000050
	Boron (B)-Total (mg/L)	0.011	<0.010			<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000334	0.0000242			0.0000261
	Calcium (Ca)-Total (mg/L)	10.9	5.53			18.6
	Cesium (Cs)-Total (mg/L)	0.000052	0.000033			0.000016
	Chromium (Cr)-Total (mg/L)	0.00144	0.00103			0.00464
	Cobalt (Co)-Total (mg/L)	0.00052	0.00041			0.00027
	Copper (Cu)-Total (mg/L)	0.00385	0.00448			0.00183
	Iron (Fe)-Total (mg/L)	1.26	0.851			1.05
	Lead (Pb)-Total (mg/L)	0.00126	0.000926			0.00117
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010			<0.0010
	Magnesium (Mg)-Total (mg/L)	1.69	1.22			5.10
	Manganese (Mn)-Total (mg/L)	0.0365	0.0436			0.0831
	Molybdenum (Mo)-Total (mg/L)	0.000411	0.000209			0.000154
	Nickel (Ni)-Total (mg/L)	0.00104	0.00099			0.00098
	Phosphorus (P)-Total (mg/L)	0.067	<0.050			<0.050
	Potassium (K)-Total (mg/L)	1.32	0.967			1.05
	Rubidium (Rb)-Total (mg/L)	0.00133	0.00103			0.00060
	Selenium (Se)-Total (mg/L)	<0.000050	0.000079			0.000206
	Silicon (Si)-Total (mg/L)	3.91	3.21			9.26
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010			<0.000010
	Sodium (Na)-Total (mg/L)	14.9	27.1			13.0
	Strontium (Sr)-Total (mg/L)	0.0405	0.0333			0.128
	Sulfur (S)-Total (mg/L)	0.58	0.55			2.93
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020			<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010			<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010			<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-6 WATER 22-MAR-18 14:36 WT10	L2071339-7 WATER 22-MAR-18 13:52 WT9	L2071339-8 WATER 22-MAR-18 FIELD-DUP	L2071339-9 WATER 22-MAR-18 12:38 FIELD-BLANK	L2071339-10 WATER 22-MAR-18 TRAVEL BLANK
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	153	88.8	99.1	<2.0	<2.0 ^{HTC}
	Hardness (as CaCO3) (mg/L)	58.1	37.4	15.1	<0.50	<0.50
	pH (pH)	7.79	7.57	7.44	5.73	5.73
	Total Suspended Solids (mg/L)	43.0	202	98.0	<3.0	<3.0
	Turbidity (NTU)	29.5	63.1	61.6	<0.10	<0.10
Total Metals	Aluminum (Al)-Total (mg/L)	1.03	3.38	2.27	<0.0030	0.0046 ^{RRV}
	Antimony (Sb)-Total (mg/L)	0.00014	0.00017	0.00034	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00202	0.00197	0.00093	<0.00010	<0.00010
	Barium (Ba)-Total (mg/L)	0.0142	0.0257	0.0237	0.00024 ^{RRV}	<0.00010
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000283	0.0000626	0.0000471	<0.000050	<0.000050
	Calcium (Ca)-Total (mg/L)	15.0	10.3	6.62	<0.050	<0.050
	Cesium (Cs)-Total (mg/L)	0.000036	0.000109	0.000095	<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)	0.00433	0.00500	0.00232	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00056	0.00179	0.00091	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00456	0.00675	0.00627	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	1.75	3.91	1.95	<0.010	<0.010
	Lead (Pb)-Total (mg/L)	0.00127	0.00218	0.00242	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0011	0.0019	0.0013	<0.0010	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.04	5.22	1.13	<0.0050	<0.0050
	Manganese (Mn)-Total (mg/L)	0.0696	0.189	0.0549	<0.00010	<0.00010
	Molybdenum (Mo)-Total (mg/L)	0.000339	0.000286	0.000246	<0.000050	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00166	0.00506	0.00190	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	0.064	0.218	0.075	<0.050	<0.050
	Potassium (K)-Total (mg/L)	1.90	1.42	0.908	<0.050	<0.050
	Rubidium (Rb)-Total (mg/L)	0.00127	0.00223	0.00150	<0.00020	<0.00020
	Selenium (Se)-Total (mg/L)	0.000318	0.000203	0.000053	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	8.69	9.38	3.87	<0.10	<0.10
	Silver (Ag)-Total (mg/L)	<0.000010	0.000017	0.000014	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	8.36	3.79	13.0	<0.050	<0.050
	Strontium (Sr)-Total (mg/L)	0.0823	0.0538	0.0289	<0.00020	<0.00020
	Sulfur (S)-Total (mg/L)	2.15	0.94	<0.50	<0.50	<0.50
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	0.000014	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2071339-1 WATER 22-MAR-18 13:00 WT2	L2071339-2 WATER 22-MAR-18 13:24 WT3	L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7	L2071339-5 WATER 22-MAR-18 14:12 WT8
Grouping	Analyte						
WATER							
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010				<0.00010
	Titanium (Ti)-Total (mg/L)	0.0413	0.0320				0.0135
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010				<0.00010
	Uranium (U)-Total (mg/L)	0.000061	0.000026				0.000084
	Vanadium (V)-Total (mg/L)	0.00278	0.00239				0.00274
	Zinc (Zn)-Total (mg/L)	0.0330	0.0240				0.0051
	Zirconium (Zr)-Total (mg/L)	0.000097	0.000145				0.000085
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD				FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0406	0.0753				0.0590
	Antimony (Sb)-Dissolved (mg/L)	0.00027	0.00010				<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00061	0.00021				0.00033
	Barium (Ba)-Dissolved (mg/L)	0.00749	0.0131				0.00905
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010				<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050				<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010				<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.0000125	0.0000127				0.0000057
	Calcium (Ca)-Dissolved (mg/L)	10.3	5.53				19.0
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010				<0.000010
	Chromium (Cr)-Dissolved (mg/L)	0.00032	0.00020				0.00169
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010				<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00133	0.00259				0.00092
	Iron (Fe)-Dissolved (mg/L)	0.023	0.053				0.087
	Lead (Pb)-Dissolved (mg/L)	0.000076	0.000074				0.000128
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010				<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	1.22	0.987				5.40
	Manganese (Mn)-Dissolved (mg/L)	0.00655	0.0102				0.00283
	Molybdenum (Mo)-Dissolved (mg/L)	0.000344	0.000175				0.000134
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050				<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050				<0.050
	Potassium (K)-Dissolved (mg/L)	1.17	0.929				1.12
	Rubidium (Rb)-Dissolved (mg/L)	0.00070	0.00071				0.00055
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050				0.000120
	Silicon (Si)-Dissolved (mg/L)	1.69	1.80				9.08
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010				<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.1	27.6				13.7
	Strontium (Sr)-Dissolved (mg/L)	0.0344	0.0310				0.132
	Sulfur (S)-Dissolved (mg/L)	<0.50	<0.50				2.60

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-6 WATER 22-MAR-18 14:36 WT10	L2071339-7 WATER 22-MAR-18 13:52 WT9	L2071339-8 WATER 22-MAR-18 FIELD-DUP	L2071339-9 WATER 22-MAR-18 12:38 FIELD-BLANK	L2071339-10 WATER 22-MAR-18 TRAVEL BLANK
Grouping	Analyte					
WATER						
Total Metals	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00012	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.0355	0.0977	0.0711	<0.00030	<0.00030
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000143	0.000114	0.000062	<0.000010	<0.000010
	Vanadium (V)-Total (mg/L)	0.00492	0.0106	0.00442	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	0.0088	0.0168	0.0382	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	0.000164	0.000455	0.000139	<0.000060	<0.000060
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	LAB	
	Aluminum (Al)-Dissolved (mg/L)	0.117	0.314	0.0470	<0.0010	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00011	0.00021	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00134	0.00086	0.00053	<0.00010	
	Barium (Ba)-Dissolved (mg/L)	0.00792	0.00553	0.00497	<0.00010	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000087	0.0000107	0.0000109	<0.000050	
	Calcium (Ca)-Dissolved (mg/L)	15.0	8.27	5.43	<0.050	
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Chromium (Cr)-Dissolved (mg/L)	0.00132	0.00124	0.00017	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00014	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00247	0.00238	0.00143	<0.00020	
	Iron (Fe)-Dissolved (mg/L)	0.164	0.374	0.025	<0.010	
	Lead (Pb)-Dissolved (mg/L)	0.000153	0.000276	0.000089	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	5.04	4.07	0.384	<0.0050	
	Manganese (Mn)-Dissolved (mg/L)	0.0101	0.0117	0.00641	<0.00010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.000285	0.000232	0.000171	<0.000050	
	Nickel (Ni)-Dissolved (mg/L)	0.00060	0.00114	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	1.92	1.07	0.650	<0.050	
	Rubidium (Rb)-Dissolved (mg/L)	0.00095	0.00074	0.00041	<0.00020	
	Selenium (Se)-Dissolved (mg/L)	0.000164	0.000183	<0.000050	<0.000050	
	Silicon (Si)-Dissolved (mg/L)	7.50	4.99	0.538	<0.050	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	8.62	3.28	12.2	<0.050	
	Strontium (Sr)-Dissolved (mg/L)	0.0808	0.0382	0.0197	<0.00020	
	Sulfur (S)-Dissolved (mg/L)	2.16	0.73	<0.50	<0.50	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-1 WATER 22-MAR-18 13:00 WT2	L2071339-2 WATER 22-MAR-18 13:24 WT3	L2071339-3 SEAWATER 22-MAR-18 12:00 WT5	L2071339-4 SEAWATER 22-MAR-18 12:14 WT7	L2071339-5 WATER 22-MAR-18 14:12 WT8
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020			<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010			<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.00064	0.00133			0.00144
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010			<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000029	<0.000010			0.000031
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050			0.00111
	Zinc (Zn)-Dissolved (mg/L)	0.0123	0.0104			0.0017
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	0.000094			<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	82.5	77.9	71.3	79.0	92.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2071339-6 WATER 22-MAR-18 14:36 WT10	L2071339-7 WATER 22-MAR-18 13:52 WT9	L2071339-8 WATER 22-MAR-18 FIELD-DUP	L2071339-9 WATER 22-MAR-18 12:38 FIELD-BLANK	L2071339-10 WATER 22-MAR-18 TRAVEL BLANK
Grouping	Analyte					
WATER						
Dissolved Metals	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	0.00364	0.0201	0.00074	<0.00030	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.000046	0.000025	0.000012	<0.000010	
	Vanadium (V)-Dissolved (mg/L)	0.00172	0.00216	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0027	0.0024	0.0082	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	0.000126	0.000503	<0.000060	<0.000060	
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	97.1	88.2	87.6	85.2	77.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Chromium (Cr)-Total	B	L2071339-10, -9
Method Blank	Silver (Ag)-Total	B	L2071339-10, -9
Method Blank	Thallium (Tl)-Total	B	L2071339-3, -4
Method Blank	Sodium (Na)-Dissolved	MB-LOR	L2071339-9
Method Blank	Thallium (Tl)-Dissolved	MB-LOR	L2071339-3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2071339-1, -2, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2071339-1, -2, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2071339-1, -2, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2071339-1, -2, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2071339-1, -10, -2, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

MET-D-L-HRMS-VA Seawater Diss. Metals in Seawater by HR-ICPMS EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve laboratory sample filtration based on APHA Method 3030B.

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-L-HRMS-VA Seawater Tot. Metals in Seawater by HR-ICPMS EPA 200.8
Trace metals in seawater are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) based on US EPA Method 200.8, (Revision 5.5). The procedures may involve preliminary sample treatment by acid digestion based on APHA Method 3030E.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

TURBIDITY-C-VA Seawater Turbidity by Meter in Seawater APHA 2130 Turbidity
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity
This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Chain of Custody (COC) / Analytical Request Form



COC Number: 17 -

L2071339-COFC

Page 1 of 1

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company: Stantec		Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)		Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact: Barrie Tuite		Quality Control (QC) Report with Report <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIORITY (Business Days) 4 day [P4-20%] <input type="checkbox"/>	
Phone: 778-328-1027		<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		EMERGENCY 1 Business day [E1 - 100%] <input type="checkbox"/>	
Company address below will appear on the final report		Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] <input type="checkbox"/>	
Street: 500-4730 Kingsway		Email 1 or Fax: barrie.tuite@stantec.com, Jaclyn.Bowman@stantec.		Date and Time Required for all E&P TATs:	
City/Province: Burnaby, BC		Email 2		For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code: V5H 0C6		Email 3		Analysis Request	
Invoice To: Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		pH	
Company:		Email 1 or Fax: stantec.accounts.payable@stantec.com		Turbidity	
Contact:		Email 2		EC, Hardness	
Project Information		Oil and Gas Required Fields (client use)		TSS	
ALS Account # / Quote #:		AFE/Cost Center:		Total Metals (excluding Hg)	
Job #: 123512431		Major/Minor Code:		Dissolved Metals (excluding Hg)	
PO / AFE:		Requisitioner:		Total Extractable Hydrocarbons (F-F4)	
LSD:		Location:			
ALS Lab Work Order # (lab use only):		ALS Contact: BRENT MACK		SAMPLES ON HOLD	
		Sampler: B. Tuite J. Bowman		Sample is hazardous (please provide further details)	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS
	WT2	22-Mar-18	13:00	Water	7
	WT3	22-Mar-18	13:24	Water	
	WT5	22-Mar-18	12:00	Seawater	
	WT7	22-Mar-18	12:14	Seawater	
	WT8	22-Mar-18	14:12	Water	
	WT10	22-Mar-18	14:36	Water	
	WT9	22-Mar-18	13:52	Water	
	FIELD-DUP	22-Mar-18	-	Water	
	FIELD-BLANK	22-Mar-18	12:38	Water	4
	TRAVEL BLANK	22-Mar-18	-	Water	
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		FIELD-BLANK DIS-METALS, NOT PRESERVED		Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		CSR, CCME, BCWQG		Ice Packs <input type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C: 8.4 8.9	
				FINAL COOLER TEMPERATURES °C:	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Jaclyn Bowman	Date: 22 MAR 18	Time: 15:28	Received by: TP	Date: Mar 22	Time: 15:28

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 2017 FROTH

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 03-MAY-19
Report Date: 14-MAY-19 11:09 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2267589
Project P.O. #: 123512431.601.200
Job Reference: 123512431.601.200
C of C Numbers:
Legal Site Desc: TMEP Bayview Dr. Burnaby, BC V5A4T3

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE	L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	27800	28100	33200	28900	
	Hardness (as CaCO3) (mg/L)	4370	4110	5130	4350	
	pH (pH)	7.95	7.86	7.90	7.98	
	Total Suspended Solids (mg/L)	12.1	2.2	3.8	2.6	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0120	0.0121	0.0217	0.0111	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Phosphorus (P)-Total (mg/L)	0.0206	0.0205	0.0589	0.0215	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0324	0.0258	0.0183	0.0236	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00108	0.00109	0.00141	0.00125	
	Barium (Ba)-Total (mg/L)	0.0075	0.0065	0.0097	0.0067	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	2.69	2.58	2.93	2.51	
	Cadmium (Cd)-Total (mg/L)	0.000044	0.000043	0.000075	0.000056	
	Calcium (Ca)-Total (mg/L)	256	258	322	270	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	0.00075	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	0.00066	0.00056	0.00056	0.00102	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.020	0.023	0.021	0.018	
	Lead (Pb)-Total (mg/L)	0.000062	0.000095	<0.000050	0.000219	
	Lithium (Li)-Total (mg/L)	0.110	0.104	0.111	0.092	
	Magnesium (Mg)-Total (mg/L)	881	869	1090	894	
	Manganese (Mn)-Total (mg/L)	0.00314	0.00362	0.00323	0.00324	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.000025 ^{DLIS}	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00695	0.00685	0.00860	0.00712	
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00054	
	Phosphorus (P)-Total (mg/L)	0.057	<0.050	0.075	<0.050	
	Potassium (K)-Total (mg/L)	282	285	371	311	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0743	0.0743	0.0963	0.0788	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE	L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP	
Grouping	Analyte					
SEAWATER						
Total Metals	Sodium (Na)-Total (mg/L)	6690	6780	8410	7150	
	Strontium (Sr)-Total (mg/L)	4.44	4.51	5.77	4.66	
	Sulfur (S)-Total (mg/L)	607	674	821	778	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00186	0.00179	0.00228	0.00193	
	Vanadium (V)-Total (mg/L)	0.00145	0.00151	0.00187	0.00152	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0103	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0113	0.0105	<0.0050	0.0114	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00109	0.00110	0.00130	0.00106	
	Barium (Ba)-Dissolved (mg/L)	0.0047	0.0055	0.0078	0.0048	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	2.38	2.41	2.77	2.41	
	Cadmium (Cd)-Dissolved (mg/L)	0.000059	0.000051	0.000071	0.000059	
	Calcium (Ca)-Dissolved (mg/L)	269	275	355	283	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00067	0.00053	0.00042	0.00059	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000089	
	Lithium (Li)-Dissolved (mg/L)	0.099	0.092	0.107	0.094	
	Magnesium (Mg)-Dissolved (mg/L)	898	832	1030	884	
	Manganese (Mn)-Dissolved (mg/L)	0.00183	0.00230	0.00197	0.00209	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00701	0.00717	0.00919	0.00741	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE	L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.00055	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	0.066	<0.050	
	Potassium (K)-Dissolved (mg/L)	299	280	357	300	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0775	0.0753	0.0950	0.0767	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	6800	7020	8380	7160	
	Strontium (Sr)-Dissolved (mg/L)	4.86	4.76	6.25	4.95	
	Sulfur (S)-Dissolved (mg/L)	629	695	879	686	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00179	0.00196	0.00247	0.00197	
	Vanadium (V)-Dissolved (mg/L)	0.00137	0.00136	0.00167	0.00136	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0025	0.0014	0.0015	0.0102	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-1 Surface Water 03-MAY-19 14:20 WT11	L2267589-2 Surface Water 03-MAY-19 13:30 WT10	L2267589-3 Surface Water 03-MAY-19 12:50 WT9	L2267589-4 Surface Water 03-MAY-19 12:20 WT8	L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	255	233	221	245	
	Hardness (as CaCO3) (mg/L)	108	84.2	91.5	75.6	
	pH (pH)	8.22	8.06	8.02	8.03	
	Total Suspended Solids (mg/L)	77.1	28.1	63.9	67.5	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0172	0.0180	0.0152	<0.0050	
	Nitrate (as N) (mg/L)	0.268	0.972	0.0464	1.42 ^{HTD}	
	Nitrite (as N) (mg/L)	0.0029	0.0024	0.0013	0.0015	
	Phosphorus (P)-Total (mg/L)	0.161	0.0861	0.0297	0.0212	
Total Metals	Aluminum (Al)-Total (mg/L)	0.632	0.492	0.663	0.207	
	Antimony (Sb)-Total (mg/L)	0.00021	0.00014	0.00013	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00254	0.00200	0.00306	0.00034	
	Barium (Ba)-Total (mg/L)	0.0295	0.0189	0.0175	0.0106	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	0.020	0.015	0.010	0.013	
	Cadmium (Cd)-Total (mg/L)	0.0000195	0.0000251	0.0000344	0.0000192	
	Calcium (Ca)-Total (mg/L)	32.1	23.3	24.0	23.2	
	Cesium (Cs)-Total (mg/L)	0.000030	0.000023	0.000059	0.000070	
	Chromium (Cr)-Total (mg/L)	0.00062	0.00364	0.00225	0.00309	
	Cobalt (Co)-Total (mg/L)	0.00036	0.00031	0.00148	0.00014	
	Copper (Cu)-Total (mg/L)	0.00296	0.00216	0.00205	0.00078	
	Iron (Fe)-Total (mg/L)	0.606	0.984	1.16	0.503	
	Lead (Pb)-Total (mg/L)	0.000485	0.000873	0.000847	0.000564	
	Lithium (Li)-Total (mg/L)	<0.0010	0.0014	0.0020	0.0017	
	Magnesium (Mg)-Total (mg/L)	7.84	6.97	9.52	5.73	
	Manganese (Mn)-Total (mg/L)	0.0364	0.0743	0.687	0.0453	
	Mercury (Hg)-Total (mg/L)	<0.0000050	0.0000062	0.0000089	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.000943	0.000515	0.000406	0.000106	
	Nickel (Ni)-Total (mg/L)	0.00075	0.00107	0.00278	0.00057	
	Phosphorus (P)-Total (mg/L)	0.066	0.103	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	3.54	2.03	2.42	0.828	
	Rubidium (Rb)-Total (mg/L)	0.00171	0.00101	0.00171	0.00075	
	Selenium (Se)-Total (mg/L)	0.000191	0.000275	0.000215	0.000134	
	Silicon (Si)-Total (mg/L)	8.64	11.3	10.6	11.5	
	Silver (Ag)-Total (mg/L)	<0.000010	0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	8.76	12.6	8.96	17.1	
	Strontium (Sr)-Total (mg/L)	0.106	0.125	0.107	0.151	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-7 Surface Water 03-MAY-19 15:55 WT3	L2267589-8 Surface Water 03-MAY-19 14:50 WT2	L2267589-9 Surface Water 03-MAY-19 DUP	L2267589-10 Water 03-MAY-19 16:15 FIELD BLANK
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)		265	192	264	<2.0
	Hardness (as CaCO3) (mg/L)		100	72.2	103	<0.50
	pH (pH)		8.23	8.20	8.25	6.20
	Total Suspended Solids (mg/L)		6.9	10.5	3.3	<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)		<0.0050	0.0108	<0.0050	<0.0050
	Nitrate (as N) (mg/L)		0.0536	0.0172	0.0538	<0.0050
	Nitrite (as N) (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)		0.0699	0.0591	0.0682	<0.0020
Total Metals	Aluminum (Al)-Total (mg/L)		0.0121	0.385	0.0084	<0.0030
	Antimony (Sb)-Total (mg/L)		<0.00010	0.00011	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)		0.00477	0.00461	0.00477	<0.00010
	Barium (Ba)-Total (mg/L)		0.00577	0.0126	0.00554	<0.00010
	Beryllium (Be)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)		0.015	0.068	0.016	<0.010
	Cadmium (Cd)-Total (mg/L)		<0.0000050	0.0000775	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)		27.2	22.3	27.5	<0.050
	Cesium (Cs)-Total (mg/L)		<0.000010	0.000065	<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)		0.00100	0.00089	0.00016	0.00011 ^{RRV}
	Cobalt (Co)-Total (mg/L)		<0.00010	0.00094	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)		<0.00050	0.00673	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)		0.012	1.73	<0.010	<0.010
	Lead (Pb)-Total (mg/L)		<0.000050	0.00170	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)		0.0011	0.0013	0.0012	<0.0010
	Magnesium (Mg)-Total (mg/L)		8.83	4.83	8.80	<0.0050
	Manganese (Mn)-Total (mg/L)		0.00545	0.0753	0.00416	<0.00010
	Mercury (Hg)-Total (mg/L)		<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)		0.000917	0.00110	0.000883	<0.000050
	Nickel (Ni)-Total (mg/L)		<0.00050	0.00244	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)		0.099	0.156	0.068	<0.050
	Potassium (K)-Total (mg/L)		2.96	2.50	2.94	<0.050
	Rubidium (Rb)-Total (mg/L)		0.00075	0.00132	0.00081	<0.00020
	Selenium (Se)-Total (mg/L)		0.000057	<0.000050	0.000062	<0.000050
	Silicon (Si)-Total (mg/L)		10.2	8.01	10.2	<0.10
	Silver (Ag)-Total (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)		11.6	12.1	11.4	<0.050
	Strontium (Sr)-Total (mg/L)		0.0925	0.0722	0.0901	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP			
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)					
	Hardness (as CaCO3) (mg/L)					
	pH (pH)					
	Total Suspended Solids (mg/L)					
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					
	Nitrate (as N) (mg/L)					
	Nitrite (as N) (mg/L)					
	Phosphorus (P)-Total (mg/L)					
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Cesium (Cs)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					
	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Rubidium (Rb)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-1 Surface Water 03-MAY-19 14:20 WT11	L2267589-2 Surface Water 03-MAY-19 13:30 WT10	L2267589-3 Surface Water 03-MAY-19 12:50 WT9	L2267589-4 Surface Water 03-MAY-19 12:20 WT8	L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	5.42	3.75	1.83	3.89	
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Total (mg/L)	<0.00010	0.00016	0.00632	0.00075	
	Titanium (Ti)-Total (mg/L)	0.0198	0.0168	0.0275	0.00819	
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)	0.000145	0.000132	0.000072	0.000086	
	Vanadium (V)-Total (mg/L)	0.00203	0.00275	0.00394	0.00169	
	Zinc (Zn)-Total (mg/L)	0.0278	0.0120	0.0064	<0.0030	
	Zirconium (Zr)-Total (mg/L)	0.000097	0.000082	0.000274	<0.000060	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0176	0.0260	0.137	0.0084	
	Antimony (Sb)-Dissolved (mg/L)	0.00019	<0.00010	0.00011	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00211	0.00119	0.00264	0.00019	
	Barium (Ba)-Dissolved (mg/L)	0.0239	0.0132	0.0140	0.00815	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.018	0.013	<0.010	0.013	
	Cadmium (Cd)-Dissolved (mg/L)	0.0000121	<0.000050	0.0000236	<0.000050	
	Calcium (Ca)-Dissolved (mg/L)	29.7	22.0	20.6	20.3	
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	0.000027	0.000063	
	Chromium (Cr)-Dissolved (mg/L)	0.00012	0.00151	0.00134	0.00130	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	0.00121	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00107	0.00059	0.00122	0.00024	
	Iron (Fe)-Dissolved (mg/L)	0.016	0.050	0.556	0.012	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000329	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0011	0.0016	0.0019	
	Magnesium (Mg)-Dissolved (mg/L)	8.17	7.07	9.71	6.03	
	Manganese (Mn)-Dissolved (mg/L)	0.0150	0.0149	0.606	0.00072	
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	0.0000051	<0.000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00103	0.000484	0.000368	0.000110	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00206	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.16	1.85	2.12	0.765	
	Rubidium (Rb)-Dissolved (mg/L)	0.00150	0.00076	0.00137	0.00069	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-7 Surface Water 03-MAY-19 15:55 WT3	L2267589-8 Surface Water 03-MAY-19 14:50 WT2	L2267589-9 Surface Water 03-MAY-19 DUP	L2267589-10 Water 03-MAY-19 16:15 FIELD BLANK
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)		4.38	1.25	4.33	<0.50
	Tellurium (Te)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)		<0.00010	0.00170	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)		0.00033	0.0146	<0.00030	<0.00030
	Tungsten (W)-Total (mg/L)		<0.00010	0.00024	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)		0.000090	0.000054	0.000091	<0.000010
	Vanadium (V)-Total (mg/L)		<0.00050	0.00180	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)		0.0040	0.0477	0.0039	<0.0030
	Zirconium (Zr)-Total (mg/L)		<0.000060	0.000076	<0.000060	<0.000060
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)		0.0044	0.0016	0.0041	<0.0010
	Antimony (Sb)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)		0.00457	0.00164	0.00453	<0.00010
	Barium (Ba)-Dissolved (mg/L)		0.00574	0.00686	0.00582	<0.00010
	Beryllium (Be)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)		0.014	0.067	0.015	<0.010
	Cadmium (Cd)-Dissolved (mg/L)		<0.000050	0.0000176	<0.000050	<0.000050
	Calcium (Ca)-Dissolved (mg/L)		25.5	20.4	26.4	<0.050
	Cesium (Cs)-Dissolved (mg/L)		<0.000010	0.000060	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)		0.00019	0.00013	0.00042 ^{DTC}	<0.00010
	Cobalt (Co)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)		<0.00020	0.00035	<0.00020	<0.00020
	Iron (Fe)-Dissolved (mg/L)		<0.010	0.023	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)		0.0011	0.0016	0.0011	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)		8.94	5.15	8.92	<0.0050
	Manganese (Mn)-Dissolved (mg/L)		0.00272	0.0159	0.00283	<0.00010
	Mercury (Hg)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)		0.000932	0.00106	0.000898	<0.000050
	Nickel (Ni)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)		0.074	<0.050	0.051	<0.050
	Potassium (K)-Dissolved (mg/L)		2.81	2.35	2.73	<0.050
	Rubidium (Rb)-Dissolved (mg/L)		0.00076	0.00121	0.00074	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP			
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)					
	Tellurium (Te)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Thorium (Th)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Tungsten (W)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
	Zirconium (Zr)-Total (mg/L)					
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Cesium (Cs)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Rubidium (Rb)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-1 Surface Water 03-MAY-19 14:20 WT11	L2267589-2 Surface Water 03-MAY-19 13:30 WT10	L2267589-3 Surface Water 03-MAY-19 12:50 WT9	L2267589-4 Surface Water 03-MAY-19 12:20 WT8	L2267589-5 Seawater 03-MAY-19 09:30 WT7-SURFACE
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	0.000215	0.000168	0.000141	0.000096	
	Silicon (Si)-Dissolved (mg/L)	7.46	10.3	9.08	10.7	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	9.10	12.1	8.18	16.9	
	Strontium (Sr)-Dissolved (mg/L)	0.110	0.129	0.107	0.146	
	Sulfur (S)-Dissolved (mg/L)	5.17	3.72	1.62	3.48	
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00142	0.00049	
	Titanium (Ti)-Dissolved (mg/L)	0.00037	0.00054	0.00800	<0.00030	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.000131	0.000083	0.000058	0.000051	
	Vanadium (V)-Dissolved (mg/L)	0.00073	0.00103	0.00232	0.00067	
	Zinc (Zn)-Dissolved (mg/L)	0.0182	0.0025	0.0042	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	0.000431 ^{DTC}	<0.000060	
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	95.1	97.2	95.6	96.0	92.2

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-6 Seawater 03-MAY-19 09:00 WT5-SURFACE	L2267589-7 Surface Water 03-MAY-19 15:55 WT3	L2267589-8 Surface Water 03-MAY-19 14:50 WT2	L2267589-9 Surface Water 03-MAY-19 DUP	L2267589-10 Water 03-MAY-19 16:15 FIELD BLANK
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)		9.72	6.98	9.88	<0.050
	Silver (Ag)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)		11.5	12.6	11.3	<0.050
	Strontium (Sr)-Dissolved (mg/L)		0.0952	0.0696	0.0907	<0.00020
	Sulfur (S)-Dissolved (mg/L)		4.12	1.37	4.49	<0.50
	Tellurium (Te)-Dissolved (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)		<0.00010	0.00018	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)		<0.00010	0.00017	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)		0.000087	0.000035	0.000090	<0.000010
	Vanadium (V)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)		0.0040	0.0083	0.0038	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)		<0.000060	<0.000060	<0.000060	<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	119.7	82.5	87.9	86.7	76.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2267589-11 Seawater 03-MAY-19 09:40 WT7-DEEP	L2267589-12 Seawater 03-MAY-19 09:20 WT5-DEEP			
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Sulfur (S)-Dissolved (mg/L)					
	Tellurium (Te)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Thorium (Th)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Tungsten (W)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
	Zirconium (Zr)-Dissolved (mg/L)					
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10			
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30			
	F3 (C16-C34) (mg/L)	<0.30	<0.30			
	F4 (C34-C50) (mg/L)	<0.30	<0.30			
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	89.3	98.3			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	F4 (C34-C50)	LCS-ND	L2267589-10, -11, -12, -7, -8, -9
Laboratory Control Sample	Phosphorus (P)-Total	MES	L2267589-11, -12, -5, -6
Laboratory Control Sample	Sulfur (S)-Total	MES	L2267589-11, -12, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2267589-9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2267589-3
Matrix Spike	Boron (B)-Dissolved	MS-B	L2267589-3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2267589-9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2267589-3
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L2267589-3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2267589-9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2267589-3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2267589-3
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2267589-3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2267589-3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2267589-9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2267589-3
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2267589-3
Matrix Spike	Boron (B)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9
Matrix Spike	Boron (B)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Potassium (K)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Sulfur (S)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Sodium (Na)-Total	MS-B	L2267589-11, -12, -5, -6
Matrix Spike	Phosphorus (P)-Total	MS-B	L2267589-1, -10, -2, -3, -4, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
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Reference Information

DLIS	Detection Limit Adjusted: Insufficient Sample
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
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.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method			

Reference Information

245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
 Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-T-PRES-COL-VA Seawater Total P in Seawater by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Reference Information

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)
 Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC
 This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

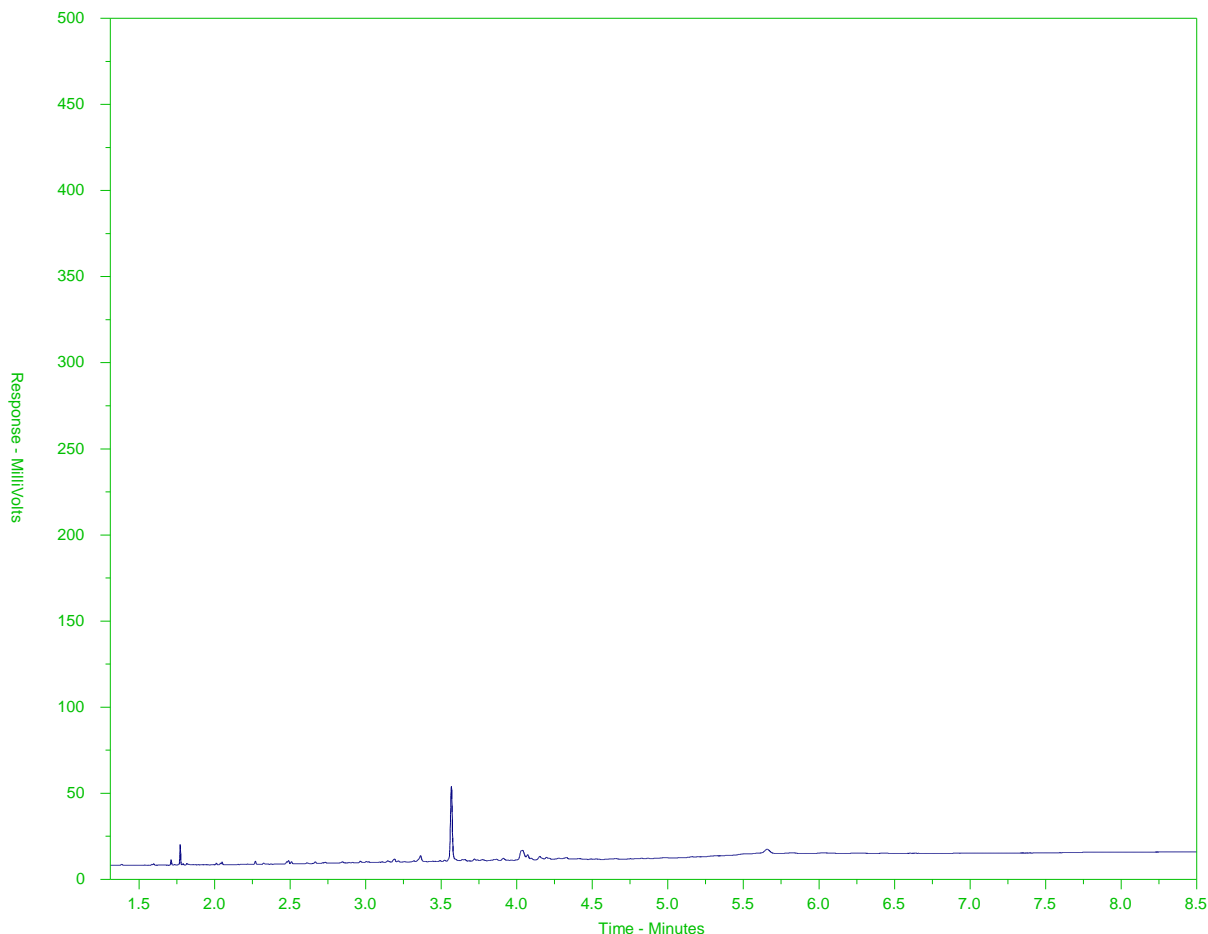
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-1
Client Sample ID: WT11



F2		F3	F4	
nC10	nC16		nC34	nC50
174°C	287°C		481°C	575°C
346°F	549°F		898°F	1067°F
← Gasoline →		Motor Oils/ Lube Oils/ Grease		
← Diesel/ Jet Fuels →				

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

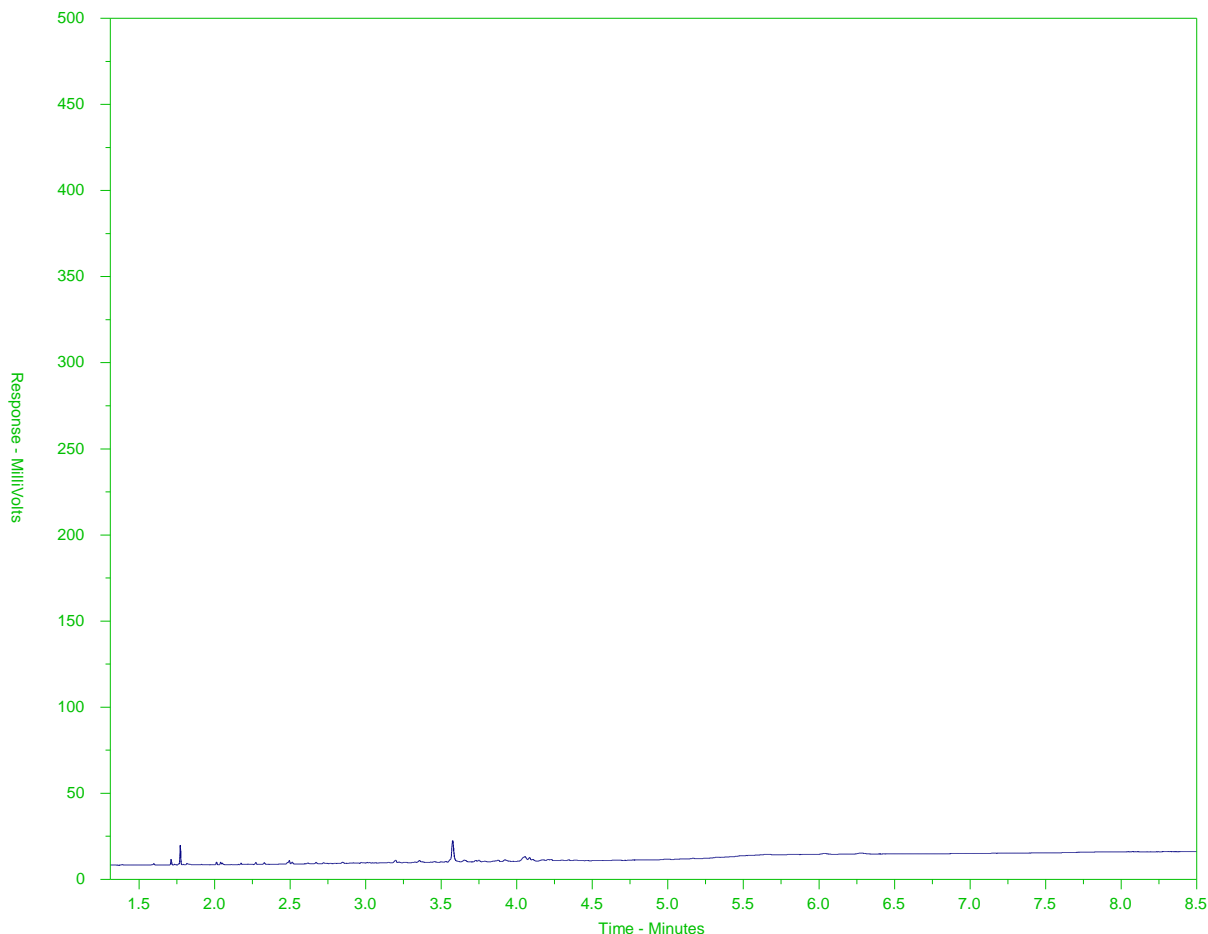
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-2
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

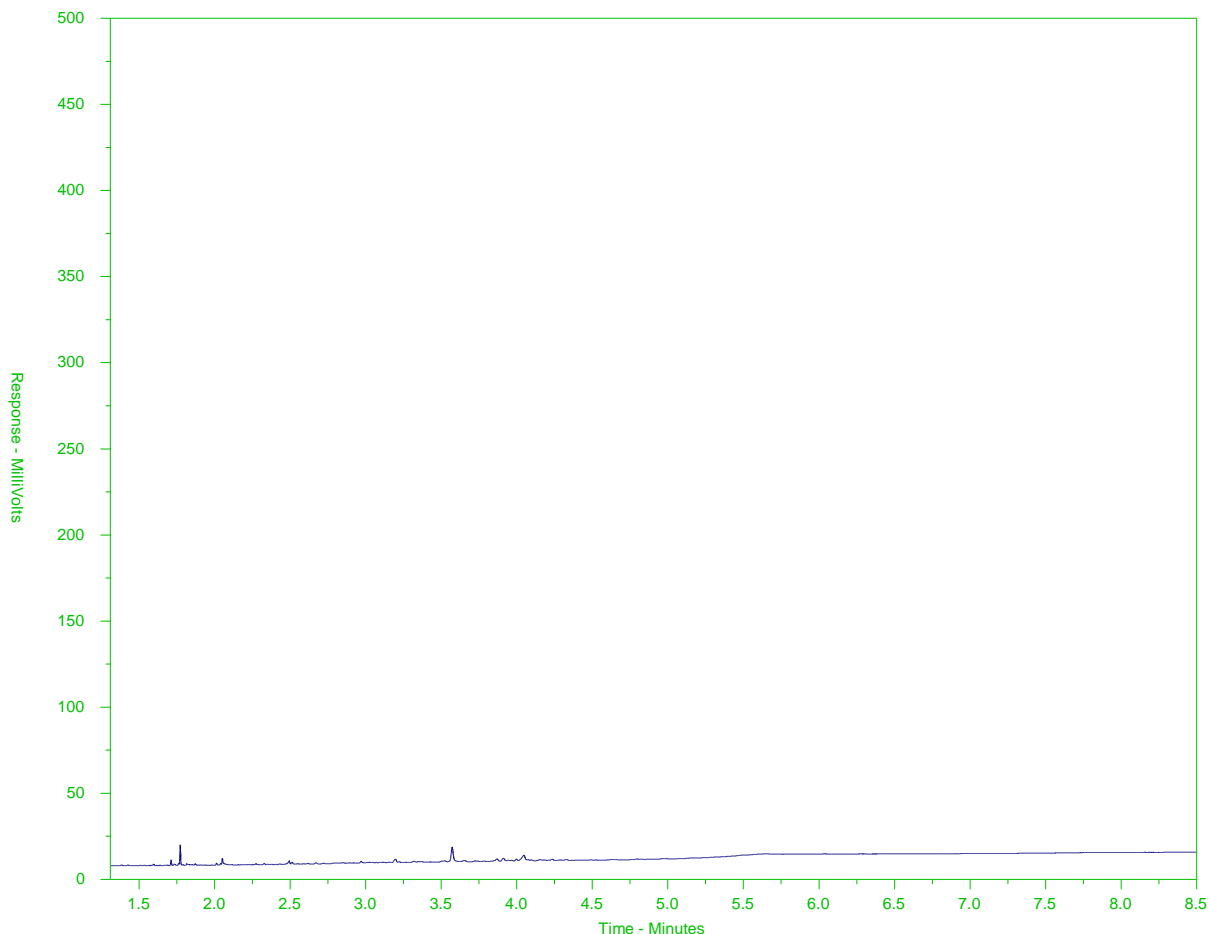
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-3
Client Sample ID: WT9



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

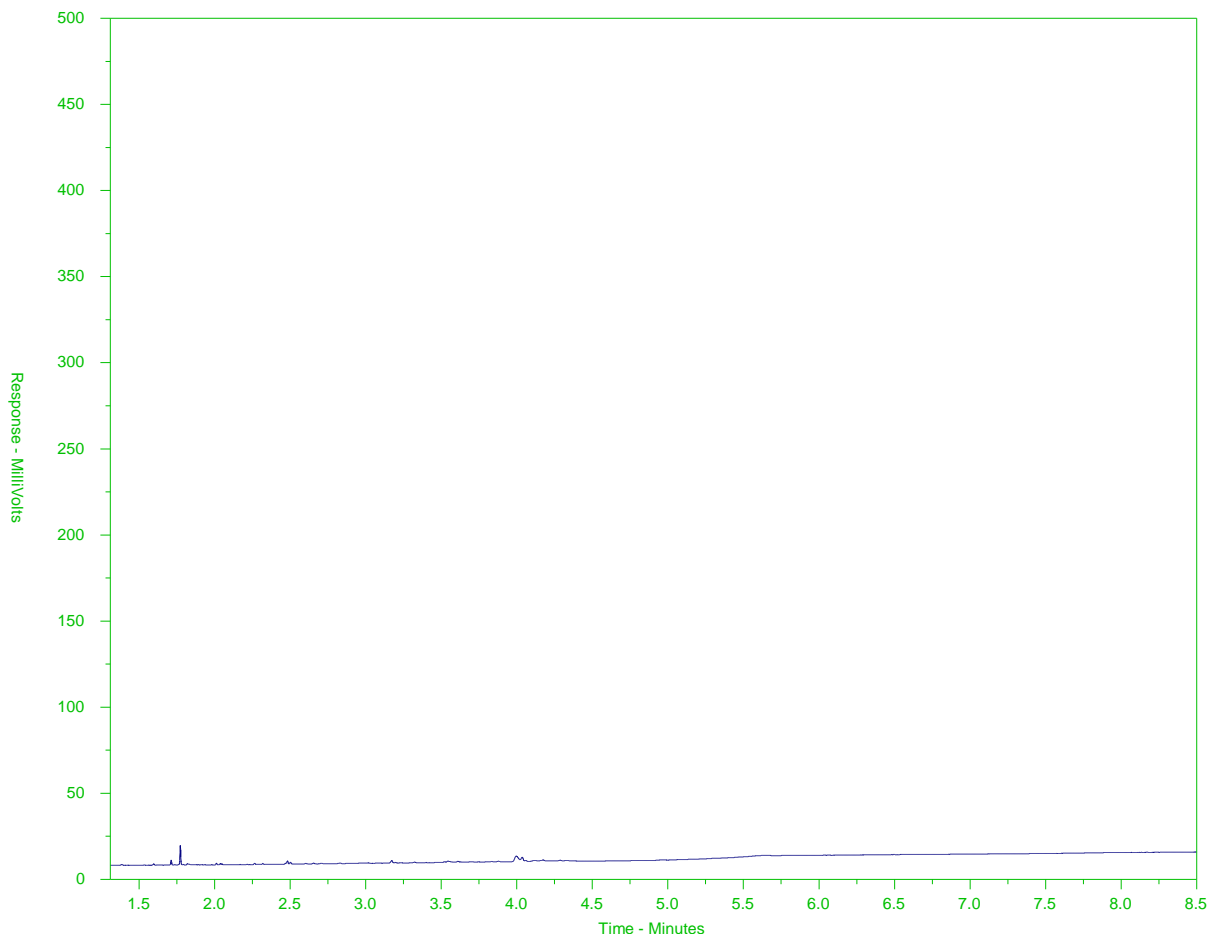
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-4
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

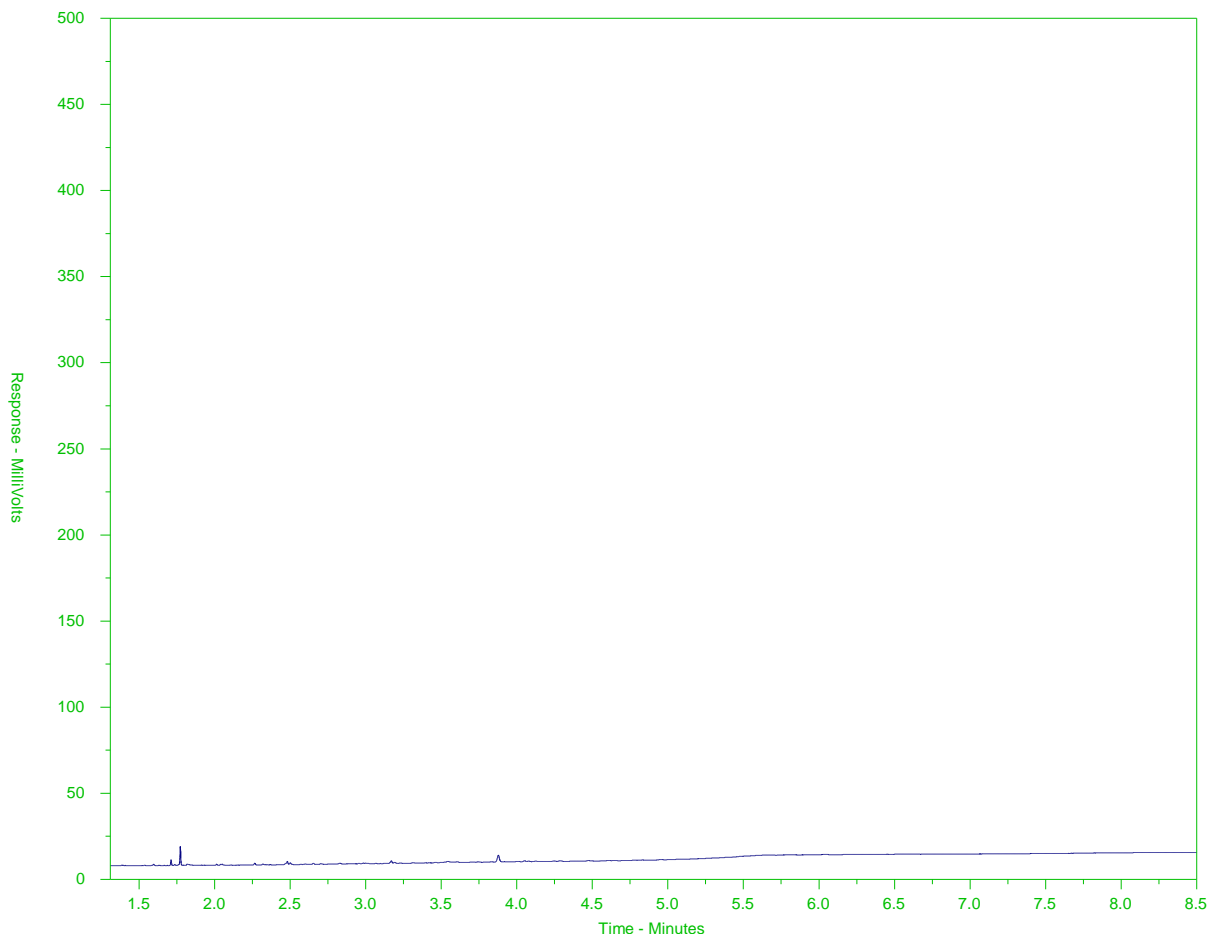
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-5
Client Sample ID: WT7-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

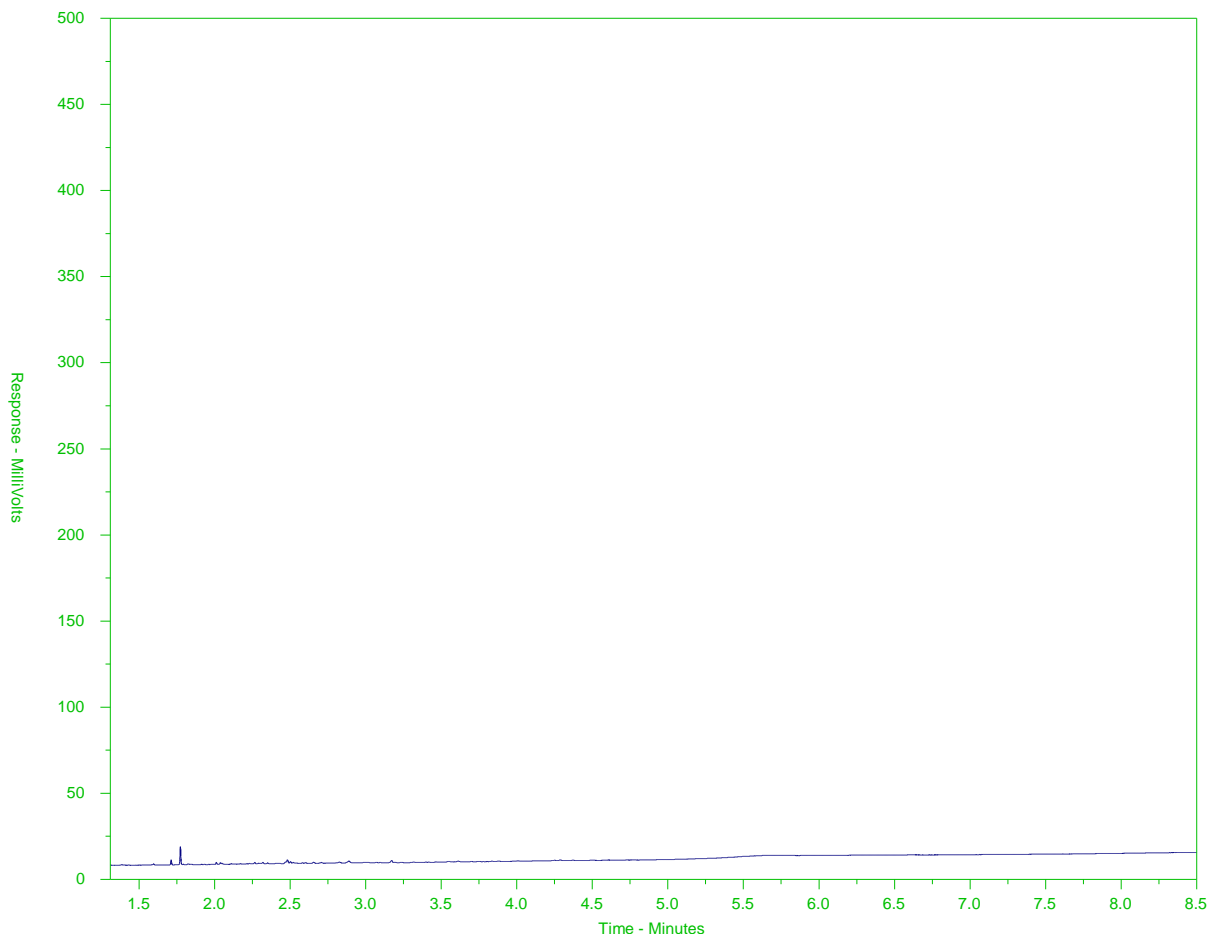
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-7
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

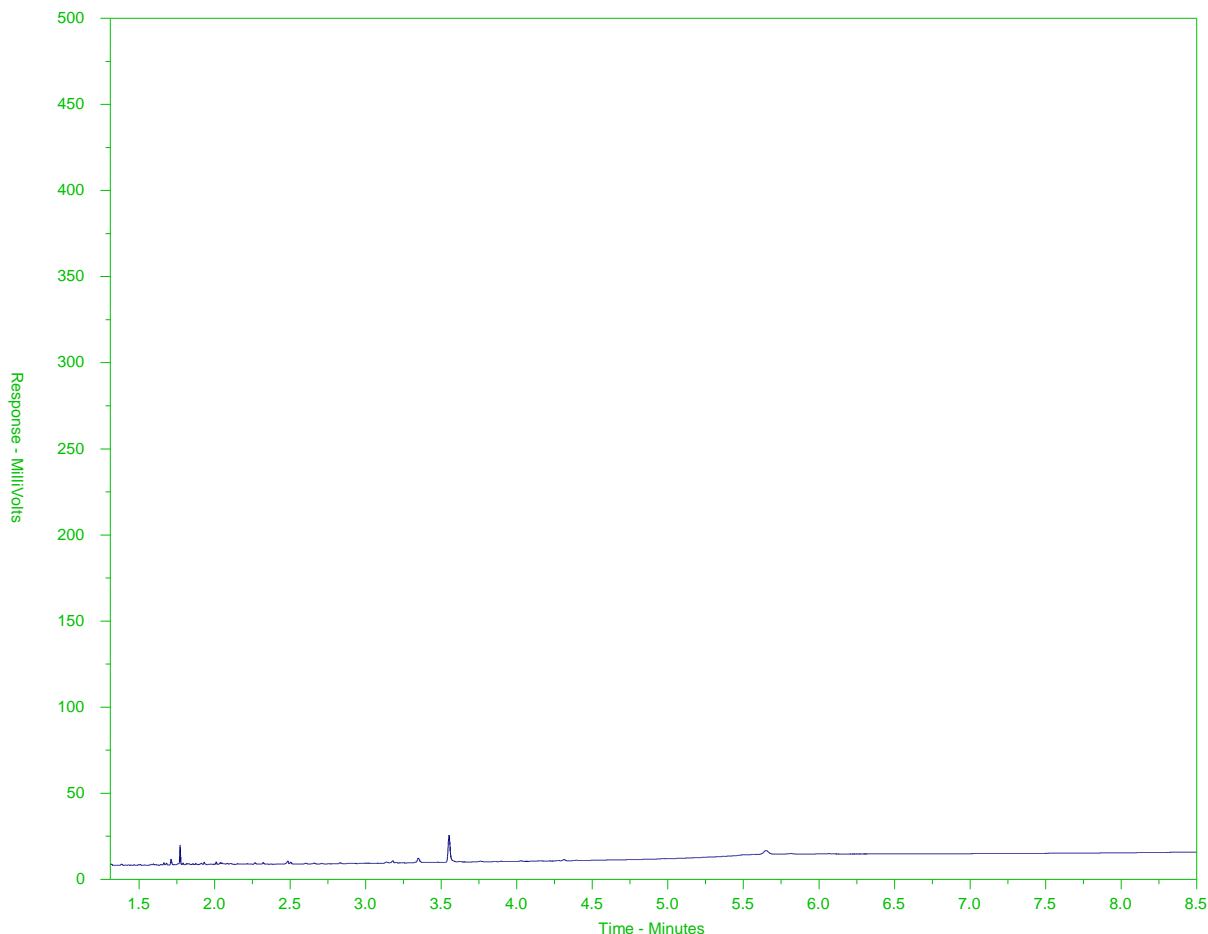
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-8
Client Sample ID: WT2



F2		F3		F4	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

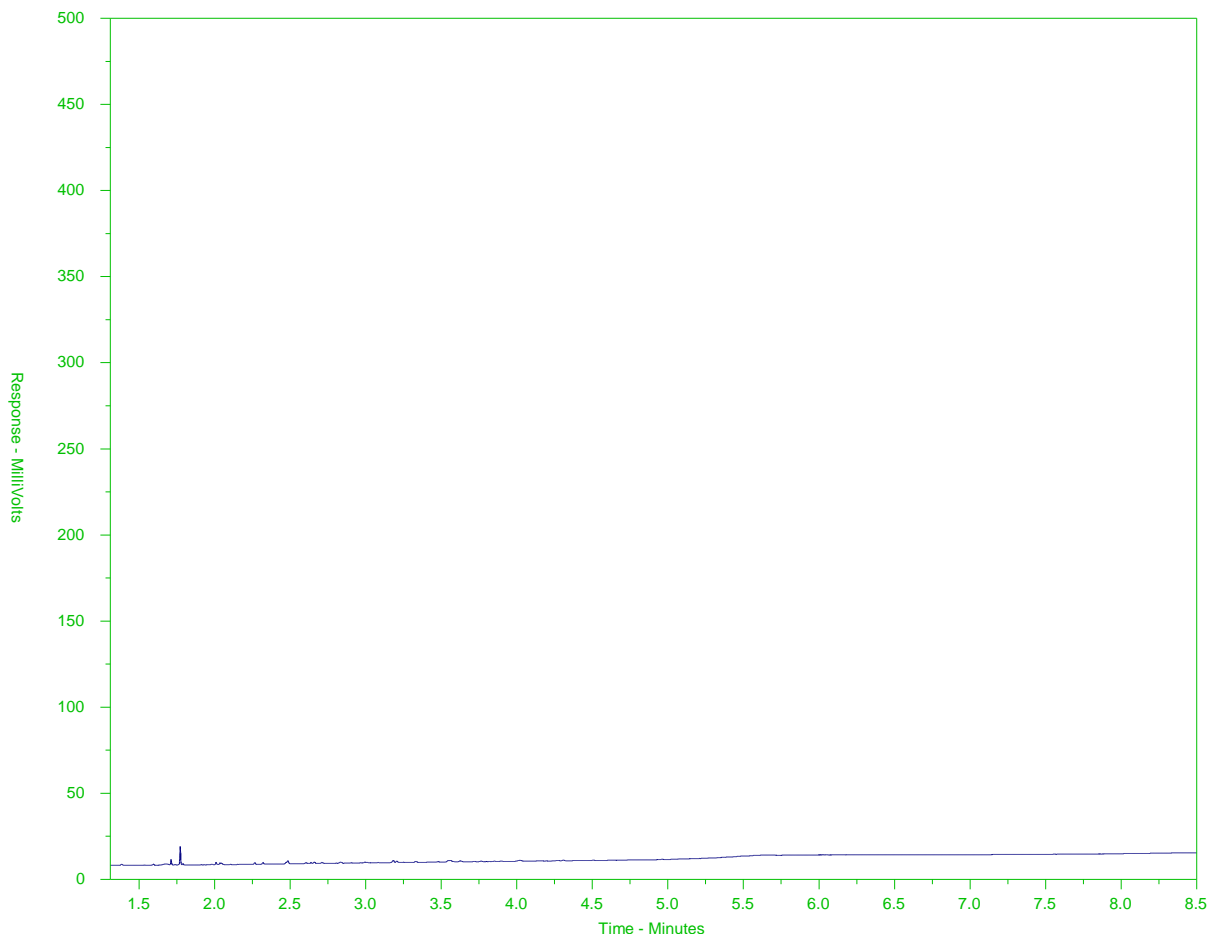
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-9
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

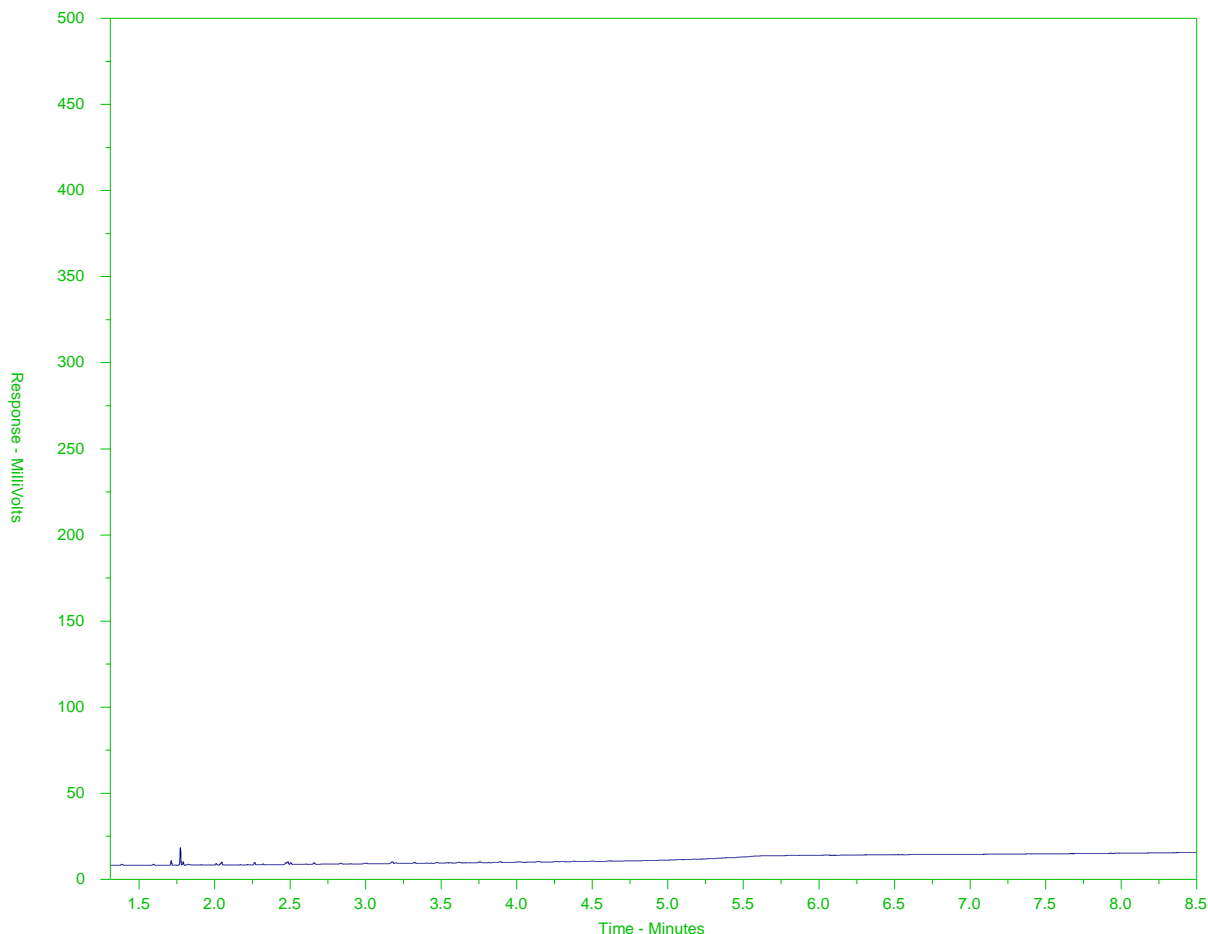
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-10
Client Sample ID: FIELD BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

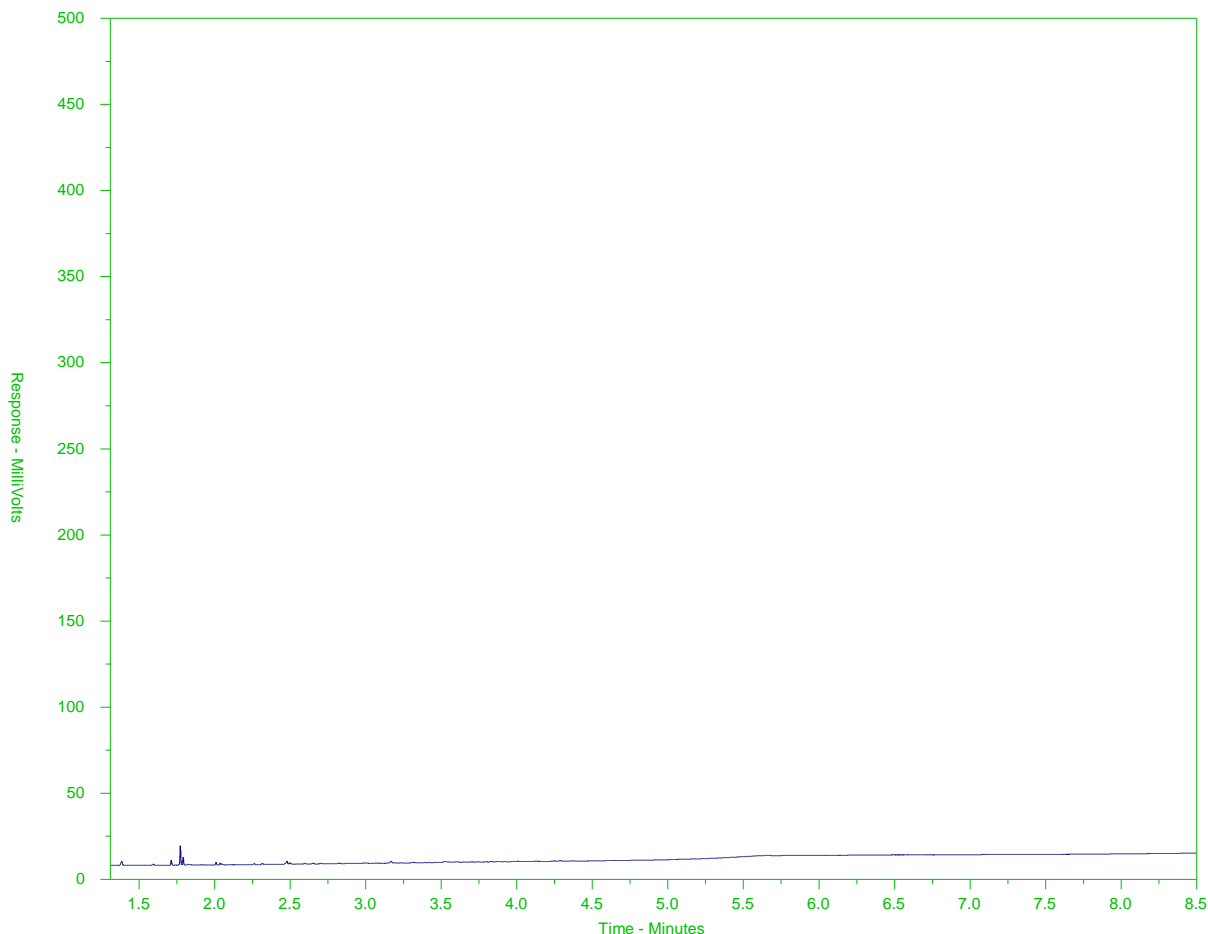
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-11
Client Sample ID: WT7-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

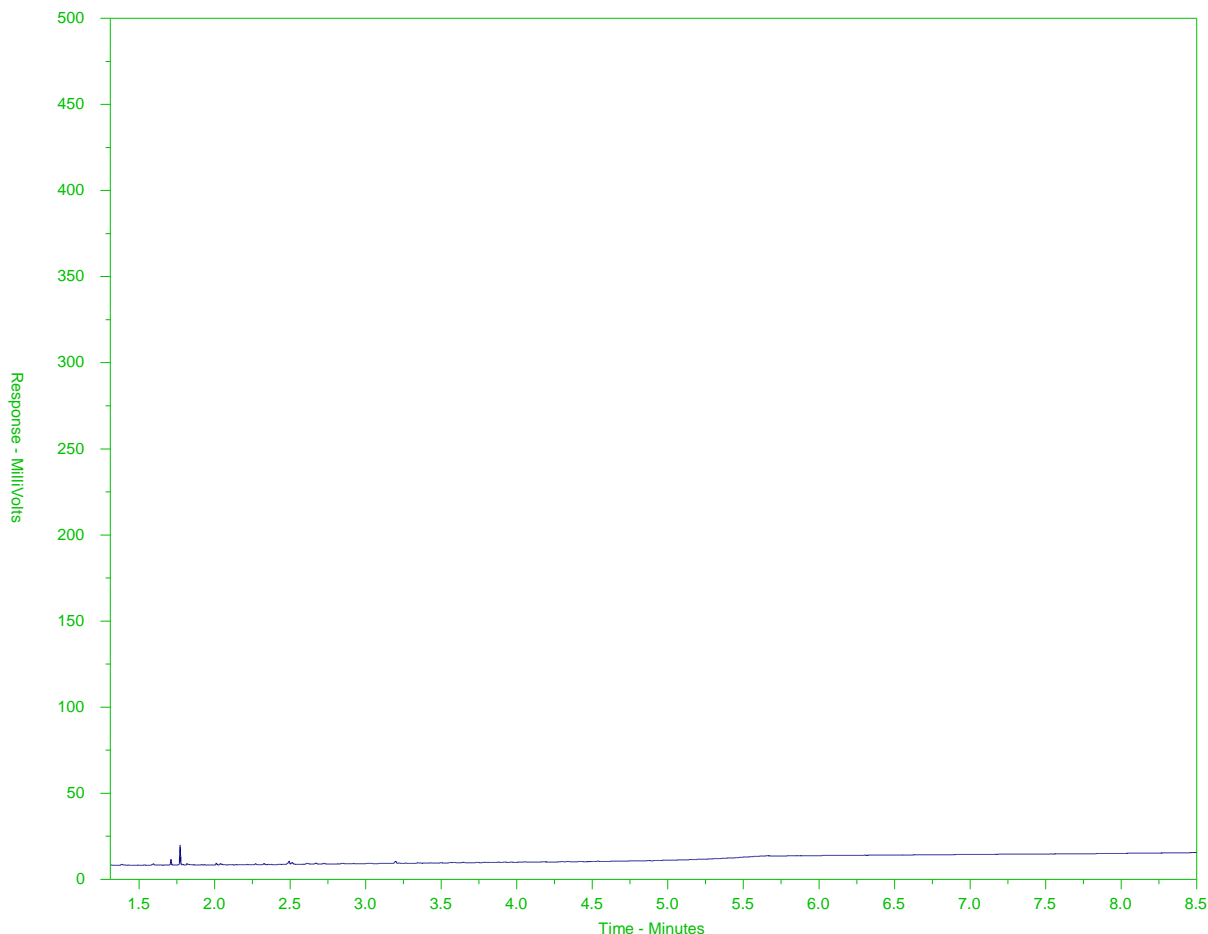
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2267589-C-12
Client Sample ID: WT5-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2267589-COFC

COC Number: 17 -

Page 1 of 1

Report To Contact and company name below will appear on the final report		Report Form Select Report Format: <input type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)		Contact your AM to confirm all E&P TATs (surcharges may apply)																																																
Company: Stantec Consulting Ltd		Quality Control (QC) Report with Report <input type="checkbox"/> YES <input type="checkbox"/> NO		Regular [R] <input type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply																																																
Contact: Tyler Joyce		<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		4 day [P4-20%] <input type="checkbox"/>																																																
Phone: 778-328-1041		Select Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		3 day [P3-25%] <input type="checkbox"/>																																																
Company address below will appear on the final report		Email 1 or Fax: EDD@stantec.com		2 day [P2-50%] <input type="checkbox"/>																																																
Street: 4730 Kingsway Ave, Suite 500		Email 2: tyler.joyce@stantec.com		1 Business day [E - 100%] <input type="checkbox"/>																																																
City/Province: Burnaby, BC		Email 3: matthew.friend@stantec.com		Same Day, Weekend or Statutory holiday [E2 - 200%] <input type="checkbox"/>																																																
Postal Code: V5H0C6				(Laboratory opening fees may apply)																																																
Invoice To: Same as Report To <input type="checkbox"/> YES <input type="checkbox"/> NO		Invoice Distribution		Date and Time Required for all E&P TATs:																																																
Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO		Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		For tests that can not be performed according to the service level selected, you will be contacted.																																																
Company: Stantec Consulting Ltd		Email 1 or Fax: SAPInvoices@stantec.com		Analysis Request																																																
Contact: Accounts Payable c/o Tyler Joyce		Email 2: tyler.joyce@stantec.com		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (FP) below																																																
Project Information		Oil and Gas Required Fields (client use)		<table border="1"> <tr> <th rowspan="4">NUMBER OF CONTAINERS</th> <th rowspan="4">pH, electrical conductivity, hardness</th> <th rowspan="4">Total Suspended Solids</th> <th rowspan="4">Nutrients (Ammonia (as N), Nitrate (as N), Nitrite (as N), Phosphorus (P)-total)</th> <th rowspan="4">Total Metals</th> <th rowspan="4">Dissolved Metals</th> <th rowspan="4">Total Extractable Hydrocarbons (F1-F4)</th> <th colspan="10">SAMPLES ON HOLD</th> </tr> <tr><th colspan="10"></th></tr> <tr><th colspan="10"></th></tr> <tr><th colspan="10"></th></tr> </table>		NUMBER OF CONTAINERS	pH, electrical conductivity, hardness	Total Suspended Solids	Nutrients (Ammonia (as N), Nitrate (as N), Nitrite (as N), Phosphorus (P)-total)	Total Metals	Dissolved Metals	Total Extractable Hydrocarbons (F1-F4)	SAMPLES ON HOLD																																							
NUMBER OF CONTAINERS	pH, electrical conductivity, hardness	Total Suspended Solids	Nutrients (Ammonia (as N), Nitrate (as N), Nitrite (as N), Phosphorus (P)-total)										Total Metals	Dissolved Metals	Total Extractable Hydrocarbons (F1-F4)	SAMPLES ON HOLD																																				
ALS Account # / Quote #: 034015 TBP - Brent Mack (TMEP Rates)		AFE/Cost Center:		PO# 123512431.601.200																																																
Job #: 123512431.601.200		Major/Minor Code:		Routing Code:																																																
PO / AFE: 123512431.601.200		Requisitioner: WMT Baseline Water Quality Sampling																																																		
LSD: TMEP Bayview Dr, Burnaby, BC V5A 4T3		Location: TMEP WMT, Burnaby, BC																																																		
ALS Lab Work Order # (lab use only):		ALS Contact: Brent Mack		Sampler(s): M.Friend / J.Johnston																																																
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type																																																
WT11		03-MAY-19	14:20	Surface Water	X X X X X X																																															
WT10			13:30	Surface Water	X X X X X X																																															
WT9			12:50	Surface Water	X X X X X X																																															
WT8			12:20	Surface Water	X X X X X X																																															
WT7 - Surface			09:30	Seawater	X X X X X X																																															
WT5 - Surface			09:00	Seawater	X X X X X X																																															
WT3			15:55	Surface Water	X X X X X X																																															
WT2			14:50	Surface Water	X X X X X X																																															
FIELD DUP				Surface Water	X X X X X X																																															
FIELD BLANK			16:15	Water	X X X X X X																																															
WT7 - Deep			09:40	Seawater	X X X X X X																																															
WT5 - Deep		03/MAY/19	09:20	Seawater	X X X X X X																																															
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																																																
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input type="checkbox"/> NO		BC CSR Stage 10 Amendment (NOV 2017), BC Oil and Gas Waste Regulation - B.C.Reg. 254/2005 (JUL 2005), Federal CCME Canadian Environmental Quality Guidelines (JUL 2012) and Canadian Environmental Protection Act (CEPA).		Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>																																																
Are samples for human consumption/use? <input type="checkbox"/> YES <input type="checkbox"/> NO		Metals samples are not preserved. Lab filtration (disc, mem) and lab preservation are required. Diss Metals are FF 3 Preserved.		Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>																																																
				Cooling Initiated <input checked="" type="checkbox"/>																																																
				INITIAL COOLER TEMPERATURES °C																																																
				FINAL COOLER TEMPERATURES °C																																																
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																																																
Released by: Matt Friend	Date: 03-MAY-19	Time: 18:28	Received by:	Date: 5/3	Time: 6:30 PM																																															

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

NOTE: Nutrients = Ammonia (as N), Nitrate (as N), Nitrite (as N), Phosphorus (P) - total.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 09-MAY-19
Report Date: 21-MAY-19 10:44 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2270780

Project P.O. #:

TASK CODE: 601.200

Job Reference:

123512431

C of C Numbers:

Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

21-MAY-19 10:44 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-9 Water 09-MAY-19 FIELD DUP
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	35600	36500	35500	36900	35500
	Hardness (as CaCO3) (mg/L)	4380	4650	4460	4690	4800
	pH (pH)	8.02	8.03	8.02	8.00	8.06
	Total Suspended Solids (mg/L)	8.4	2.7	6.4	2.6	2.9
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0053	0.0108	0.0125	0.0133	<0.0050
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Phosphorus (P)-Total (mg/L)	0.0351	0.0328	0.0302	0.0333	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0548	0.0330	0.162	0.0440	0.0373
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Total (mg/L)	0.00124	0.00127	0.00121	0.00120	0.00121
	Barium (Ba)-Total (mg/L)	0.0067	0.0073	0.0077	0.0078	0.0069
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	2.59	2.61	2.77	2.89	2.89
	Cadmium (Cd)-Total (mg/L)	0.000068	0.000068	0.000059	0.000069	0.000057
	Calcium (Ca)-Total (mg/L)	280	300	286	297	297
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total (mg/L)	0.000062	0.000058	0.000107	<0.000050	<0.000050
	Copper (Cu)-Total (mg/L)	0.00107	0.00077	0.00082	0.00067	0.00106
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.045	0.039	0.182	0.053	0.043
	Lead (Pb)-Total (mg/L)	0.000186	0.000068	0.000078	0.000057	0.000124
	Lithium (Li)-Total (mg/L)	0.112	0.124	0.125	0.133	0.125
	Magnesium (Mg)-Total (mg/L)	998	1040	877	919	885
	Manganese (Mn)-Total (mg/L)		0.00417	0.00664	0.00414	0.00414
	Molybdenum (Mo)-Total (mg/L)	0.00764	0.00809	0.00776	0.00813	0.00804
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	0.00053	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	0.057	<0.050	0.055	0.062	0.051
	Potassium (K)-Total (mg/L)	315	328	292	306	293
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Total (mg/L)	0.0865	0.0919	0.0779	0.0811	0.0797
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	7850	8330	7980	8420	7490

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-9 Water 09-MAY-19 FIELD DUP
Grouping	Analyte					
SEAWATER						
Total Metals	Strontium (Sr)-Total (mg/L)	5.05	5.35	5.05	5.26	5.18
	Sulfur (S)-Total (mg/L)	688	782	709	771	748
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.010 ^{DLM}	<0.0050	<0.0050
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Total (mg/L)	0.00233	0.00219	0.00221	0.00234	0.00218
	Vanadium (V)-Total (mg/L)	0.00177	0.00173	0.00184	0.00152	0.00145
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0057	0.0056	0.0083	<0.0050	0.0052
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Arsenic (As)-Dissolved (mg/L)	0.00115	0.00126	0.00120	0.00123	0.00116
	Barium (Ba)-Dissolved (mg/L)	0.0053	0.0062	0.0063	0.0069	0.0051
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	2.58	2.85	2.79	2.99	2.40
	Cadmium (Cd)-Dissolved (mg/L)	0.000059	0.000058	0.000055	0.000056	0.000053
	Calcium (Ca)-Dissolved (mg/L)	277	296	293	305	267
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Copper (Cu)-Dissolved (mg/L)	0.00062	0.00068	0.00056	0.00061	0.00064
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.123	0.136	0.128	0.137	0.118
	Magnesium (Mg)-Dissolved (mg/L)	896	949	904	954	1000
	Manganese (Mn)-Dissolved (mg/L)	0.00200	0.00226	0.00248	0.00241	0.00217
	Molybdenum (Mo)-Dissolved (mg/L)	0.00774	0.00790	0.00786	0.00806	0.00776
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	295	315	297	319	325

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-9 Water 09-MAY-19 FIELD DUP
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Rubidium (Rb)-Dissolved (mg/L)	0.0814	0.0837	0.0808	0.0847	0.0891
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Dissolved (mg/L)	7530	7750	7610	7980	7470
	Strontium (Sr)-Dissolved (mg/L)	4.89	5.22	5.04	5.44	5.06
	Sulfur (S)-Dissolved (mg/L)	684	732	736	793	747
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Uranium (U)-Dissolved (mg/L)	0.00235	0.00225	0.00220	0.00232	0.00220
	Vanadium (V)-Dissolved (mg/L)	0.00134	0.00143	0.00137	0.00153	0.00156
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	0.0013	0.0014	0.0010	0.0015	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-5 Water 09-MAY-19 11:30 WT3
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)					259
	Hardness (as CaCO3) (mg/L)					105
	pH (pH)					8.25
	Total Suspended Solids (mg/L)					9.8
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					0.0541
	Nitrate (as N) (mg/L)					0.0381
	Nitrite (as N) (mg/L)					<0.0010
	Phosphorus (P)-Total (mg/L)					0.0532
Total Metals	Aluminum (Al)-Total (mg/L)					0.0160
	Antimony (Sb)-Total (mg/L)					<0.00010
	Arsenic (As)-Total (mg/L)					0.00492
	Barium (Ba)-Total (mg/L)					0.00523
	Beryllium (Be)-Total (mg/L)					<0.00010
	Bismuth (Bi)-Total (mg/L)					<0.000050
	Boron (B)-Total (mg/L)					0.018
	Cadmium (Cd)-Total (mg/L)					<0.0000050
	Calcium (Ca)-Total (mg/L)					25.8
	Cesium (Cs)-Total (mg/L)					<0.000010
	Chromium (Cr)-Total (mg/L)					<0.00010
	Cobalt (Co)-Total (mg/L)					<0.00010
	Copper (Cu)-Total (mg/L)					<0.00050
	Iron (Fe)-Total (mg/L)					0.010
	Lead (Pb)-Total (mg/L)					<0.000050
	Lithium (Li)-Total (mg/L)					0.0013
	Magnesium (Mg)-Total (mg/L)					9.69
	Manganese (Mn)-Total (mg/L)					0.00967
	Molybdenum (Mo)-Total (mg/L)					0.000916
	Nickel (Ni)-Total (mg/L)					<0.00050
	Phosphorus (P)-Total (mg/L)					0.093
	Potassium (K)-Total (mg/L)					2.99
	Rubidium (Rb)-Total (mg/L)					0.00071
	Selenium (Se)-Total (mg/L)					<0.000050
	Silicon (Si)-Total (mg/L)					10.8
	Silver (Ag)-Total (mg/L)					<0.000010
	Sodium (Na)-Total (mg/L)					11.9
	Strontium (Sr)-Total (mg/L)					0.0943
	Sulfur (S)-Total (mg/L)					4.94

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2270780-6 Water 09-MAY-19 13:15 WT8	L2270780-7 Water 09-MAY-19 13:50 WT10	L2270780-8 Sea water 09-MAY-19 14:35 WT11	L2270780-9 Water 09-MAY-19 FIELD DUP	
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	239	231	252			
	Hardness (as CaCO3) (mg/L)	75.0	87.3	107			
	pH (pH)	8.02	8.08	8.21			
	Total Suspended Solids (mg/L)	11.4	16.4	32.4			
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	0.0138	0.0146			
	Nitrate (as N) (mg/L)	1.49	0.970	0.240			
	Nitrite (as N) (mg/L)	<0.0010	0.0013	0.0012			
	Phosphorus (P)-Total (mg/L)	<0.0020	0.0595	0.0606		0.0223	
Total Metals	Aluminum (Al)-Total (mg/L)	0.141	0.328	1.04			
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00010	0.00025			
	Arsenic (As)-Total (mg/L)	0.00025	0.00171	0.00276			
	Barium (Ba)-Total (mg/L)	0.0103	0.0193	0.0299			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050			
	Boron (B)-Total (mg/L)	0.012	0.017	0.024			
	Cadmium (Cd)-Total (mg/L)	0.0000118	0.0000162	0.0000236			
	Calcium (Ca)-Total (mg/L)	20.7	23.1	30.5			
	Cesium (Cs)-Total (mg/L)	<0.000010	0.000018	0.000053			
	Chromium (Cr)-Total (mg/L)	0.00238	0.00285	0.00090			
	Cobalt (Co)-Total (mg/L)	<0.00010	0.00020	0.00056			
	Copper (Cu)-Total (mg/L)	0.00056	0.00135	0.00456			
	Iron (Fe)-Total (mg/L)	0.331	0.644	1.22			
	Lead (Pb)-Total (mg/L)	0.000375	0.000565	0.000759			
	Lithium (Li)-Total (mg/L)	0.0011	0.0015	<0.0010			
	Magnesium (Mg)-Total (mg/L)	6.39	7.73	8.47			
	Manganese (Mn)-Total (mg/L)	0.0266	0.0470	0.0575			
	Molybdenum (Mo)-Total (mg/L)	0.000107	0.000507	0.00108			
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00080	0.00108			
	Phosphorus (P)-Total (mg/L)	<0.050	0.069	0.085			
	Potassium (K)-Total (mg/L)	0.770	2.33	3.31			
	Rubidium (Rb)-Total (mg/L)	0.00037	0.00098	0.00182			
	Selenium (Se)-Total (mg/L)	0.000110	0.000266	0.000221			
	Silicon (Si)-Total (mg/L)	11.9	11.6	9.17			
	Silver (Ag)-Total (mg/L)	<0.000010	0.000012	0.000010			
	Sodium (Na)-Total (mg/L)	16.7	13.2	9.27			
	Strontium (Sr)-Total (mg/L)	0.155	0.126	0.111			
	Sulfur (S)-Total (mg/L)	4.19	4.04	5.47			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-5 Water 09-MAY-19 11:30 WT3
Grouping	Analyte						
WATER							
Total Metals	Tellurium (Te)-Total (mg/L)						<0.00020
	Thallium (Tl)-Total (mg/L)						<0.000010
	Thorium (Th)-Total (mg/L)						<0.00010
	Tin (Sn)-Total (mg/L)						<0.00010
	Titanium (Ti)-Total (mg/L)						0.00036
	Tungsten (W)-Total (mg/L)						<0.00010
	Uranium (U)-Total (mg/L)						0.000093
	Vanadium (V)-Total (mg/L)						<0.00050
	Zinc (Zn)-Total (mg/L)						<0.0030
	Zirconium (Zr)-Total (mg/L)						<0.000060
Dissolved Metals	Dissolved Metals Filtration Location						FIELD
	Aluminum (Al)-Dissolved (mg/L)						0.0041
	Antimony (Sb)-Dissolved (mg/L)						<0.00010
	Arsenic (As)-Dissolved (mg/L)						0.00469
	Barium (Ba)-Dissolved (mg/L)						0.00505
	Beryllium (Be)-Dissolved (mg/L)						<0.00010
	Bismuth (Bi)-Dissolved (mg/L)						<0.000050
	Boron (B)-Dissolved (mg/L)						0.015
	Cadmium (Cd)-Dissolved (mg/L)						<0.0000050
	Calcium (Ca)-Dissolved (mg/L)						26.4
	Cesium (Cs)-Dissolved (mg/L)						<0.000010
	Chromium (Cr)-Dissolved (mg/L)						<0.00010
	Cobalt (Co)-Dissolved (mg/L)						<0.00010
	Copper (Cu)-Dissolved (mg/L)						<0.00020
	Iron (Fe)-Dissolved (mg/L)						<0.010
	Lead (Pb)-Dissolved (mg/L)						<0.000050
	Lithium (Li)-Dissolved (mg/L)						0.0011
	Magnesium (Mg)-Dissolved (mg/L)						9.51
	Manganese (Mn)-Dissolved (mg/L)						0.00280
	Molybdenum (Mo)-Dissolved (mg/L)						0.000884
	Nickel (Ni)-Dissolved (mg/L)						<0.00050
	Phosphorus (P)-Dissolved (mg/L)						0.077
	Potassium (K)-Dissolved (mg/L)						2.84
	Rubidium (Rb)-Dissolved (mg/L)						0.00076
	Selenium (Se)-Dissolved (mg/L)						<0.000050
	Silicon (Si)-Dissolved (mg/L)						10.1
	Silver (Ag)-Dissolved (mg/L)						<0.000010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2270780-6 Water 09-MAY-19 13:15 WT8	L2270780-7 Water 09-MAY-19 13:50 WT10	L2270780-8 Sea water 09-MAY-19 14:35 WT11	L2270780-9 Water 09-MAY-19 FIELD DUP	
Grouping	Analyte						
WATER							
Total Metals	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020			
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000010			
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Tin (Sn)-Total (mg/L)	<0.00010	0.00049	0.00023			
	Titanium (Ti)-Total (mg/L)	0.00563	0.0121	0.0326			
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010			
	Uranium (U)-Total (mg/L)	0.000071	0.000124	0.000163			
	Vanadium (V)-Total (mg/L)	0.00135	0.00211	0.00276			
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0152	0.0349			
	Zirconium (Zr)-Total (mg/L)	<0.000060	0.000095	0.000090			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0080	0.0202	0.0118			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00021			
	Arsenic (As)-Dissolved (mg/L)	0.00016	0.00121	0.00229			
	Barium (Ba)-Dissolved (mg/L)	0.00792	0.0149	0.0200			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Boron (B)-Dissolved (mg/L)	0.010	0.014	0.020			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000093			
	Calcium (Ca)-Dissolved (mg/L)	21.1	23.0	29.7			
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Chromium (Cr)-Dissolved (mg/L)	0.00113	0.00092	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00040	0.00102			
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.048	0.013			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0012	<0.0010			
	Magnesium (Mg)-Dissolved (mg/L)	5.42	7.25	8.00			
	Manganese (Mn)-Dissolved (mg/L)	0.00044	0.0122	0.00745			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000105	0.000525	0.00105			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	0.680	1.83	3.13			
	Rubidium (Rb)-Dissolved (mg/L)	0.00033	0.00072	0.00154			
	Selenium (Se)-Dissolved (mg/L)	0.000076	0.000207	0.000157			
	Silicon (Si)-Dissolved (mg/L)	10.9	10.5	7.42			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2270780-1 Sea water 09-MAY-19 10:30 WT5 - SURFACE	L2270780-2 Sea water 09-MAY-19 10:45 WT5 - DEEP	L2270780-3 Sea water 09-MAY-19 10:00 WT7 - SURFACE	L2270780-4 Sea water 09-MAY-19 10:15 WT7 - DEEP	L2270780-5 Water 09-MAY-19 11:30 WT3
Grouping	Analyte					
WATER						
Dissolved Metals	Sodium (Na)-Dissolved (mg/L)					11.1
	Strontium (Sr)-Dissolved (mg/L)					0.0937
	Sulfur (S)-Dissolved (mg/L)					4.31
	Tellurium (Te)-Dissolved (mg/L)					<0.00020
	Thallium (Tl)-Dissolved (mg/L)					<0.000010
	Thorium (Th)-Dissolved (mg/L)					<0.00010
	Tin (Sn)-Dissolved (mg/L)					<0.00010
	Titanium (Ti)-Dissolved (mg/L)					<0.00030
	Tungsten (W)-Dissolved (mg/L)					<0.00010
	Uranium (U)-Dissolved (mg/L)					0.000083
	Vanadium (V)-Dissolved (mg/L)					<0.00050
	Zinc (Zn)-Dissolved (mg/L)					0.0025
	Zirconium (Zr)-Dissolved (mg/L)					<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	88.6	85.2	83.4	87.3	85.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2270780-6 Water 09-MAY-19 13:15 WT8	L2270780-7 Water 09-MAY-19 13:50 WT10	L2270780-8 Sea water 09-MAY-19 14:35 WT11	L2270780-9 Water 09-MAY-19 FIELD DUP	
Grouping	Analyte						
WATER							
Dissolved Metals	Sodium (Na)-Dissolved (mg/L)	14.4	12.5	9.09			
	Strontium (Sr)-Dissolved (mg/L)	0.157	0.129	0.111			
	Sulfur (S)-Dissolved (mg/L)	3.74	3.55	5.04			
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010			
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00015			
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	0.00039	<0.00030			
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010			
	Uranium (U)-Dissolved (mg/L)	0.000043	0.000085	0.000129			
	Vanadium (V)-Dissolved (mg/L)	0.00058	0.00104	0.00072			
	Zinc (Zn)-Dissolved (mg/L)	0.0011	0.0031	0.0189			
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	<0.000060			
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10		
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30		
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30		
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30		
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	84.4	93.3	80.6	76.4		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	Antimony (Sb)-Total	MES	L2270780-2, -3, -4, -9
Laboratory Control Sample	Selenium (Se)-Total	MES	L2270780-2, -3, -4, -9
Laboratory Control Sample	Tellurium (Te)-Total	MES	L2270780-2, -3, -4, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Boron (B)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Copper (Cu)-Total	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2270780-5, -6, -7, -8
Matrix Spike	Boron (B)-Total	MS-B	L2270780-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L2270780-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2270780-1
Matrix Spike	Potassium (K)-Total	MS-B	L2270780-1
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2270780-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2270780-1
Matrix Spike	Sulfur (S)-Total	MS-B	L2270780-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2270780-1, -2, -3, -4, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2270780-9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
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.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)

Reference Information

This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.

F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.

F2-F4-ME-FID-VA Water CCME F2-F4 Hydrocarbons in Water CCME CWS-PHC, Pub #1310, Dec 2001

F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HARDNESS-CALC-VA Seawater Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-T-PRES-COL-VA Seawater Total P in Seawater by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Reference Information

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

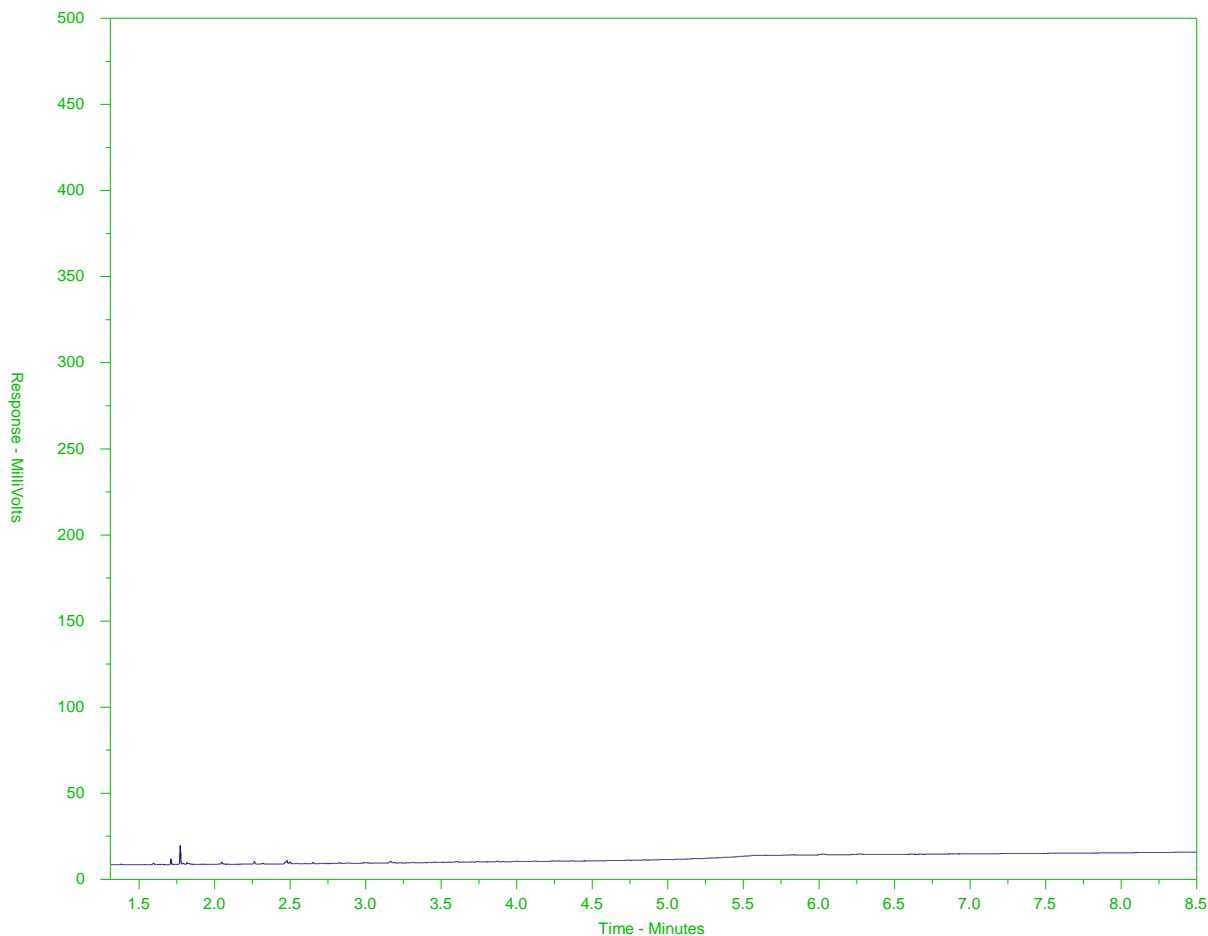
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-1
Client Sample ID: WT5 - SURFACE



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

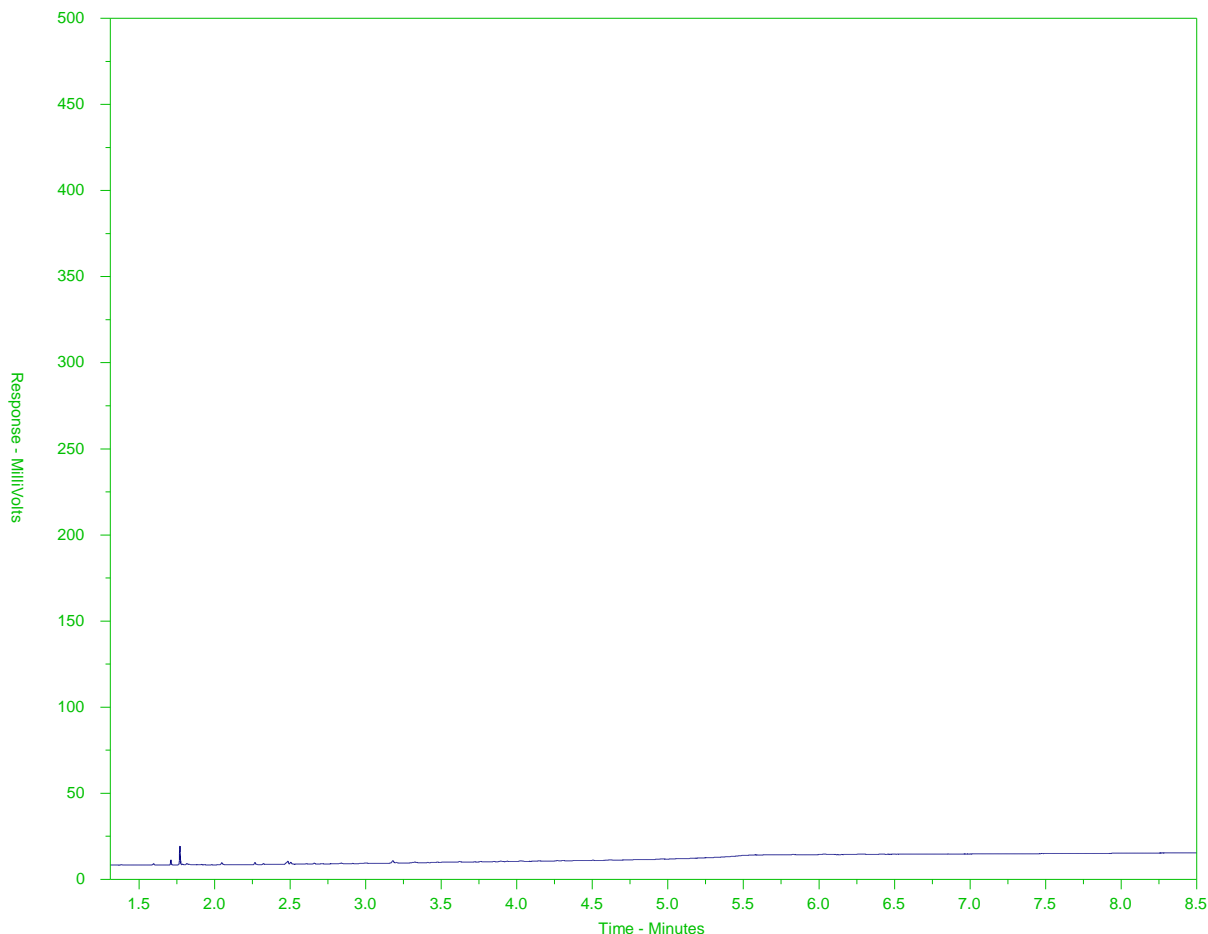
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-2
Client Sample ID: WT5 - DEEP



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

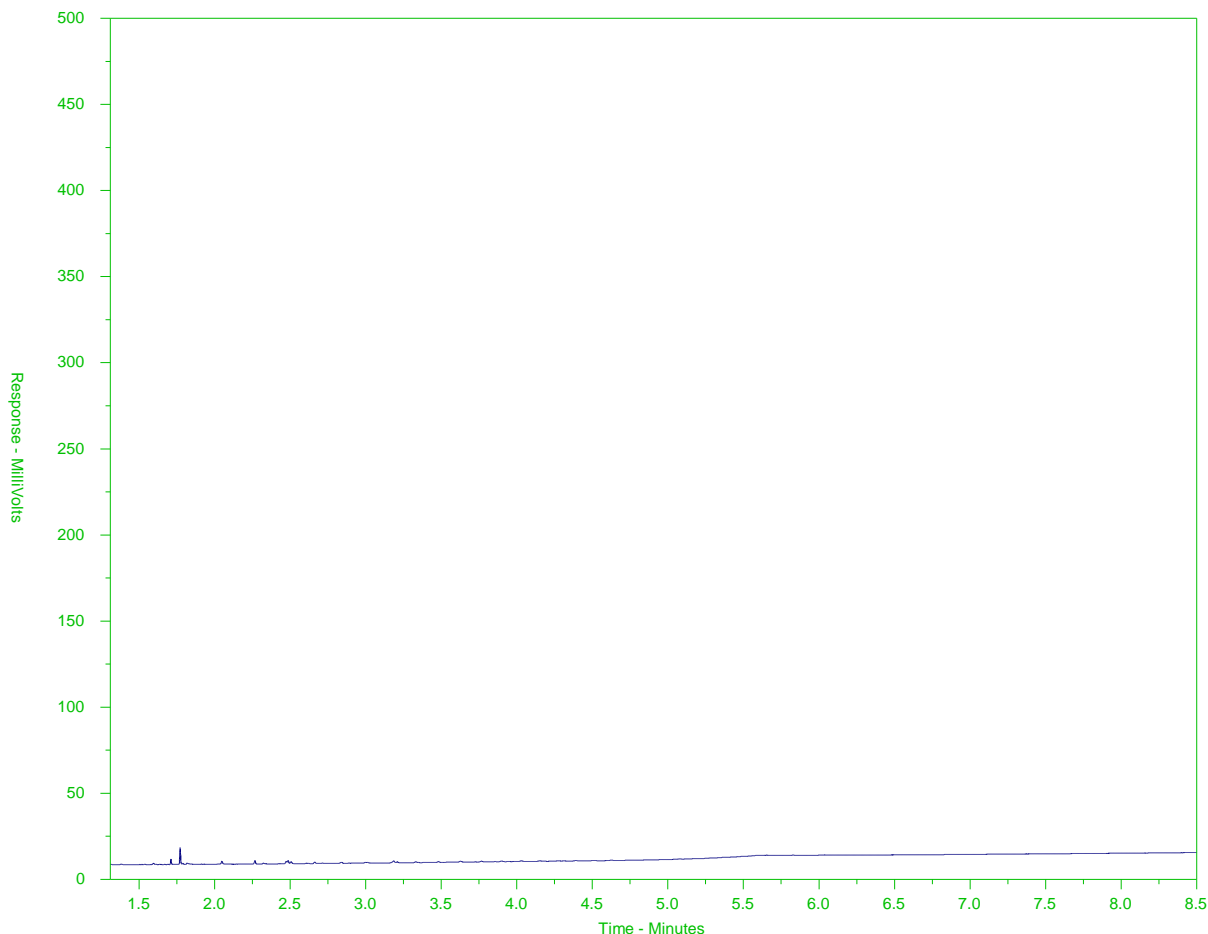
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-3
Client Sample ID: WT7 - SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

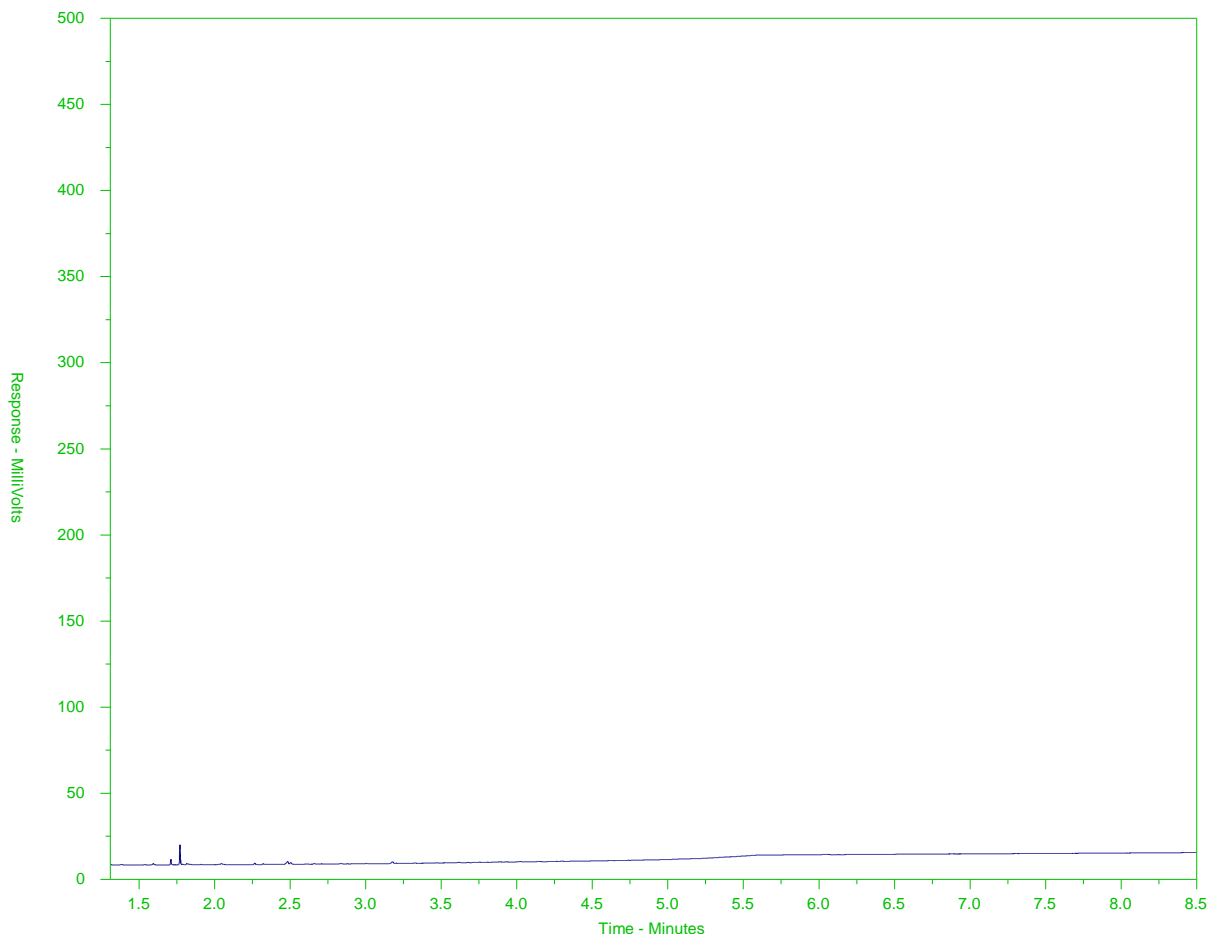
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-4
Client Sample ID: WT7 - DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

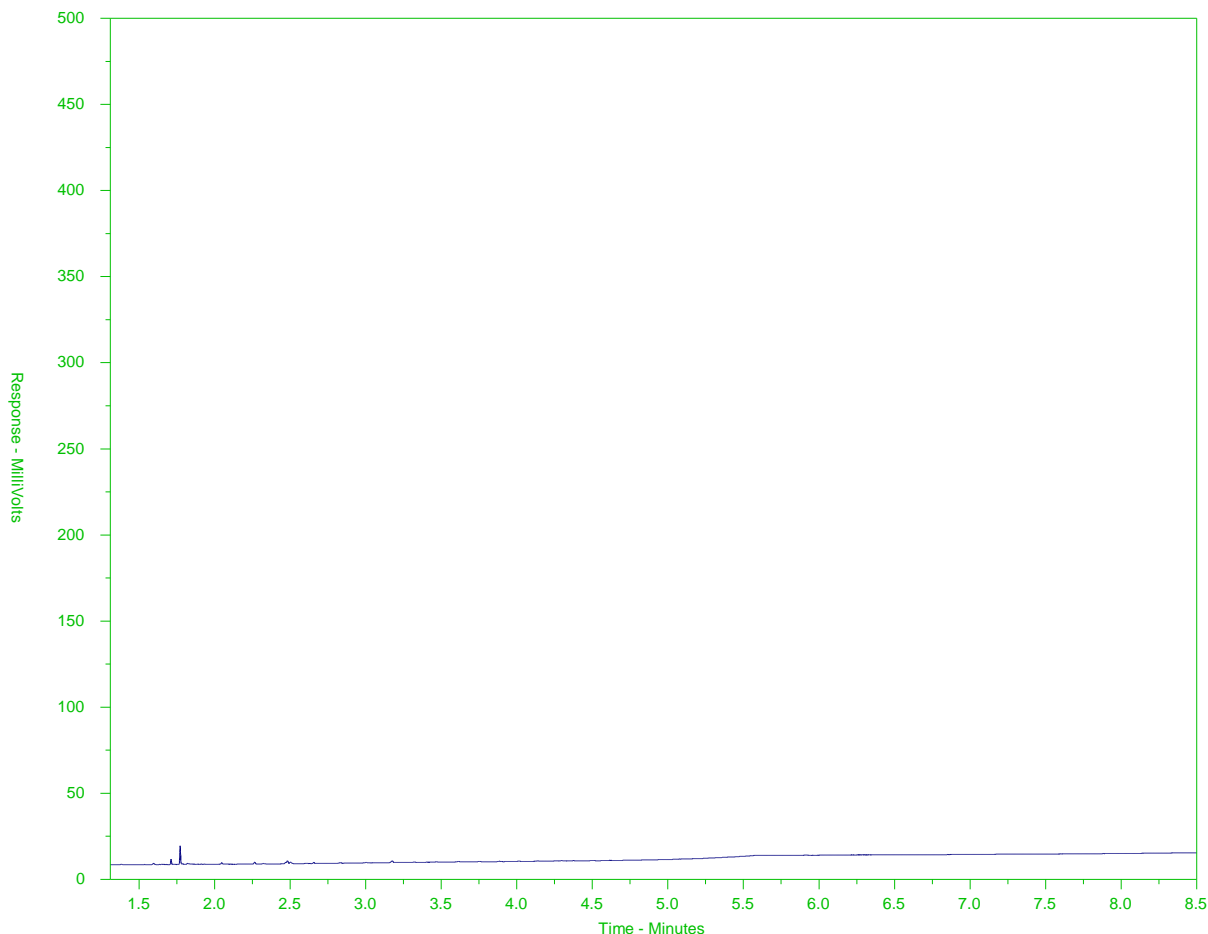
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-5
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

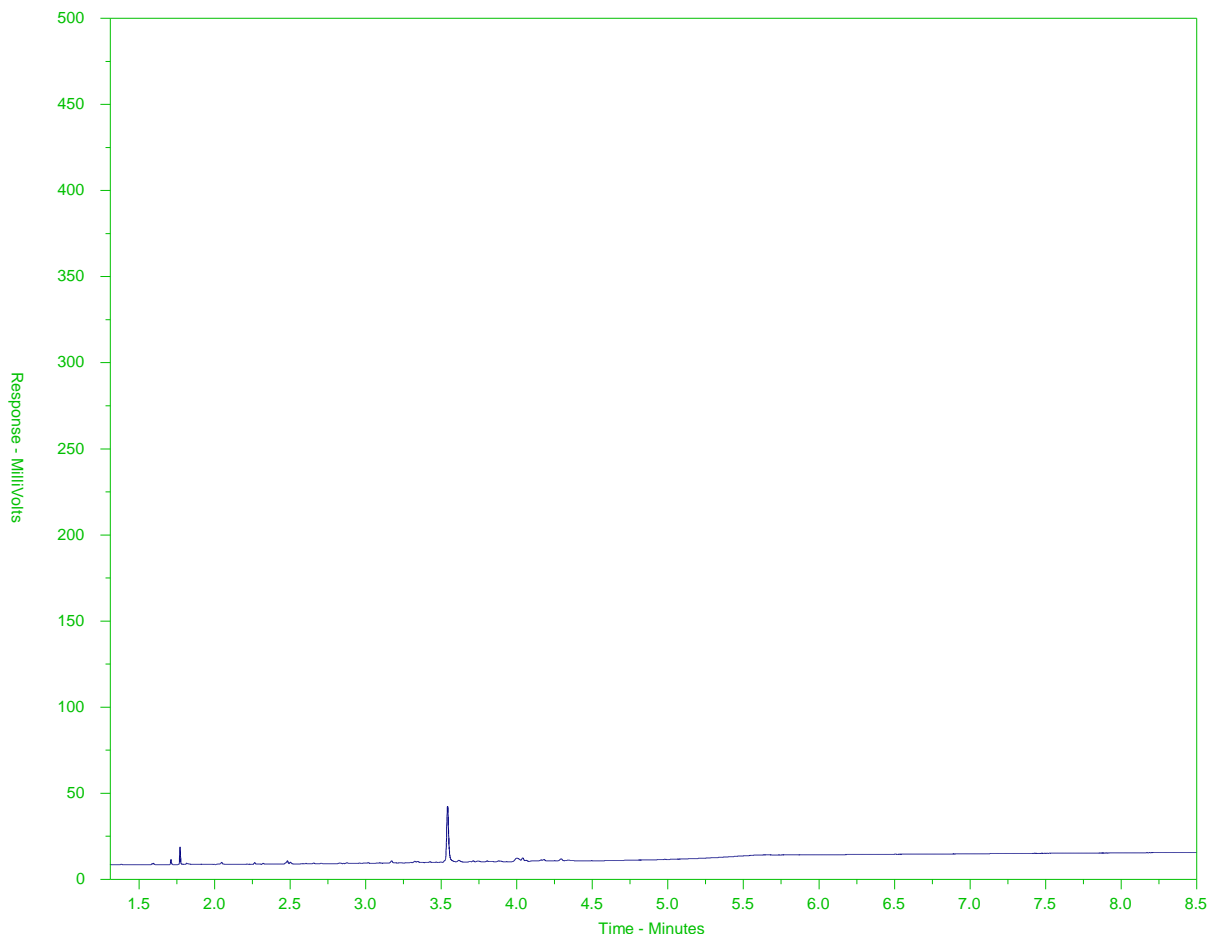
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-6
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

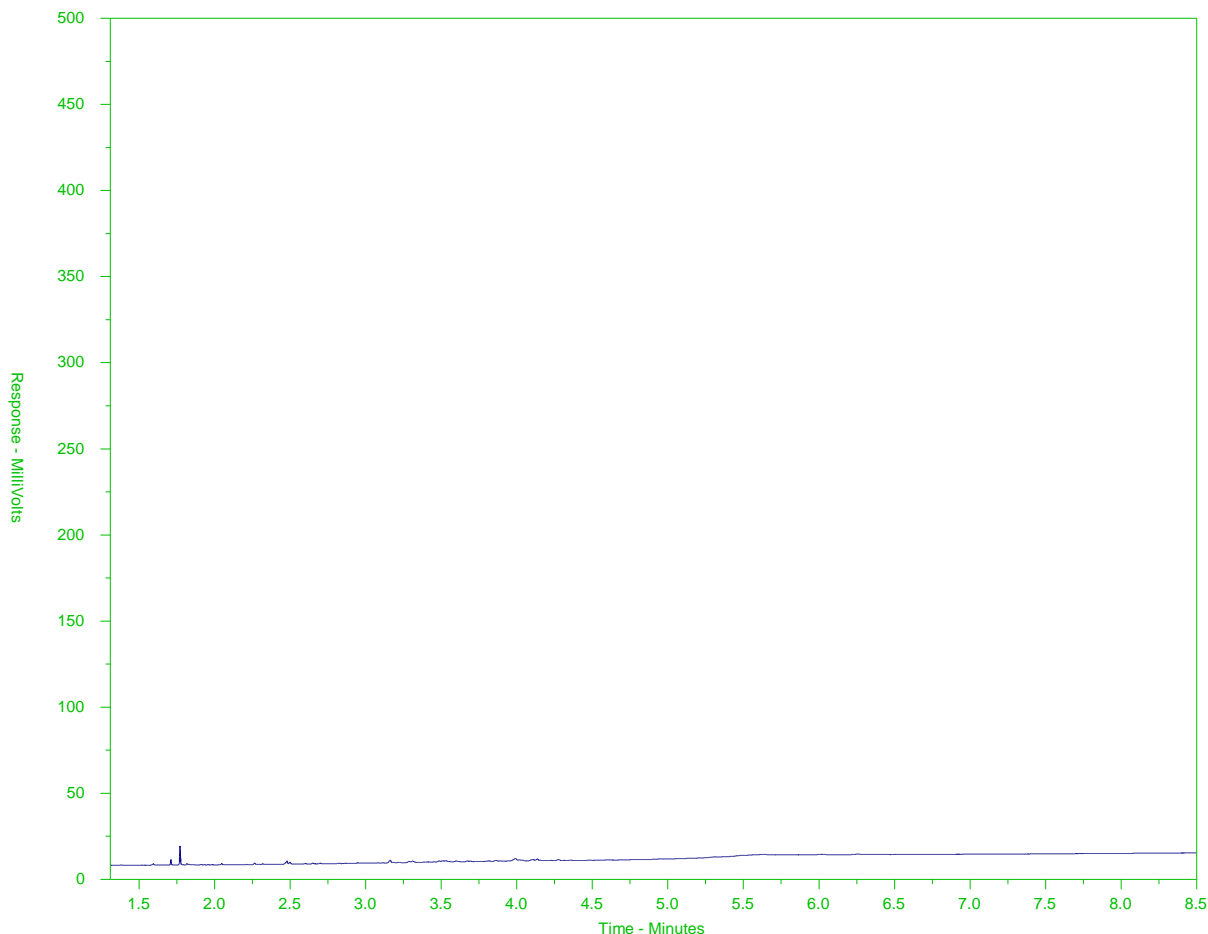
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-7
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

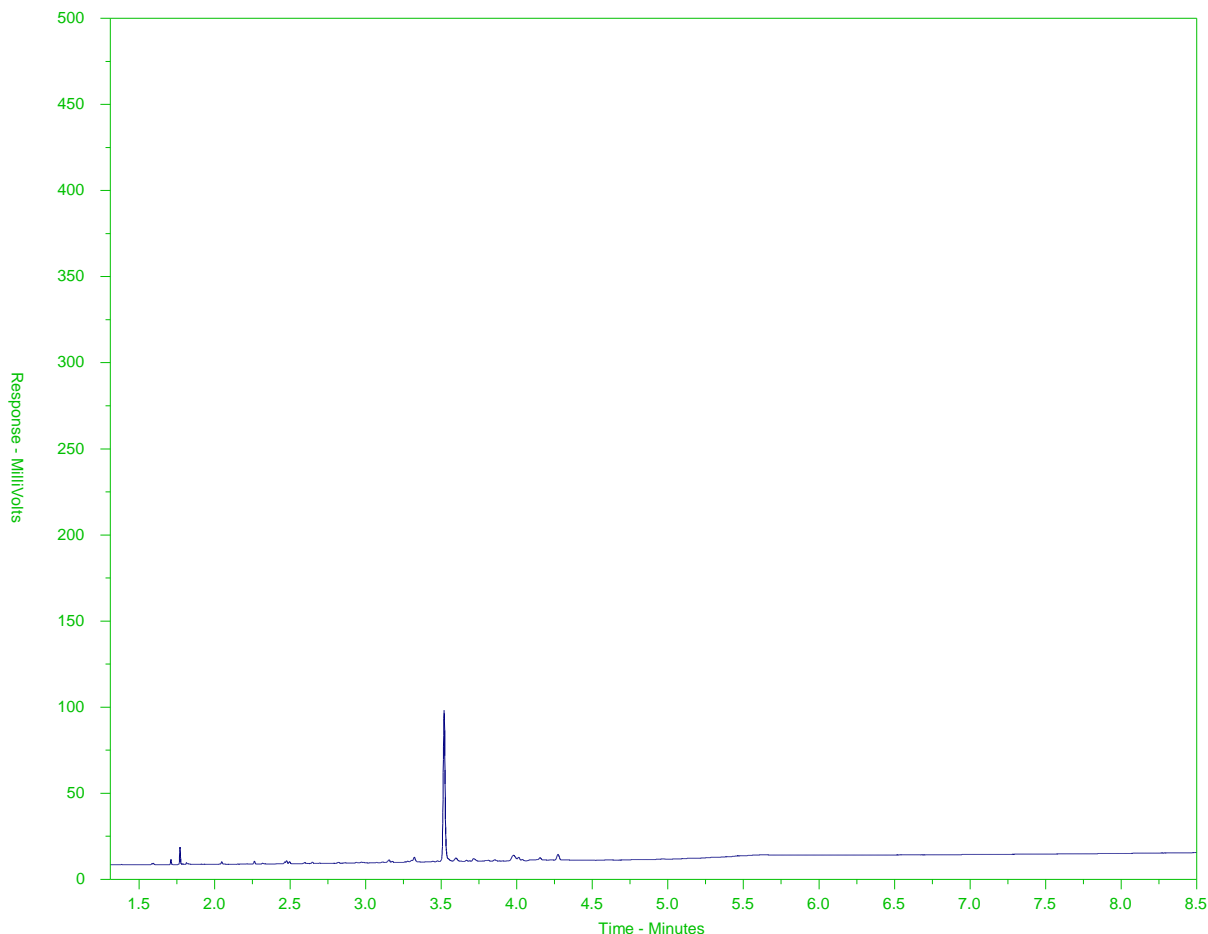
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-8
Client Sample ID: WT11



F2		F3	F4	
nC10	nC16		nC34	nC50
174°C	287°C		481°C	575°C
346°F	549°F		898°F	1067°F
← Gasoline →		Motor Oils/ Lube Oils/ Grease		
← Diesel/ Jet Fuels →				

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

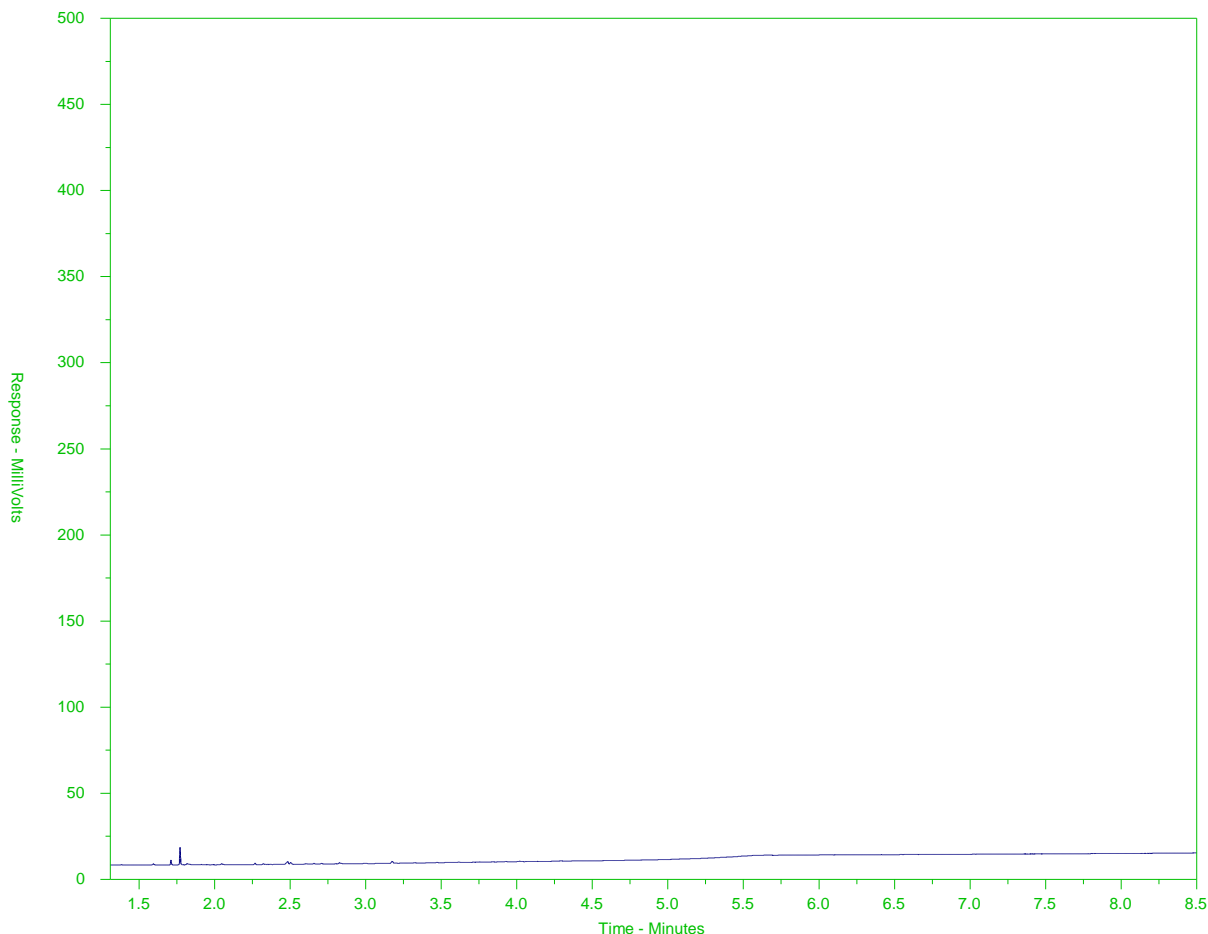
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2270780-C-9
Client Sample ID: FIELD DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2270780-COFC

COC Number: 15 -

Page of

Report To Contact and company name below will appear on the final report		Report Format / Distribution		Select Service Level Below - Please confirm all E&P TATs with your AM - surcharges will apply																										
Company:	STANTEC CONSULTING	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply																										
Contact:		Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4] <input type="checkbox"/>																										
Phone:		<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] <input type="checkbox"/>																										
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2] <input type="checkbox"/>																										
Street:	500 - 4730 Kingsway	Email 1 or Fax:	tyler.joyce@stantec.com	1 Business day [E1] <input type="checkbox"/>																										
City/Province:	Burnaby, BC	Email 2:	Matthew.Friend@Stantec.com	Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/>																										
Postal Code:	V5H 0C6	Email 3:	EDD@Stantec.com																											
Invoice To:	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution		Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																										
	Copy of invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	For tests that can not be performed according to the service level selected, you will be contacted.																										
Company:		Email 1 or Fax:		Analysis Request																										
Contact:		Email 2:		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below.																										
Project Information		Oil and Gas Required Fields (client use)		<table border="1"> <tr> <td>PH, electrical conductivity, resistivity</td> <td>TSS</td> <td>Total metals</td> <td>Total dissolved metals</td> <td>Total extractable hydrocarbons (E1-E4)</td> <td>NUTRIENTS: Ammonia (AS-P), Nitrate (AS-P), Nitrite (AS-P), Phosphate (AS-P)</td> <td rowspan="4">Number of Containers</td> </tr> <tr> <td>ALS Account # / Quote #:</td> <td>Q74015</td> <td>AFE/Cost Center:</td> <td>PO# 1235 (2431, 601, 200)</td> <td></td> <td></td> </tr> <tr> <td>Job #:</td> <td>123512431</td> <td>Major/Minor Code:</td> <td>Routing Code:</td> <td></td> <td></td> </tr> <tr> <td>PO / AFE:</td> <td>TASK CODE: 601.200</td> <td>Requisitioner:</td> <td></td> <td></td> <td></td> </tr> </table>		PH, electrical conductivity, resistivity	TSS	Total metals	Total dissolved metals	Total extractable hydrocarbons (E1-E4)	NUTRIENTS: Ammonia (AS-P), Nitrate (AS-P), Nitrite (AS-P), Phosphate (AS-P)	Number of Containers	ALS Account # / Quote #:	Q74015	AFE/Cost Center:	PO# 1235 (2431, 601, 200)			Job #:	123512431	Major/Minor Code:	Routing Code:			PO / AFE:	TASK CODE: 601.200	Requisitioner:			
PH, electrical conductivity, resistivity	TSS	Total metals	Total dissolved metals			Total extractable hydrocarbons (E1-E4)	NUTRIENTS: Ammonia (AS-P), Nitrate (AS-P), Nitrite (AS-P), Phosphate (AS-P)	Number of Containers																						
ALS Account # / Quote #:	Q74015	AFE/Cost Center:	PO# 1235 (2431, 601, 200)																											
Job #:	123512431	Major/Minor Code:	Routing Code:																											
PO / AFE:	TASK CODE: 601.200	Requisitioner:																												
PO / AFE:	TASK CODE: 601.200	Location:																												
ALS Lab Work Order # (lab use only)		ALS Contact:	Brent Mack	Sampler:	MF/AB																									
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type																										
	WTS - surface	09-MAY-19	10:30	Sea water	X	X																								
	WTS - Deep		10:45																											
	WT7 - surface		10:00																											
	WT7 - Deep		10:15																											
	WT3		11:30	water																										
	WT8		13:15																											
	WT10		13:50																											
	WT11		14:35																											
	Field Dup			Sea water																										
				water																										
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)																										
Are samples taken from a Regulated DW System?		metals are not preserved		Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>																										
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>																										
Are samples for human drinking water use?				Cooling Initiated <input checked="" type="checkbox"/>																										
<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				INITIAL COOLER TEMPERATURES °C																										
				FINAL COOLER TEMPERATURES °C																										
				20 18																										
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)																										
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:																								
Matthew Friend	09-MAY-19					SP																								

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 PRINT

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 16-MAY-19
Report Date: 29-MAY-19 16:23 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2274937
Project P.O. #: Task Code: 601.200
Job Reference: 123512431
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE	L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	32000	33600	29400	37200	
	Hardness (as CaCO3) (mg/L)	4410	4650	4140	5350	
	pH (pH)	7.87	7.88	7.90	7.90	
	Total Suspended Solids (mg/L)	<2.0	2.6	2.4	2.8	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0105	0.0113	0.0110	0.0265	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Phosphorus (P)-Total (mg/L)	0.0197	0.0254	0.0202	0.0467	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0286	0.0285	0.110	0.0622	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	0.0015	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00103	0.00105	0.00121	0.00128	
	Barium (Ba)-Total (mg/L)	0.0061	0.0069	0.0079	0.0103	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	2.62	2.71	2.37	2.90	
	Cadmium (Cd)-Total (mg/L)	0.000052	0.000051	0.000052	0.000068	
	Calcium (Ca)-Total (mg/L)	261	279	238	310	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	0.000076	0.000061	
	Copper (Cu)-Total (mg/L)	0.00060	0.00063	0.00066	0.00068	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.020	0.020	0.089	0.065	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000065	
	Lithium (Li)-Total (mg/L)	0.123	0.130	0.114	0.141	
	Magnesium (Mg)-Total (mg/L)	909	954	834	1130	
	Manganese (Mn)-Total (mg/L)	0.00319	0.00324	0.00552	0.00521	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00667	0.00698	0.00640	0.00818	
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	0.087	
	Potassium (K)-Total (mg/L)	311	335	296	419	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0791	0.0858	0.0775	0.104	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	0.00102	0.00092	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE	L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Total Metals	Sodium (Na)-Total (mg/L)	6900	6910	6450	8250	
	Strontium (Sr)-Total (mg/L)	4.50	4.81	4.17	5.48	
	Sulfur (S)-Total (mg/L)	747	773	698	1030	
	Tellurium (Te)-Total (mg/L)	0.00072	<0.00050	0.00298	0.00172	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	0.0065	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00188	0.00186	0.00172	0.00211	
	Vanadium (V)-Total (mg/L)	0.00134	0.00144	0.00148	0.00182	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0144	0.0108	0.0160	0.0056	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00105	0.00114	0.00102	0.00131	
	Barium (Ba)-Dissolved (mg/L)	0.0054	0.0063	0.0050	0.0088	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	2.30	2.38	2.21	2.72	
	Cadmium (Cd)-Dissolved (mg/L)	0.000043	0.000059	0.000045	0.000088	
	Calcium (Ca)-Dissolved (mg/L)	260	270	246	314	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00061	0.00057	0.00050	0.00054	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.118	0.121	0.109	0.143	
	Magnesium (Mg)-Dissolved (mg/L)	913	964	855	1110	
	Manganese (Mn)-Dissolved (mg/L)	0.00255	0.00291	0.00263	0.00368	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00700	0.00737	0.00661	0.00804	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE	L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.073	
	Potassium (K)-Dissolved (mg/L)	324	350	301	410	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0819	0.0884	0.0752	0.100	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	1.1	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	6690	7090	6370	8070	
	Strontium (Sr)-Dissolved (mg/L)	4.70	4.88	4.30	5.47	
	Sulfur (S)-Dissolved (mg/L)	727	700	701	1010	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00185	0.00194	0.00167	0.00212	
	Vanadium (V)-Dissolved (mg/L)	0.00132	0.00142	0.00122	0.00156	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

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ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2274937-1 Water 16-MAY-19 14:00 WT3	L2274937-2 Water 16-MAY-19 12:30 WT8	L2274937-3 Water 16-MAY-19 12:50 WT10	L2274937-4 Water 16-MAY-19 14:20 WT11	L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE
Grouping	Analyte						
WATER							
Physical Tests	Conductivity (uS/cm)	263	240	240	257		
	Hardness (as CaCO3) (mg/L)	109	83.5	92.4	116		
	pH (pH)	8.20	7.96	8.08	8.17		
	Total Suspended Solids (mg/L)	<3.0	28.6	35.4	28.6		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0101	0.0106		
	Nitrate (as N) (mg/L)	0.0714	1.43	0.927	0.238		
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0013	0.0014		
	Phosphorus (P)-Total (mg/L)	0.0125	0.0108	0.0591	0.0203		
Total Metals	Aluminum (Al)-Total (mg/L)	0.0145	0.0897	0.912	1.14		
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	0.00015	0.00021		
	Arsenic (As)-Total (mg/L)	0.00452	0.00026	0.00188	0.00252		
	Barium (Ba)-Total (mg/L)	0.00621	0.0108	0.228	0.0347		
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Boron (B)-Total (mg/L)	0.013	0.011	0.014	0.022		
	Cadmium (Cd)-Total (mg/L)	<0.0000050	0.0000082	0.0000211	0.0000280		
	Calcium (Ca)-Total (mg/L)	23.9	21.4	23.1	31.4		
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	0.000040	0.000051		
	Chromium (Cr)-Total (mg/L)	<0.00010	0.00206	0.00375	<0.0010 ^{DLB}		
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	0.00041	0.00056		
	Copper (Cu)-Total (mg/L)	<0.00050	0.00051	0.00302	0.00470		
	Iron (Fe)-Total (mg/L)	0.014	0.248	1.21	1.17		
	Lead (Pb)-Total (mg/L)	<0.000050	0.000278	0.00110	0.000768		
	Lithium (Li)-Total (mg/L)	0.0011	0.0010	0.0017	<0.0010		
	Magnesium (Mg)-Total (mg/L)	9.19	6.19	7.54	8.27		
	Manganese (Mn)-Total (mg/L)	0.00945	0.0203	0.0729	0.0568		
	Mercury (Hg)-Total (mg/L)	<0.0000050 ^{DLM}	<0.0000050	<0.000010	<0.0000050		
	Molybdenum (Mo)-Total (mg/L)	0.000817	0.000105	0.000599	0.00109		
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	0.00144	0.00096		
	Phosphorus (P)-Total (mg/L)	0.097	<0.050	0.072	0.069		
	Potassium (K)-Total (mg/L)	2.87	0.751	2.07	3.29		
	Rubidium (Rb)-Total (mg/L)	0.00081	0.00041	0.00122	0.00196		
	Selenium (Se)-Total (mg/L)	<0.000050	0.000128	0.000278	0.000191		
	Silicon (Si)-Total (mg/L)	10.1	12.3	12.5	9.89		
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000012	<0.000010		
	Sodium (Na)-Total (mg/L)	11.7	16.8	13.4	9.62		
	Strontium (Sr)-Total (mg/L)	0.0907	0.149	0.137	0.108		

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	L2274937-9 Water 16-MAY-19 FIELD BLANK	L2274937-10 Water 16-MAY-19 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)				<2.0	243
	Hardness (as CaCO3) (mg/L)				<0.50	80.3
	pH (pH)				5.72	8.05
	Total Suspended Solids (mg/L)				<3.0	15.2
Anions and Nutrients	Ammonia, Total (as N) (mg/L)				<0.0050	<0.0050
	Nitrate (as N) (mg/L)				<0.0050	1.43
	Nitrite (as N) (mg/L)				<0.0010	0.0022
	Phosphorus (P)-Total (mg/L)				<0.0020	0.0106
Total Metals	Aluminum (Al)-Total (mg/L)				<0.0030	0.0483
	Antimony (Sb)-Total (mg/L)				<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)				<0.00010	0.00024
	Barium (Ba)-Total (mg/L)				<0.00010	0.0104
	Beryllium (Be)-Total (mg/L)				<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)				<0.000050	<0.000050
	Boron (B)-Total (mg/L)				<0.010	0.011
	Cadmium (Cd)-Total (mg/L)				<0.000050	0.0000123
	Calcium (Ca)-Total (mg/L)				<0.050	21.7
	Cesium (Cs)-Total (mg/L)				<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)				<0.00010	0.00216
	Cobalt (Co)-Total (mg/L)				<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)				<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)				<0.010	0.222
	Lead (Pb)-Total (mg/L)				<0.000050	0.000265
	Lithium (Li)-Total (mg/L)				<0.0010	0.0010
	Magnesium (Mg)-Total (mg/L)				<0.0050	6.16
	Manganese (Mn)-Total (mg/L)				<0.00010	0.0200
	Mercury (Hg)-Total (mg/L)				<0.000050	<0.000050
	Molybdenum (Mo)-Total (mg/L)				<0.000050	0.000093
	Nickel (Ni)-Total (mg/L)				<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)				<0.050	<0.050
	Potassium (K)-Total (mg/L)				<0.050	0.730
	Rubidium (Rb)-Total (mg/L)				<0.00020	0.00031
	Selenium (Se)-Total (mg/L)				<0.000050	0.000072
	Silicon (Si)-Total (mg/L)				<0.10	11.9
	Silver (Ag)-Total (mg/L)				<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)				<0.050	16.2
	Strontium (Sr)-Total (mg/L)				<0.00020	0.154

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-1 Water 16-MAY-19 14:00 WT3	L2274937-2 Water 16-MAY-19 12:30 WT8	L2274937-3 Water 16-MAY-19 12:50 WT10	L2274937-4 Water 16-MAY-19 14:20 WT11	L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	4.53	3.99	3.92	5.53	
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00029	0.00084	
	Titanium (Ti)-Total (mg/L)	0.00040	<0.0033 ^{DLM}	<0.033 ^{DLM}	0.0372	
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)	0.000090	0.000060	0.000177	0.000168	
	Vanadium (V)-Total (mg/L)	<0.00050	0.00113	0.00345	0.00274	
	Zinc (Zn)-Total (mg/L)	0.0038	<0.0030	0.0139	0.0322	
	Zirconium (Zr)-Total (mg/L)	<0.000060	<0.000060	0.000263	0.000179	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0039	0.0098	0.0330	0.0146	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	
	Arsenic (As)-Dissolved (mg/L)	0.00458	0.00018	0.00125	0.00214	
	Barium (Ba)-Dissolved (mg/L)	0.00558	0.00908	0.0413	0.0227	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	0.015	0.011	0.015	0.021	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	0.000065	0.0000118	
	Calcium (Ca)-Dissolved (mg/L)	28.1	22.9	24.4	33.2	
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00122	0.00101	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	<0.00020	0.00021	0.00087	0.00124	
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.013	0.066	0.017	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.0012	<0.0010	0.0013	<0.0010	
	Magnesium (Mg)-Dissolved (mg/L)	9.51	6.36	7.68	8.14	
	Manganese (Mn)-Dissolved (mg/L)	0.00273	0.00050	0.0159	0.00587	
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00103	0.000110	0.000570	0.00115	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	0.063	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	3.03	0.768	2.20	3.42	
	Rubidium (Rb)-Dissolved (mg/L)	0.00081	0.00035	0.00088	0.00151	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	L2274937-9 Water 16-MAY-19 FIELD BLANK	L2274937-10 Water 16-MAY-19 DUP
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)				<0.50	3.70
	Tellurium (Te)-Total (mg/L)				<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)				<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)				<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)				<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)				<0.00030	<0.0018 ^{DLM}
	Tungsten (W)-Total (mg/L)				<0.00010	<0.00010
	Uranium (U)-Total (mg/L)				<0.000010	0.000059
	Vanadium (V)-Total (mg/L)				<0.00050	0.00111
	Zinc (Zn)-Total (mg/L)				<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)				<0.000060	<0.000060
Dissolved Metals	Dissolved Mercury Filtration Location				FIELD	FIELD
	Dissolved Metals Filtration Location				FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)				<0.0010	0.0096
	Antimony (Sb)-Dissolved (mg/L)				<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)				<0.00010	0.00017
	Barium (Ba)-Dissolved (mg/L)				<0.00010	0.00910
	Beryllium (Be)-Dissolved (mg/L)				<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)				<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)				<0.010	0.011
	Cadmium (Cd)-Dissolved (mg/L)				<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)				<0.050	22.1
	Cesium (Cs)-Dissolved (mg/L)				<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)				<0.00010	0.00121
	Cobalt (Co)-Dissolved (mg/L)				<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)				<0.00020	0.00022
	Iron (Fe)-Dissolved (mg/L)				<0.010	0.012
	Lead (Pb)-Dissolved (mg/L)				<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)				<0.0010	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)				<0.0050	6.09
	Manganese (Mn)-Dissolved (mg/L)				<0.00010	0.00043
	Mercury (Hg)-Dissolved (mg/L)				<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)				<0.000050	0.000111
	Nickel (Ni)-Dissolved (mg/L)				<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)				<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)				<0.050	0.748
	Rubidium (Rb)-Dissolved (mg/L)				<0.00020	0.00031

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-1 Water 16-MAY-19 14:00 WT3	L2274937-2 Water 16-MAY-19 12:30 WT8	L2274937-3 Water 16-MAY-19 12:50 WT10	L2274937-4 Water 16-MAY-19 14:20 WT11	L2274937-5 Seawater 16-MAY-19 09:20 WT5-SURFACE
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000074	0.000225	0.000189	
	Silicon (Si)-Dissolved (mg/L)	9.77	11.1	10.6	7.34	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	11.6	17.4	13.1	9.46	
	Strontium (Sr)-Dissolved (mg/L)	0.103	0.169	0.130	0.115	
	Sulfur (S)-Dissolved (mg/L)	4.22	3.76	3.36	5.46	
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00011	0.00078	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	0.00083	0.00037	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.000085	0.000042	0.000085	0.000133	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	0.00071	0.00117	0.00072	
	Zinc (Zn)-Dissolved (mg/L)	0.0030	<0.0010	0.0042	0.0192	
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	90.5	98.5	84.6	93.8	96.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2274937-6 Seawater 16-MAY-19 09:30 WT5-DEEP	L2274937-7 Seawater 16-MAY-19 09:50 WT7-SURFACE	L2274937-8 Seawater 16-MAY-19 10:00 WT7-DEEP	L2274937-9 Water 16-MAY-19 FIELD BLANK	L2274937-10 Water 16-MAY-19 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)				<0.000050	0.000061
	Silicon (Si)-Dissolved (mg/L)				<0.050	11.2
	Silver (Ag)-Dissolved (mg/L)				<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)				<0.050	16.2
	Strontium (Sr)-Dissolved (mg/L)				<0.00020	0.162
	Sulfur (S)-Dissolved (mg/L)				<0.50	3.72
	Tellurium (Te)-Dissolved (mg/L)				<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)				<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)				<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)				<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)				<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)				<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)				<0.000010	0.000042
	Vanadium (V)-Dissolved (mg/L)				<0.00050	0.00071
	Zinc (Zn)-Dissolved (mg/L)				<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)				<0.000060	<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	91.2	97.0	89.9	99.9	95.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Total	B	L2274937-6, -8
Method Blank	Sodium (Na)-Total	B	L2274937-5, -6, -7, -8
Method Blank	Chromium (Cr)-Total	MB-LOR	L2274937-1, -4
Matrix Spike	Tellurium (Te)-Dissolved	MES	L2274937-5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2274937-9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2274937-9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2274937-9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2274937-9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2274937-9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2274937-1, -10, -2, -3, -4, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274937-10, -2, -9
Matrix Spike	Copper (Cu)-Total	MS-B	L2274937-10, -2, -9
Matrix Spike	Lead (Pb)-Total	MS-B	L2274937-10, -2, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274937-10, -2, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Silicon (Si)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2274937-10, -2, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2274937-1, -10, -2, -4, -9
Matrix Spike	Boron (B)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Boron (B)-Total	MS-B	L2274937-5, -7
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2274937-5, -7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2274937-5, -7
Matrix Spike	Potassium (K)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2274937-5, -7
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2274937-5, -7
Matrix Spike	Strontium (Sr)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2274937-5, -7

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfur (S)-Total	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Sulfur (S)-Total	MS-B	L2274937-5, -7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2274937-5, -6, -7, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2274937-5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Reference Information

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-T-PRES-COL-VA Seawater Total P in Seawater by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-H-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

Reference Information

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

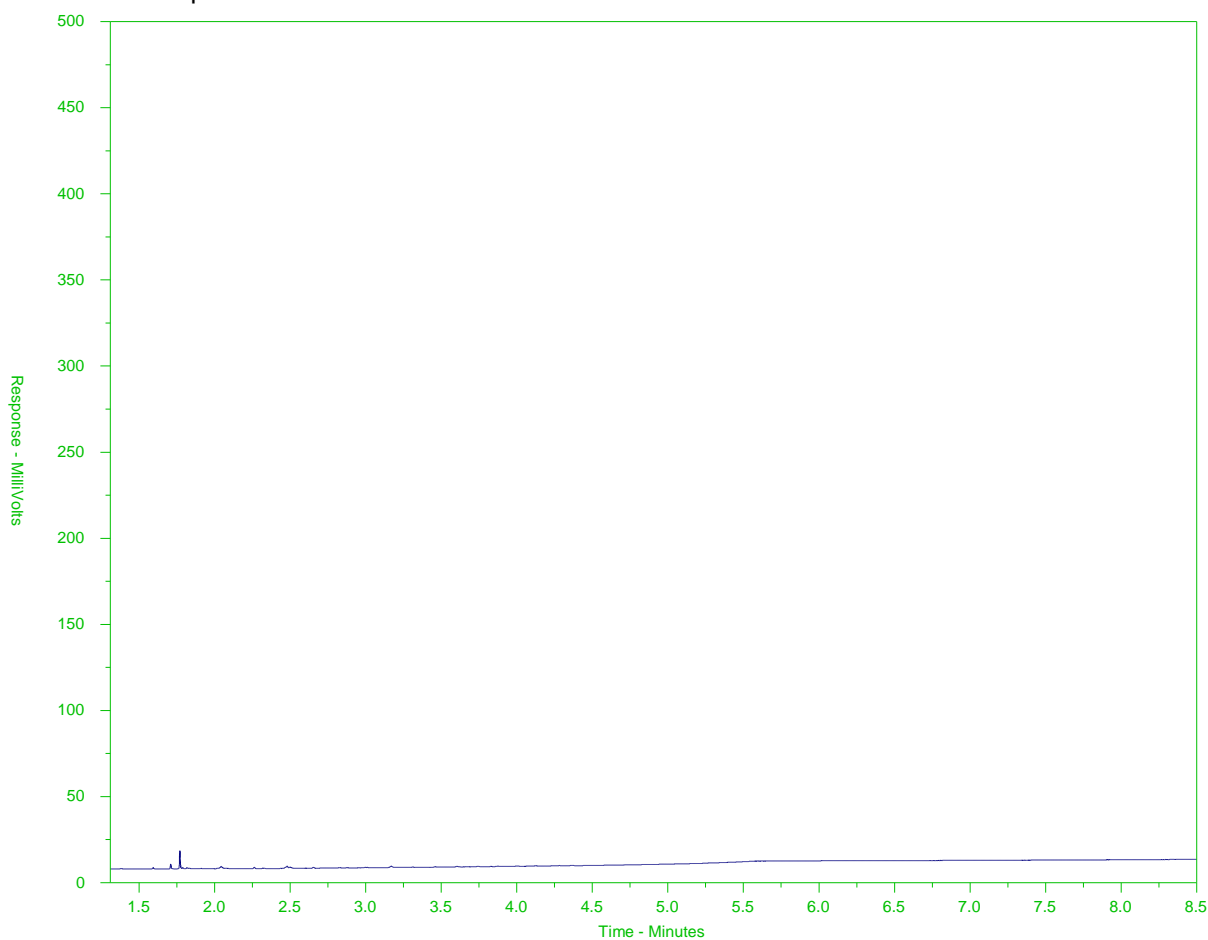
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-1
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

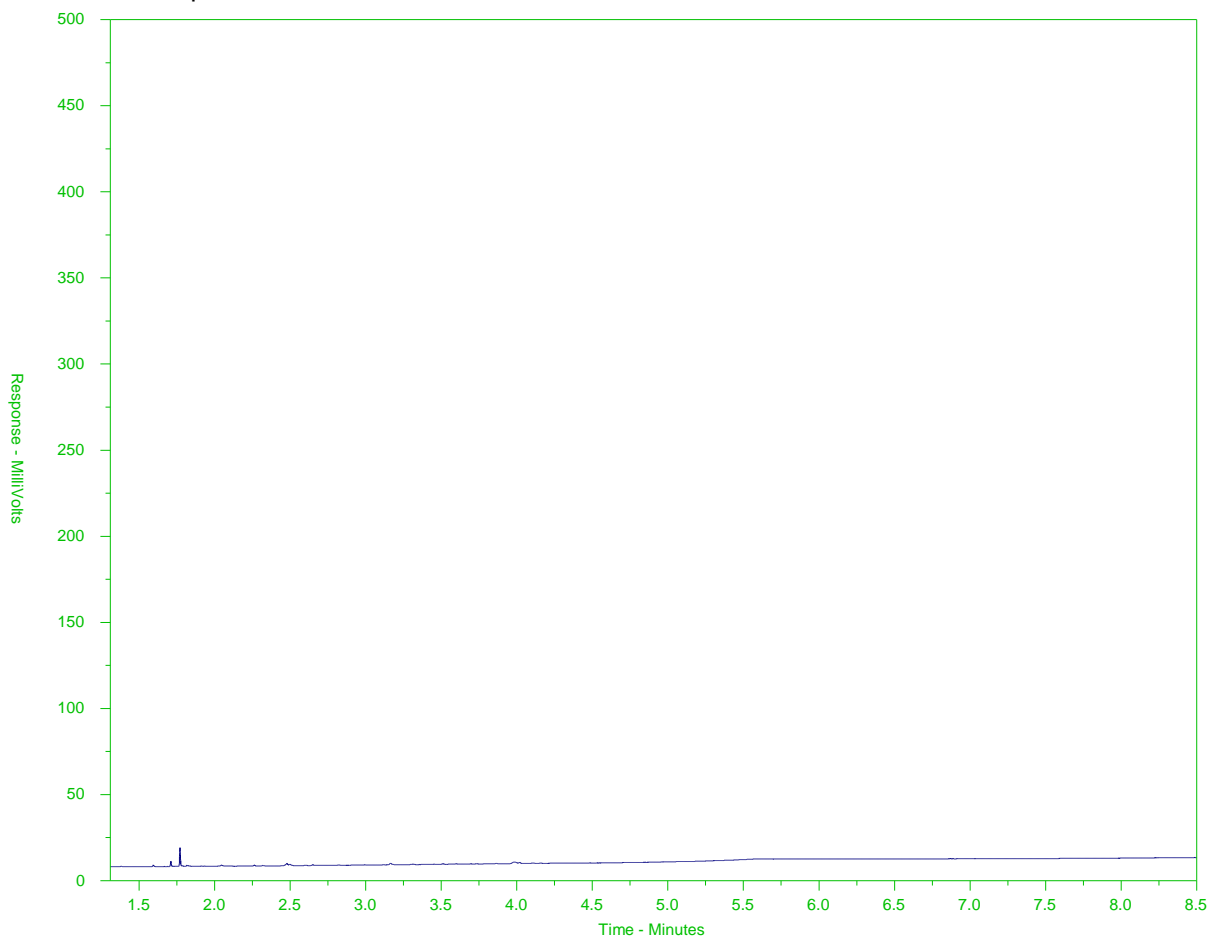
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-2
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

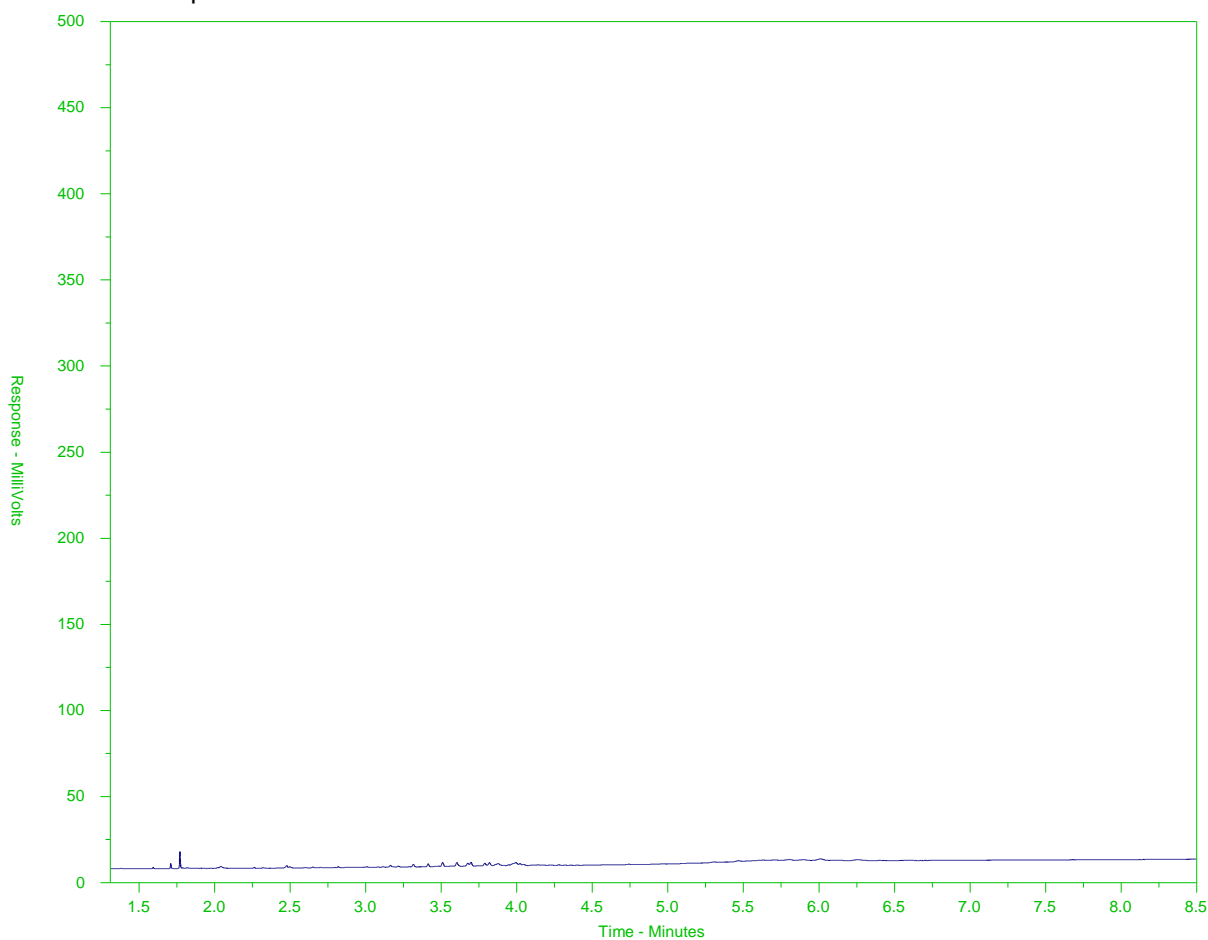
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-3
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

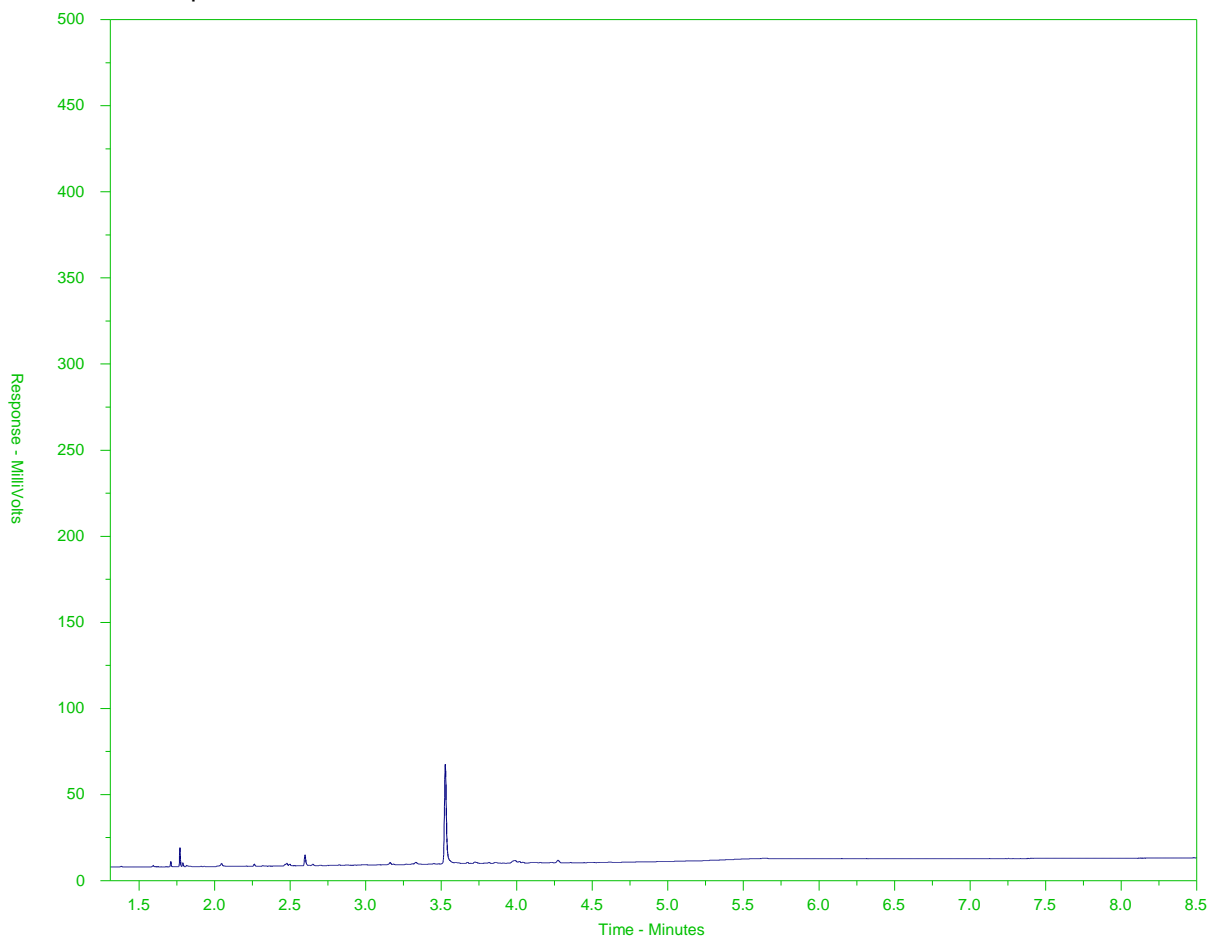
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-4
Client Sample ID: WT11



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

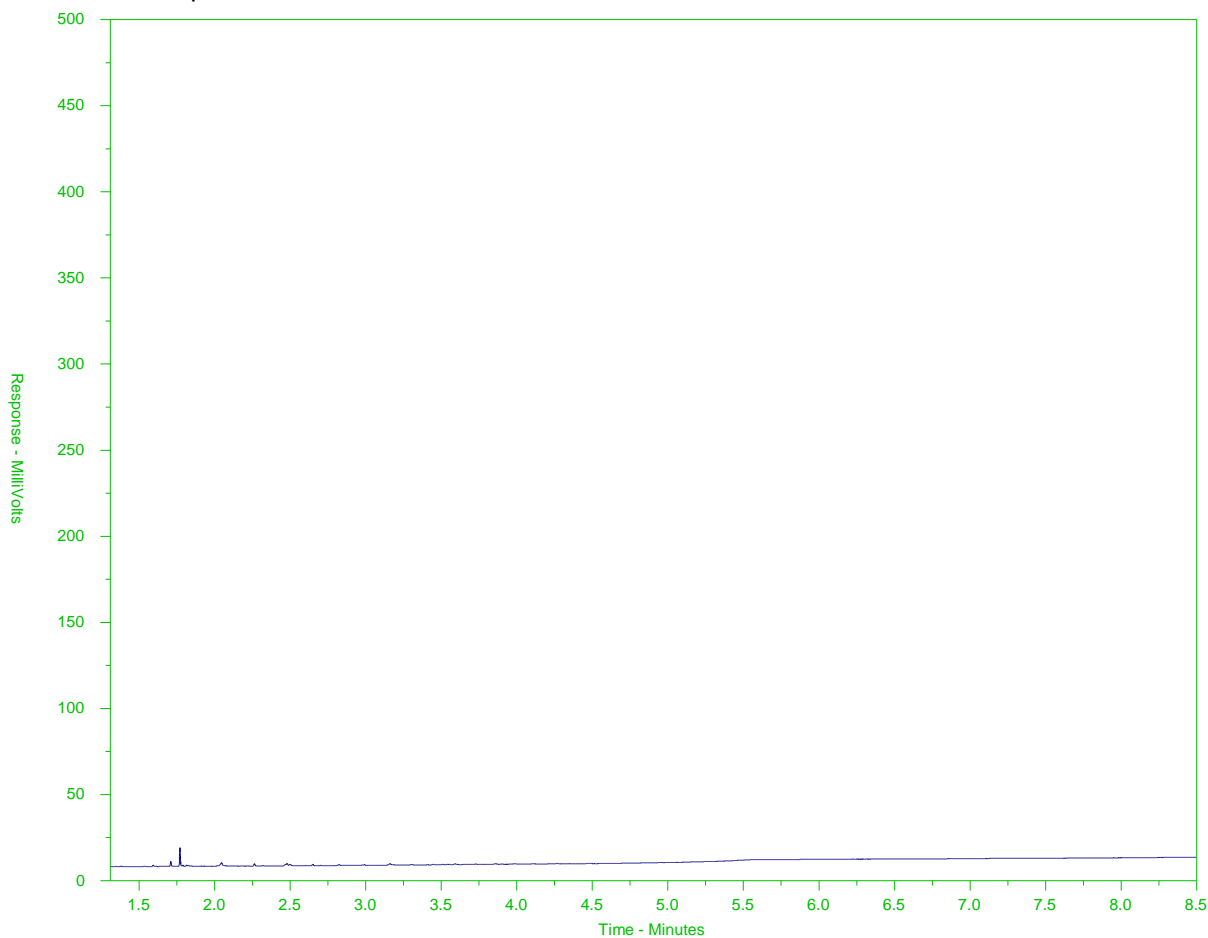
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-5
Client Sample ID: WT5-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

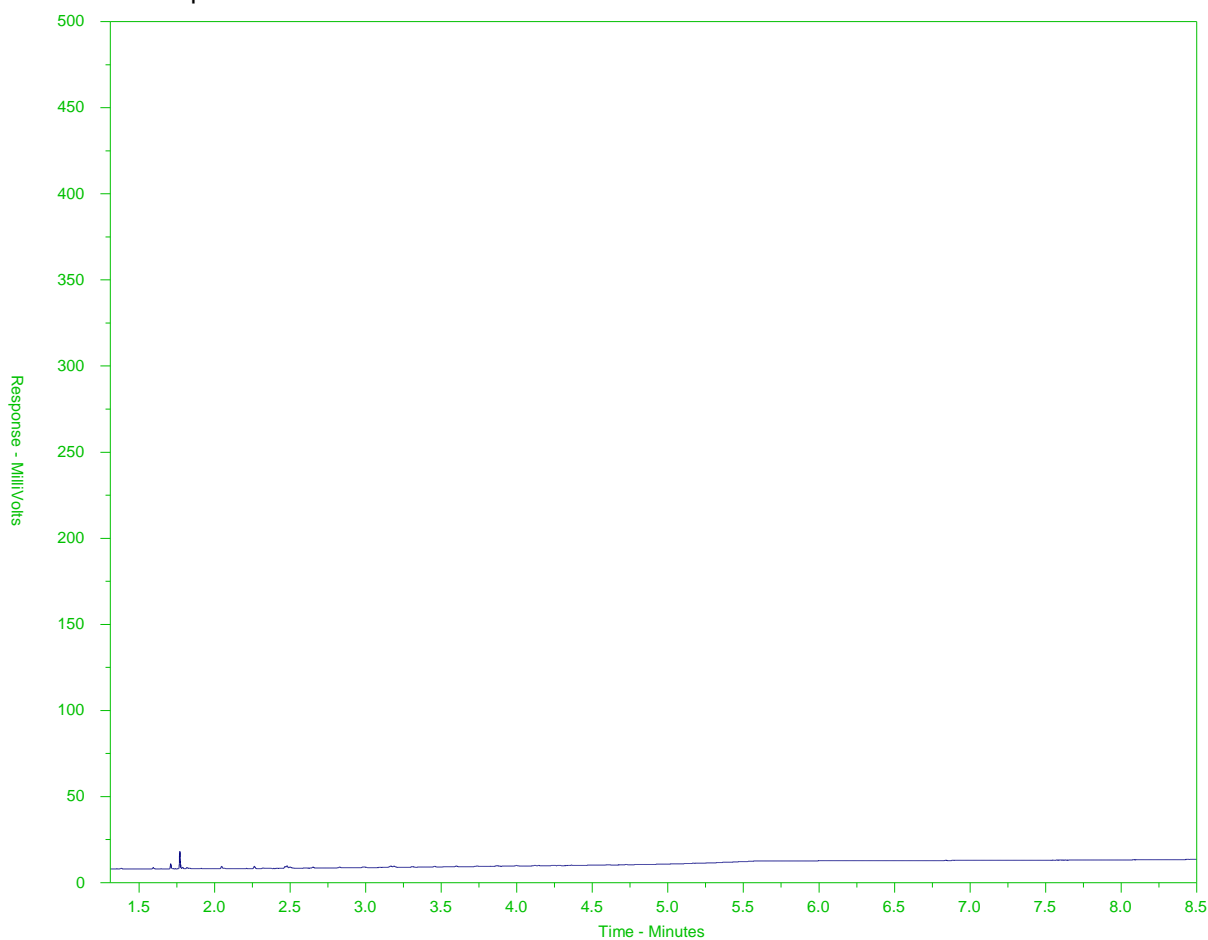
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-6
Client Sample ID: WT5-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

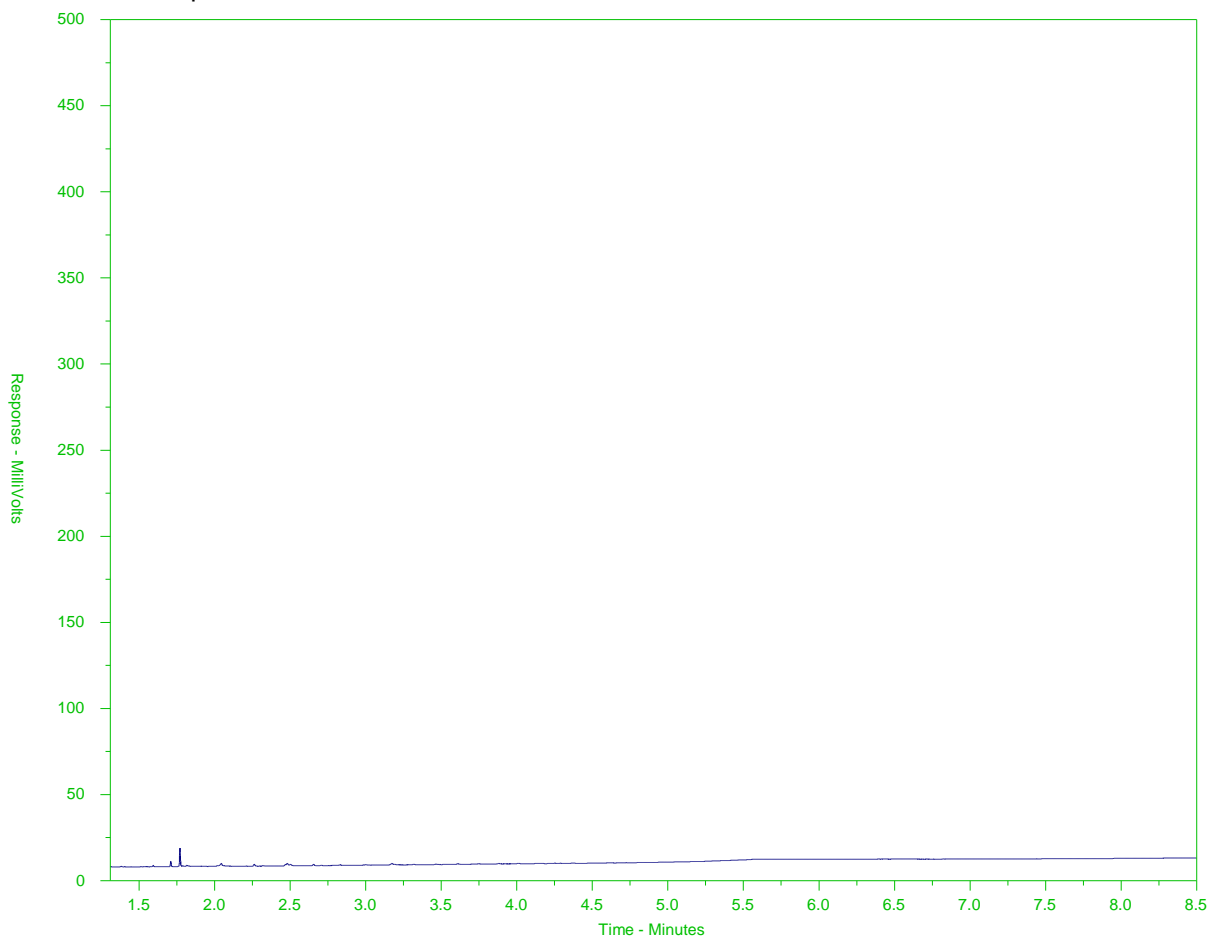
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-7
Client Sample ID: WT7-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

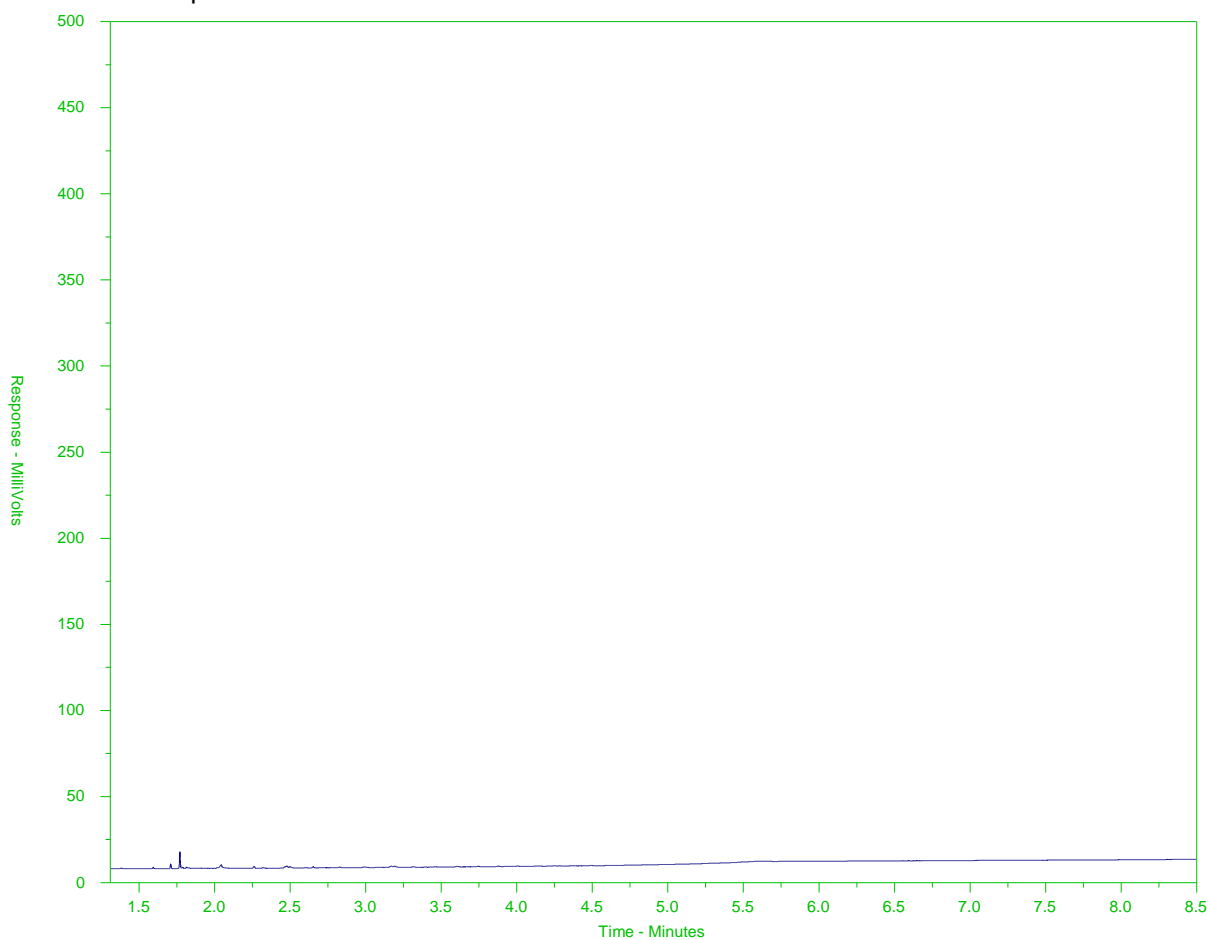
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-8
Client Sample ID: WT7-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

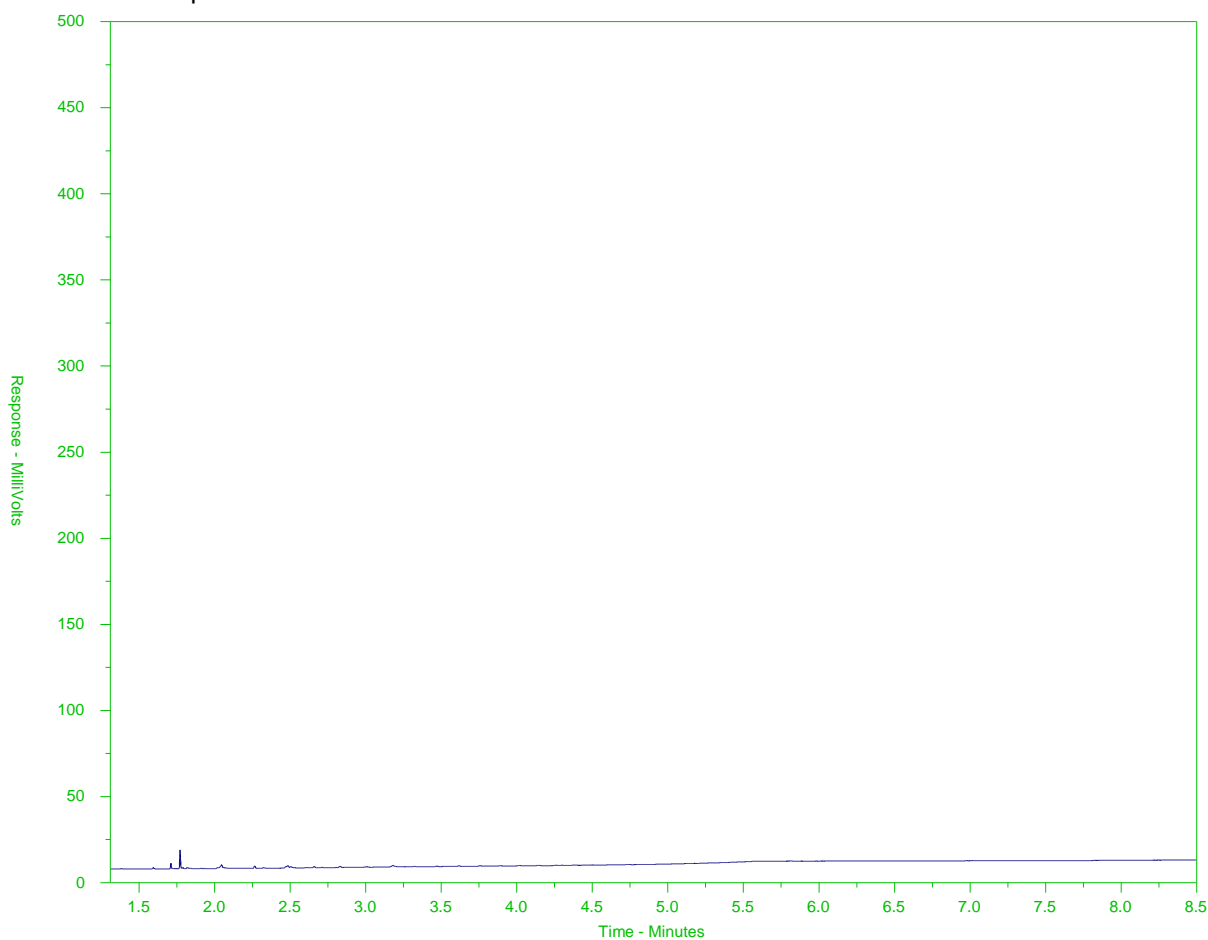
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-9
Client Sample ID: FIELD BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

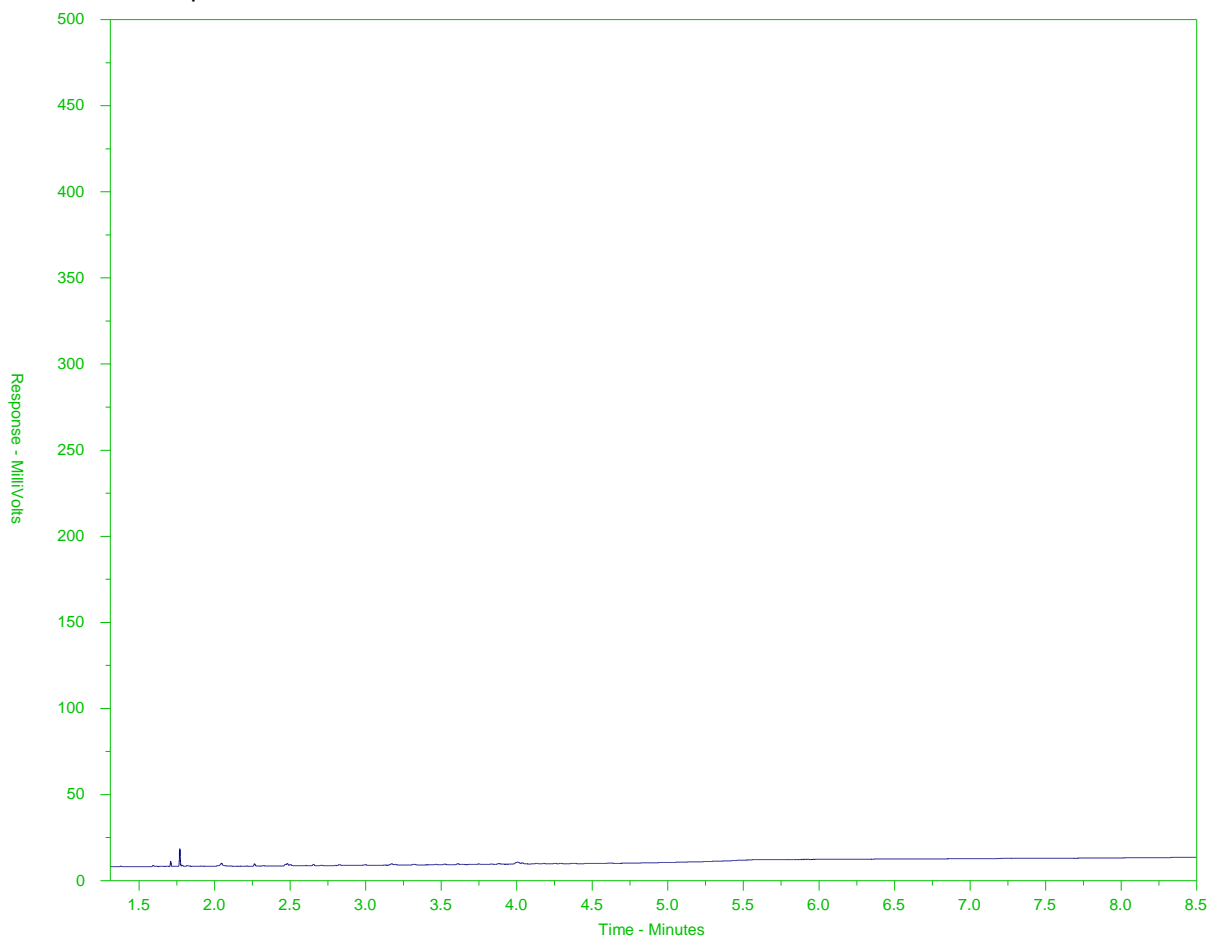
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2274937-C-10
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



DOC Number: 15 -

Page of

Report To		Report Format / Distribution		Select Service Level Below - Please Circle	
Company:	STANTEC CONSULTING	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges will apply	
Contact:	Tyler Joyce	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4] <input type="checkbox"/>	
Phone:	778-729-2278	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] <input type="checkbox"/>	1 Business day [E1] <input type="checkbox"/>
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2] <input type="checkbox"/>	Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/>
Street:	500 - 4730 Kingsway	Email 1 or Fax:	Tyler.Joyce@stantec.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm	
City/Province:	Burnaby, BC	Email 2:	Matthew.Friend@stantec.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H 0C6	Email 3:	EDD@stantec.com	Analysis Request	
Invoice To:	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
	Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX		
Company:		Email 1 or Fax:			
Contact:		Email 2:			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:	Q74015	AFE/Cost Center:			
Job #:	123512431	Major/Minor Code:			
PO / AFE:	TASK CODE: 601.200	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order #: (lab use only)		ALS Contact:	Brent Mack	Sampler:	
		MF, AB			
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	
	WT3	May 16, 2019	14:00	Water	
	WT8		12:30	Water	
	WT10		12:50	Water	
	WT11		14:20	Water	
	WT5 - surface		09:20	Sea water	
	WT5 - deep		09:30	Sea water	
	WT7 - surface		09:50	Sea water	
	WT7 - deep		10:00	Sea water	
	FIELD BLANK			Water	
	DUP			Water	
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		Sea water metals not collected in acid washed bottles.		Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by:	Date:	Time:	Received by:	Date:	Time:
Amanda Bell	May 16, 2019	16:00		5/16	3:53 PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 29-MAY-19
Report Date: 31-MAY-19 17:54 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2281691

Project P.O. #: Task Code: 601.200

Job Reference: 123512431

C of C Numbers:

Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	33200	32600	31000	33200	
	Hardness (as CaCO3) (mg/L)	4340	4470	4090	4380	
	pH (pH)	7.96	8.03	8.04	7.95	
	Total Suspended Solids (mg/L)	2.5	2.2	2.4	2.9	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0068	0.0055	0.0088	0.0194	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Phosphorus (P)-Total (mg/L)	0.0288	0.0268	0.0385	0.0503	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0239	0.0222	0.0667	0.0509	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00113	0.00125	0.00131	0.00134	
	Barium (Ba)-Total (mg/L)	0.0052	0.0046	0.0086	0.0097	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	2.61	2.62	2.59	2.72	
	Cadmium (Cd)-Total (mg/L)	0.000055	0.000051	0.000060	0.000060	
	Calcium (Ca)-Total (mg/L)	284	285	281	299	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	0.000070	0.000069	
	Copper (Cu)-Total (mg/L)	0.00080	0.00103	0.00148	0.00097	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.024	0.023	0.077	0.060	
	Lead (Pb)-Total (mg/L)	0.000064	0.000057	0.000121	0.000058	
	Lithium (Li)-Total (mg/L)	0.120	0.125	0.116	0.126	
	Magnesium (Mg)-Total (mg/L)	913	936	872	954	
	Manganese (Mn)-Total (mg/L)	0.00461	0.00451	0.00580	0.00643	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00766	0.00825	0.00786	0.00841	
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00052	0.00059	0.00065	
	Phosphorus (P)-Total (mg/L)	0.076	0.073	0.091	0.075	
	Potassium (K)-Total (mg/L)	306	320	310	325	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0778	0.0810	0.0755	0.0818	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	1.3	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte						
SEAWATER							
Total Metals	Sodium (Na)-Total (mg/L)	7090	7280	6870	7560		
	Strontium (Sr)-Total (mg/L)	5.15	5.51	5.08	5.54		
	Sulfur (S)-Total (mg/L)	755	755	691	745		
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050		
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Uranium (U)-Total (mg/L)	0.00205	0.00204	0.00194	0.00209		
	Vanadium (V)-Total (mg/L)	0.00187	0.00193	0.00186	0.00197		
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0092	<0.0030		
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0056	0.0056	0.0077	0.0056		
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010		
	Arsenic (As)-Dissolved (mg/L)	0.00125	0.00117	0.00111	0.00122		
	Barium (Ba)-Dissolved (mg/L)	0.0042	0.0023	0.0028	0.0077		
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Boron (B)-Dissolved (mg/L)	2.48	2.62	2.43	2.71		
	Cadmium (Cd)-Dissolved (mg/L)	0.000056	0.000050	0.000048	0.000061		
	Calcium (Ca)-Dissolved (mg/L)	262	278	257	291		
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Copper (Cu)-Dissolved (mg/L)	0.00071	0.00077	0.00065	0.00086		
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.119	0.126	0.110	0.126		
	Magnesium (Mg)-Dissolved (mg/L)	896	917	838	886		
	Manganese (Mn)-Dissolved (mg/L)	0.00387	0.00348	0.00253	0.00444		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00771	0.00792	0.00730	0.00826		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	0.057	
	Potassium (K)-Dissolved (mg/L)	315	306	279	316	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0774	0.0792	0.0731	0.0808	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	1.2	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	6830	7090	6750	7570	
	Strontium (Sr)-Dissolved (mg/L)	5.09	5.16	4.83	5.44	
	Sulfur (S)-Dissolved (mg/L)	737	704	692	742	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00212	0.00215	0.00188	0.00220	
	Vanadium (V)-Dissolved (mg/L)	0.00165	0.00162	0.00141	0.00163	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0012	<0.0010	0.0043	0.0024	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

31-MAY-19 17:54 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-1 Water 29-MAY-19 12:30 WT2	L2281691-2 Water 29-MAY-19 12:00 WT3	L2281691-3 Water 29-MAY-19 11:00 WT8	L2281691-4 Water 29-MAY-19 11:30 WT10	L2281691-5 Water 29-MAY-19 12:45 WT11
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	211	276	253	247	269
	Hardness (as CaCO3) (mg/L)	79.0	104	78.4	87.1	116
	pH (pH)	8.08	8.25	8.01	8.10	8.15
	Total Suspended Solids (mg/L)	11.4	<3.0	63.2	21.4	44.8
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0061	<0.0050	<0.0050	0.0318	0.0115
	Nitrate (as N) (mg/L)	0.0804	0.0586	1.41	1.01	0.235
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0016	0.0019
	Phosphorus (P)-Total (mg/L)	0.127	0.0668	0.0249	0.0477	0.0538
Total Metals	Aluminum (Al)-Total (mg/L)	0.154	0.0249	0.317	0.306	0.763
	Antimony (Sb)-Total (mg/L)	0.00017	<0.00010	<0.00010	0.00011	0.00026
	Arsenic (As)-Total (mg/L)	0.00395	0.00468	0.00037	0.00181	0.00271
	Barium (Ba)-Total (mg/L)	0.0114	0.00650	0.0132	0.0606	0.0290
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.073	0.015	0.010	0.015	0.021
	Cadmium (Cd)-Total (mg/L)	0.0000163	<0.0000050	0.0000223	0.0000137	0.0000292
	Calcium (Ca)-Total (mg/L)	23.2	26.3	21.2	22.8	30.0
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	0.000017	0.000014	0.000040
	Chromium (Cr)-Total (mg/L)	0.00024	<0.00010	0.00299	0.00193	0.00069
	Cobalt (Co)-Total (mg/L)	0.00016	<0.00010	0.00024	0.00017	0.00041
	Copper (Cu)-Total (mg/L)	0.00088	<0.00050	0.00087	0.00133	0.00394
	Iron (Fe)-Total (mg/L)	1.08	0.021	0.731	0.514	0.851
	Lead (Pb)-Total (mg/L)	0.000173	0.000067	0.000748	0.000412	0.000727
	Lithium (Li)-Total (mg/L)	<0.0010	0.0012	0.0011	0.0014	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.35	9.54	6.14	7.15	8.63
	Manganese (Mn)-Total (mg/L)	0.0594	0.00874	0.0630	0.0426	0.0420
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.000025 ^{DLM}	<0.000025 ^{DLM}	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00107	0.000877	0.000105	0.000493	0.000991
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	0.00072	0.00091	0.00082
	Phosphorus (P)-Total (mg/L)	0.128	0.076	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	2.52	2.85	0.609	2.13	3.12
	Rubidium (Rb)-Total (mg/L)	0.00108	0.00076	0.00040	0.00105	0.00173
	Selenium (Se)-Total (mg/L)	0.000064	<0.000050	0.000168	0.000289	0.000229
	Silicon (Si)-Total (mg/L)	7.89	10.3	12.1	10.8	8.84
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	12.3	11.5	15.6	11.5	9.07
	Strontium (Sr)-Total (mg/L)	0.0767	0.0908	0.143	0.117	0.103

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	L2281691-10 Water 29-MAY-19 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)					277
	Hardness (as CaCO3) (mg/L)					114
	pH (pH)					8.25
	Total Suspended Solids (mg/L)					<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					<0.0050
	Nitrate (as N) (mg/L)					0.0578
	Nitrite (as N) (mg/L)					<0.0010
	Phosphorus (P)-Total (mg/L)					0.0683
Total Metals	Aluminum (Al)-Total (mg/L)					0.0258
	Antimony (Sb)-Total (mg/L)					<0.00010
	Arsenic (As)-Total (mg/L)					0.00461
	Barium (Ba)-Total (mg/L)					0.00641
	Beryllium (Be)-Total (mg/L)					<0.00010
	Bismuth (Bi)-Total (mg/L)					<0.000050
	Boron (B)-Total (mg/L)					0.015
	Cadmium (Cd)-Total (mg/L)					0.0000429
	Calcium (Ca)-Total (mg/L)					25.6
	Cesium (Cs)-Total (mg/L)					<0.000010
	Chromium (Cr)-Total (mg/L)					<0.00010
	Cobalt (Co)-Total (mg/L)					<0.00010
	Copper (Cu)-Total (mg/L)					<0.00050
	Iron (Fe)-Total (mg/L)					0.023
	Lead (Pb)-Total (mg/L)					0.000058
	Lithium (Li)-Total (mg/L)					0.0012
	Magnesium (Mg)-Total (mg/L)					8.91
	Manganese (Mn)-Total (mg/L)					0.00940
	Mercury (Hg)-Total (mg/L)					<0.0000050
	Molybdenum (Mo)-Total (mg/L)					0.000866
	Nickel (Ni)-Total (mg/L)					<0.00050
	Phosphorus (P)-Total (mg/L)					0.086
	Potassium (K)-Total (mg/L)					2.61
	Rubidium (Rb)-Total (mg/L)					0.00072
	Selenium (Se)-Total (mg/L)					<0.000050
	Silicon (Si)-Total (mg/L)					10.0
	Silver (Ag)-Total (mg/L)					<0.000010
	Sodium (Na)-Total (mg/L)					10.7
	Strontium (Sr)-Total (mg/L)					0.0903

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-11 Water 29-MAY-19 14:00 FIELD BLANK				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50				
	pH (pH)	5.97				
	Total Suspended Solids (mg/L)	<3.0				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.00010				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Cesium (Cs)-Total (mg/L)	<0.000010				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.050				
	Rubidium (Rb)-Total (mg/L)	<0.00020				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.10				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-1 Water 29-MAY-19 12:30 WT2	L2281691-2 Water 29-MAY-19 12:00 WT3	L2281691-3 Water 29-MAY-19 11:00 WT8	L2281691-4 Water 29-MAY-19 11:30 WT10	L2281691-5 Water 29-MAY-19 12:45 WT11
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	1.96	4.94	4.46	4.16	5.63
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00063	0.00013
	Titanium (Ti)-Total (mg/L)	0.00440	0.00101	0.0141	<0.012 ^{DLM}	0.0244
	Tungsten (W)-Total (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000057	0.000083	0.000097	0.000121	0.000128
	Vanadium (V)-Total (mg/L)	0.00122	<0.00050	0.00223	0.00204	0.00235
	Zinc (Zn)-Total (mg/L)	0.0342	0.0056	0.0040	0.0293	0.0347
	Zirconium (Zr)-Total (mg/L)	0.000097	<0.000060	<0.000060	0.000115	0.000138
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0028	0.0046	0.0092	0.0249	0.0126
	Antimony (Sb)-Dissolved (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	0.00018
	Arsenic (As)-Dissolved (mg/L)	0.00192	0.00485	0.00020	0.00151	0.00224
	Barium (Ba)-Dissolved (mg/L)	0.00896	0.00612	0.00955	0.0338	0.0222
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.066	0.015	<0.010	0.014	0.020
	Cadmium (Cd)-Dissolved (mg/L)	0.000083	<0.000050	<0.000050	<0.000050	0.0000120
	Calcium (Ca)-Dissolved (mg/L)	22.9	26.2	20.8	22.7	33.0
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00126	0.00094	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	0.00036	0.00104
	Iron (Fe)-Dissolved (mg/L)	0.018	<0.010	0.010	0.062	0.019
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0012	<0.0010	0.0013	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.30	9.44	6.42	7.38	8.16
	Manganese (Mn)-Dissolved (mg/L)	0.0141	0.00280	0.00045	0.0163	0.00554
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00113	0.000906	0.000084	0.000504	0.000992
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.79	2.93	0.668	2.19	3.27
	Rubidium (Rb)-Dissolved (mg/L)	0.00111	0.00077	0.00029	0.00087	0.00147

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	L2281691-10 Water 29-MAY-19 DUP
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)						4.74
	Tellurium (Te)-Total (mg/L)						<0.00020
	Thallium (Tl)-Total (mg/L)						<0.000010
	Thorium (Th)-Total (mg/L)						<0.00010
	Tin (Sn)-Total (mg/L)						<0.00010
	Titanium (Ti)-Total (mg/L)						0.00103
	Tungsten (W)-Total (mg/L)						0.00010
	Uranium (U)-Total (mg/L)						0.000087
	Vanadium (V)-Total (mg/L)						0.00052
	Zinc (Zn)-Total (mg/L)						0.0057
	Zirconium (Zr)-Total (mg/L)						<0.000060
Dissolved Metals	Dissolved Mercury Filtration Location						FIELD
	Dissolved Metals Filtration Location						FIELD
	Aluminum (Al)-Dissolved (mg/L)						0.0040
	Antimony (Sb)-Dissolved (mg/L)						<0.00010
	Arsenic (As)-Dissolved (mg/L)						0.00478
	Barium (Ba)-Dissolved (mg/L)						0.00607
	Beryllium (Be)-Dissolved (mg/L)						<0.00010
	Bismuth (Bi)-Dissolved (mg/L)						<0.000050
	Boron (B)-Dissolved (mg/L)						0.014
	Cadmium (Cd)-Dissolved (mg/L)						<0.000050
	Calcium (Ca)-Dissolved (mg/L)						30.2
	Cesium (Cs)-Dissolved (mg/L)						<0.000010
	Chromium (Cr)-Dissolved (mg/L)						<0.00010
	Cobalt (Co)-Dissolved (mg/L)						<0.00010
	Copper (Cu)-Dissolved (mg/L)						<0.00020
	Iron (Fe)-Dissolved (mg/L)						<0.010
	Lead (Pb)-Dissolved (mg/L)						<0.000050
	Lithium (Li)-Dissolved (mg/L)						0.0012
	Magnesium (Mg)-Dissolved (mg/L)						9.25
	Manganese (Mn)-Dissolved (mg/L)						0.00283
	Mercury (Hg)-Dissolved (mg/L)						<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)						0.000863
	Nickel (Ni)-Dissolved (mg/L)						<0.00050
	Phosphorus (P)-Dissolved (mg/L)						0.064
	Potassium (K)-Dissolved (mg/L)						2.94
	Rubidium (Rb)-Dissolved (mg/L)						0.00078

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2281691-11 Water 29-MAY-19 14:00 FIELD BLANK				
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)	<0.50					
	Tellurium (Te)-Total (mg/L)	<0.00020					
	Thallium (Tl)-Total (mg/L)	<0.000010					
	Thorium (Th)-Total (mg/L)	<0.00010					
	Tin (Sn)-Total (mg/L)	<0.00010					
	Titanium (Ti)-Total (mg/L)	<0.00030					
	Tungsten (W)-Total (mg/L)	<0.00010					
	Uranium (U)-Total (mg/L)	<0.000010					
	Vanadium (V)-Total (mg/L)	<0.00050					
	Zinc (Zn)-Total (mg/L)	<0.0030					
	Zirconium (Zr)-Total (mg/L)	<0.000060					
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD					
	Dissolved Metals Filtration Location	FIELD					
	Aluminum (Al)-Dissolved (mg/L)	0.0011 ^{RRV}					
	Antimony (Sb)-Dissolved (mg/L)	<0.00010					
	Arsenic (As)-Dissolved (mg/L)	<0.00010					
	Barium (Ba)-Dissolved (mg/L)	<0.00010					
	Beryllium (Be)-Dissolved (mg/L)	<0.00010					
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050					
	Boron (B)-Dissolved (mg/L)	<0.010					
	Cadmium (Cd)-Dissolved (mg/L)	0.0000696 ^{DTC}					
	Calcium (Ca)-Dissolved (mg/L)	<0.050					
	Cesium (Cs)-Dissolved (mg/L)	<0.000010					
	Chromium (Cr)-Dissolved (mg/L)	<0.00010					
	Cobalt (Co)-Dissolved (mg/L)	<0.00010					
	Copper (Cu)-Dissolved (mg/L)	0.00030 ^{RRV}					
	Iron (Fe)-Dissolved (mg/L)	<0.010					
	Lead (Pb)-Dissolved (mg/L)	<0.000050					
	Lithium (Li)-Dissolved (mg/L)	<0.0010					
	Magnesium (Mg)-Dissolved (mg/L)	0.0054 ^{RRV}					
	Manganese (Mn)-Dissolved (mg/L)	0.00011 ^{RRV}					
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050					
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050					
	Nickel (Ni)-Dissolved (mg/L)	<0.00050					
	Phosphorus (P)-Dissolved (mg/L)	<0.050					
	Potassium (K)-Dissolved (mg/L)	<0.050					
	Rubidium (Rb)-Dissolved (mg/L)	<0.00020					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-1 Water 29-MAY-19 12:30 WT2	L2281691-2 Water 29-MAY-19 12:00 WT3	L2281691-3 Water 29-MAY-19 11:00 WT8	L2281691-4 Water 29-MAY-19 11:30 WT10	L2281691-5 Water 29-MAY-19 12:45 WT11
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000051	0.000100	0.000185	0.000187
	Silicon (Si)-Dissolved (mg/L)	7.23	9.84	11.4	10.3	7.40
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	13.8	10.6	15.6	11.8	8.89
	Strontium (Sr)-Dissolved (mg/L)	0.0792	0.0949	0.149	0.120	0.114
	Sulfur (S)-Dissolved (mg/L)	1.53	4.41	3.87	3.53	4.75
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00033	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	0.00060	0.00040
	Tungsten (W)-Dissolved (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000050	0.000084	0.000042	0.000080	0.000096
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00077	0.00105	0.00068
	Zinc (Zn)-Dissolved (mg/L)	0.0167	0.0036	<0.0010	0.0173	0.0187
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060	<0.000060	<0.000060	<0.000060	<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	91.1	74.4	61.3	102.9	89.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-6 Seawater 29-MAY-19 09:30 WT5-SURFACE	L2281691-7 Seawater 29-MAY-19 09:45 WT5-DEEP	L2281691-8 Seawater 29-MAY-19 10:15 WT7-SURFACE	L2281691-9 Seawater 29-MAY-19 10:00 WT7-DEEP	L2281691-10 Water 29-MAY-19 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)					<0.000050
	Silicon (Si)-Dissolved (mg/L)					9.81
	Silver (Ag)-Dissolved (mg/L)					<0.000010
	Sodium (Na)-Dissolved (mg/L)					10.8
	Strontium (Sr)-Dissolved (mg/L)					0.0949
	Sulfur (S)-Dissolved (mg/L)					4.34
	Tellurium (Te)-Dissolved (mg/L)					<0.00020
	Thallium (Tl)-Dissolved (mg/L)					<0.000010
	Thorium (Th)-Dissolved (mg/L)					<0.00010
	Tin (Sn)-Dissolved (mg/L)					<0.00010
	Titanium (Ti)-Dissolved (mg/L)					<0.00030
	Tungsten (W)-Dissolved (mg/L)					<0.00010
	Uranium (U)-Dissolved (mg/L)					0.000085
	Vanadium (V)-Dissolved (mg/L)					<0.00050
	Zinc (Zn)-Dissolved (mg/L)					0.0031
	Zirconium (Zr)-Dissolved (mg/L)					<0.000060
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	81.5	84.9	87.8	89.4	64.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2281691-11 Water 29-MAY-19 14:00 FIELD BLANK				
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	<0.050				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	<0.050				
	Strontium (Sr)-Dissolved (mg/L)	<0.00020				
	Sulfur (S)-Dissolved (mg/L)	<0.50				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	0.00015 ^{RRV}				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	<0.00010				
	Uranium (U)-Dissolved (mg/L)	<0.000010				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	0.0011 ^{RRV}				
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060				
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10				
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	67.1				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
WSMT	Water sample(s) for total mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.
WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2281691-11
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2281691-11
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2281691-11
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2281691-11
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2281691-11
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2281691-11
Matrix Spike	Boron (B)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L2281691-11
Matrix Spike	Calcium (Ca)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2281691-11
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2281691-11
Matrix Spike	Manganese (Mn)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2281691-11
Matrix Spike	Strontium (Sr)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2281691-11
Matrix Spike	Boron (B)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2281691-6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2281691-1, -10, -11, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-HB-F-HMI-MS-VA	Seawater	Tot Metals in Seawater by CRC ICPMS (BC)	EPA 200.2/6020B (mod)

Reference Information

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NH3-F-VA Seawater Ammonia in Seawater by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-T-PRES-COL-VA Seawater Total P in Seawater by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

PH-C-PCT-VA Seawater pH by Meter (Automated) (seawater) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

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.

Reference Information

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

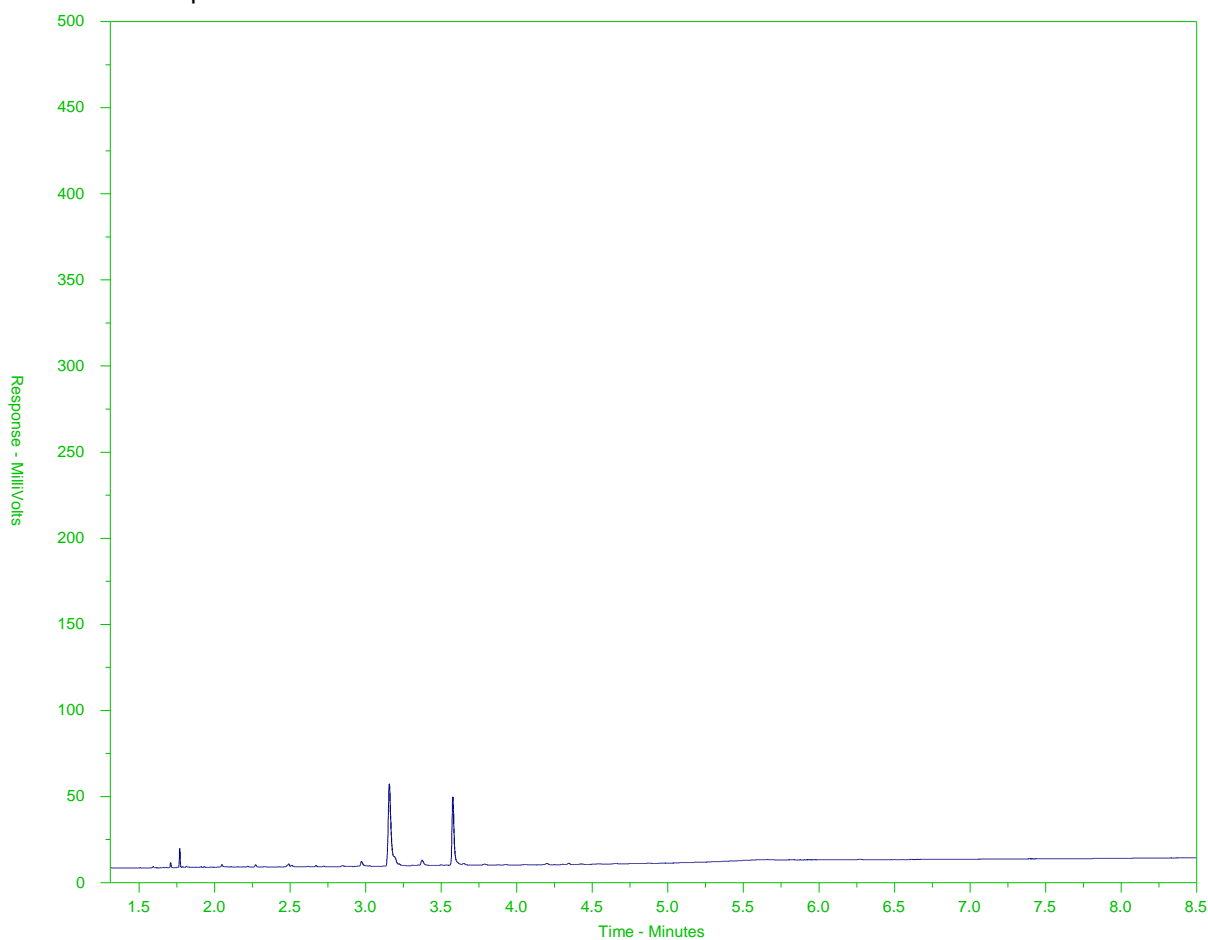
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-1
Client Sample ID: WT2



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

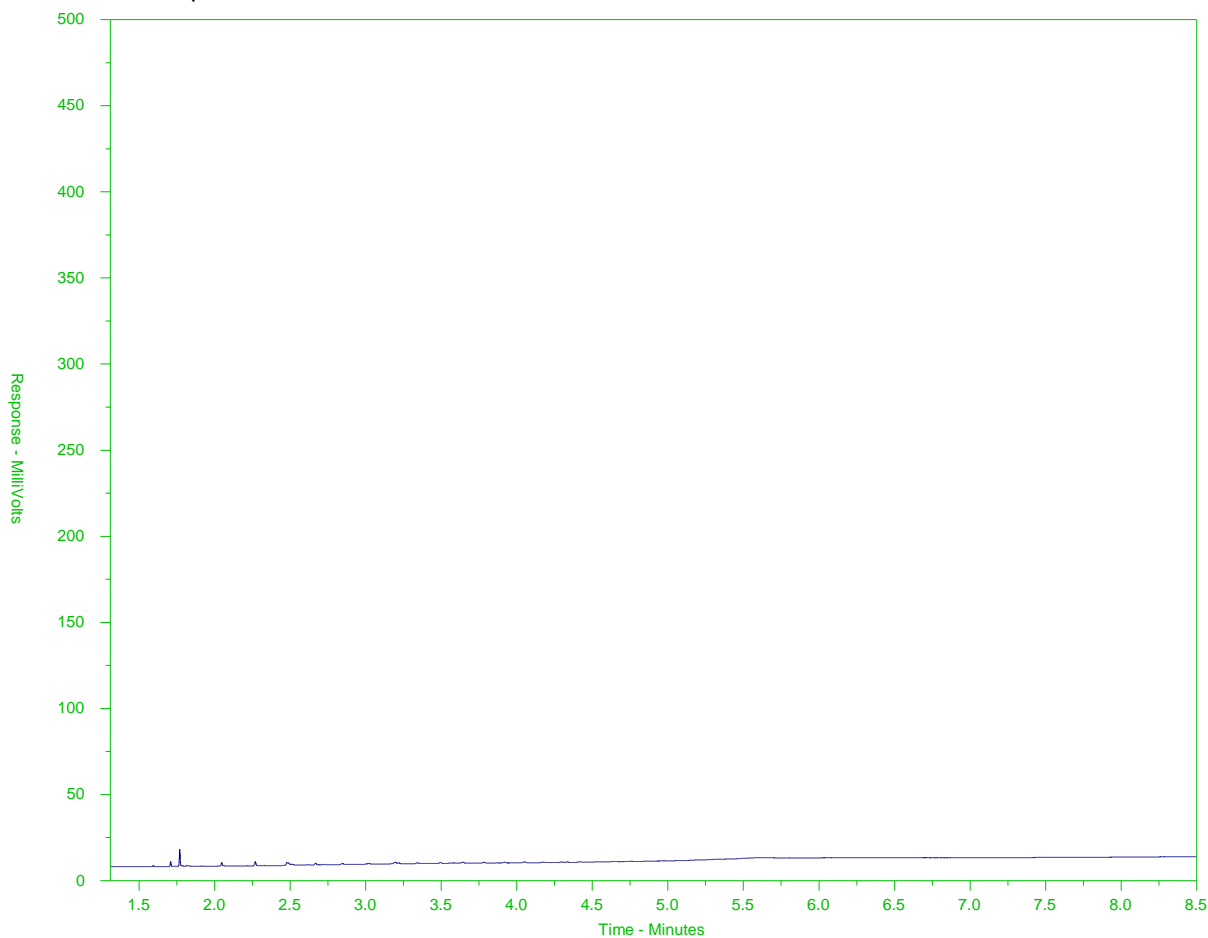
Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-2

Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

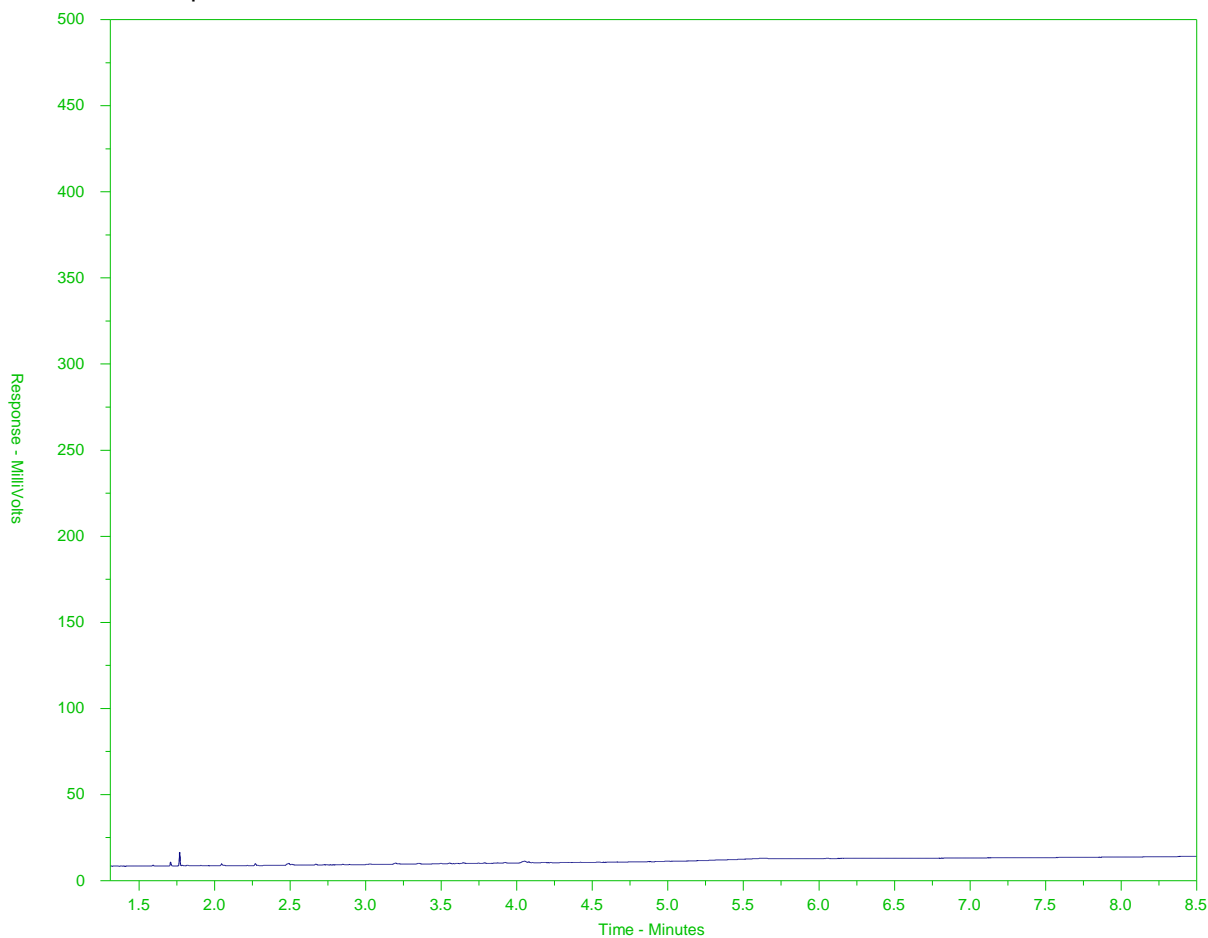
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-3
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

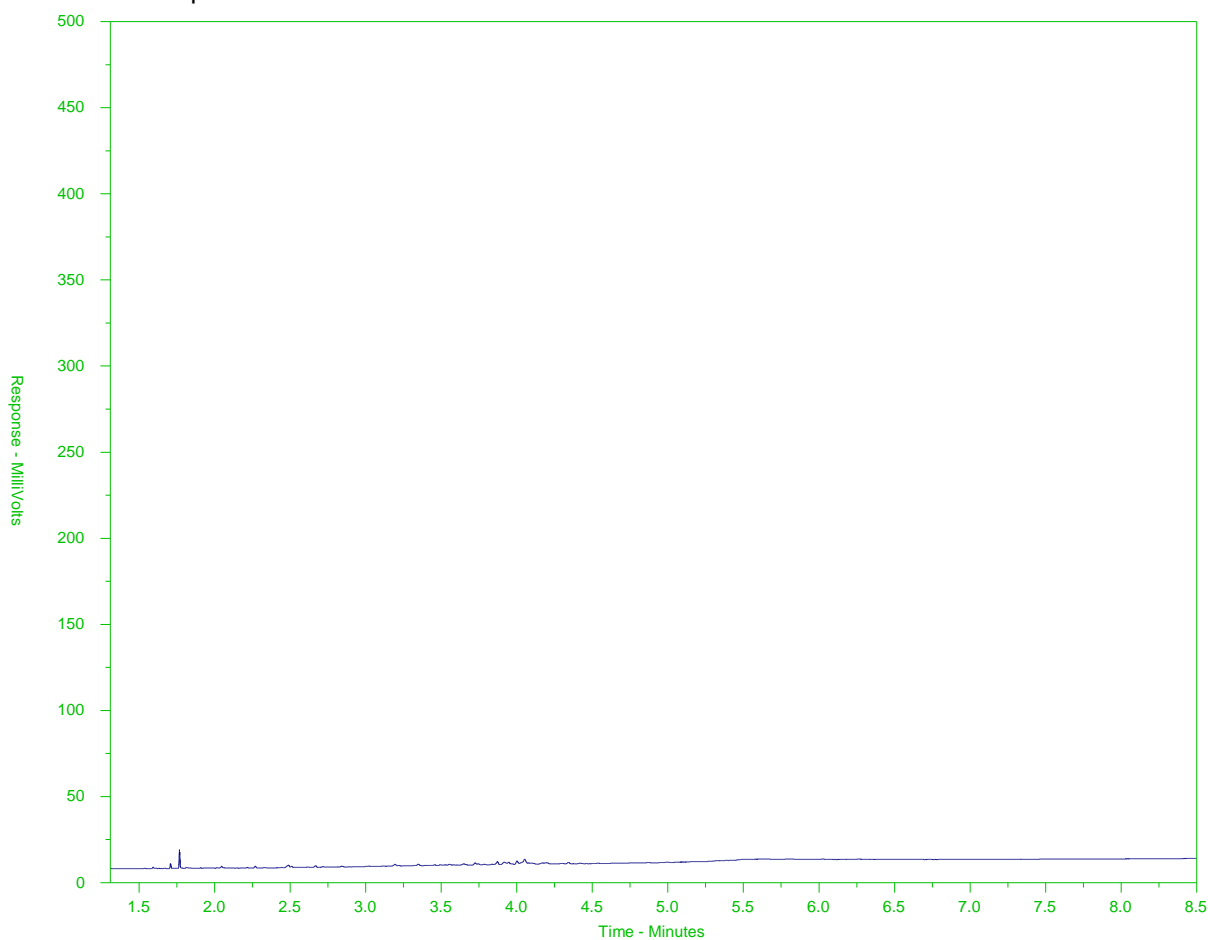
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-4
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

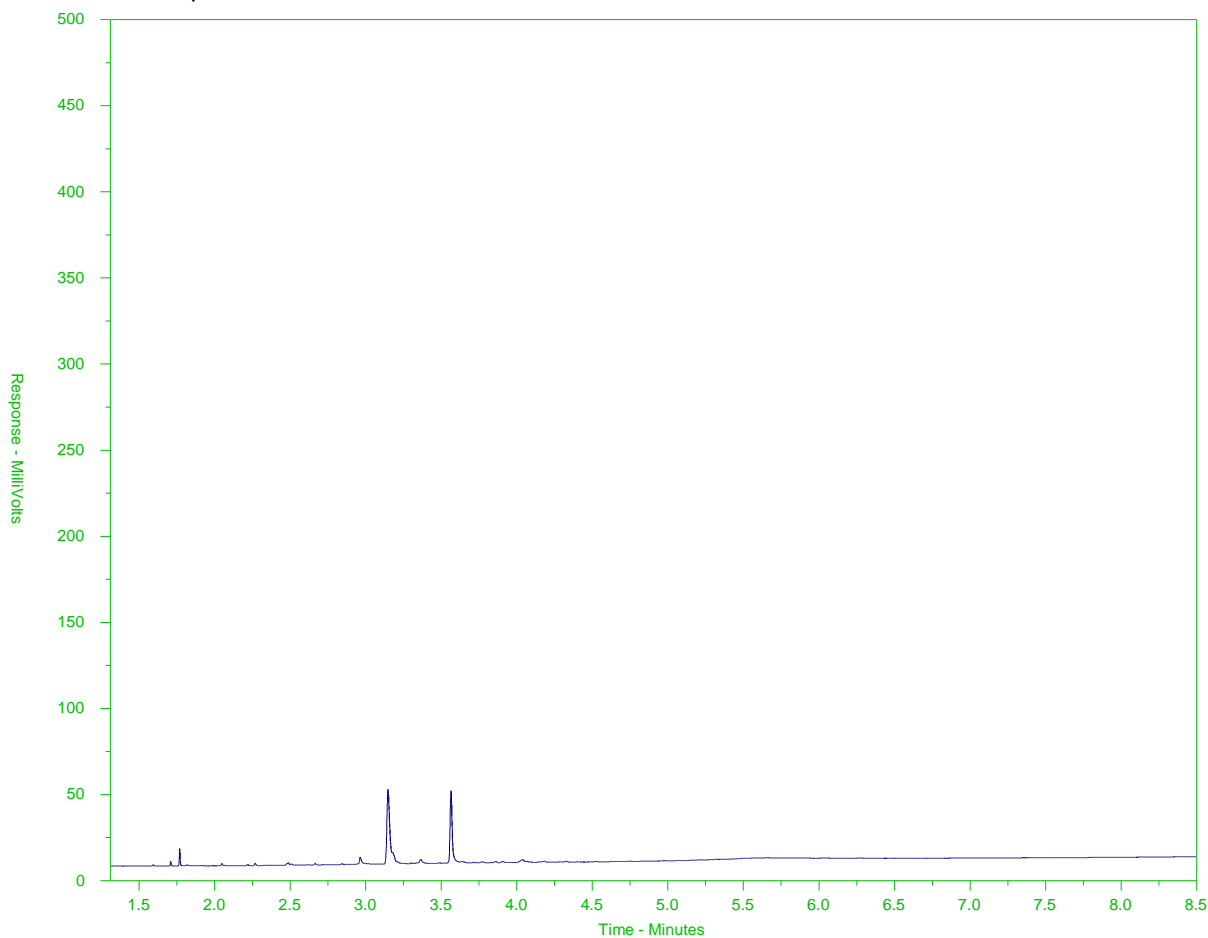
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-5
Client Sample ID: WT11



F2		F3		F4	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

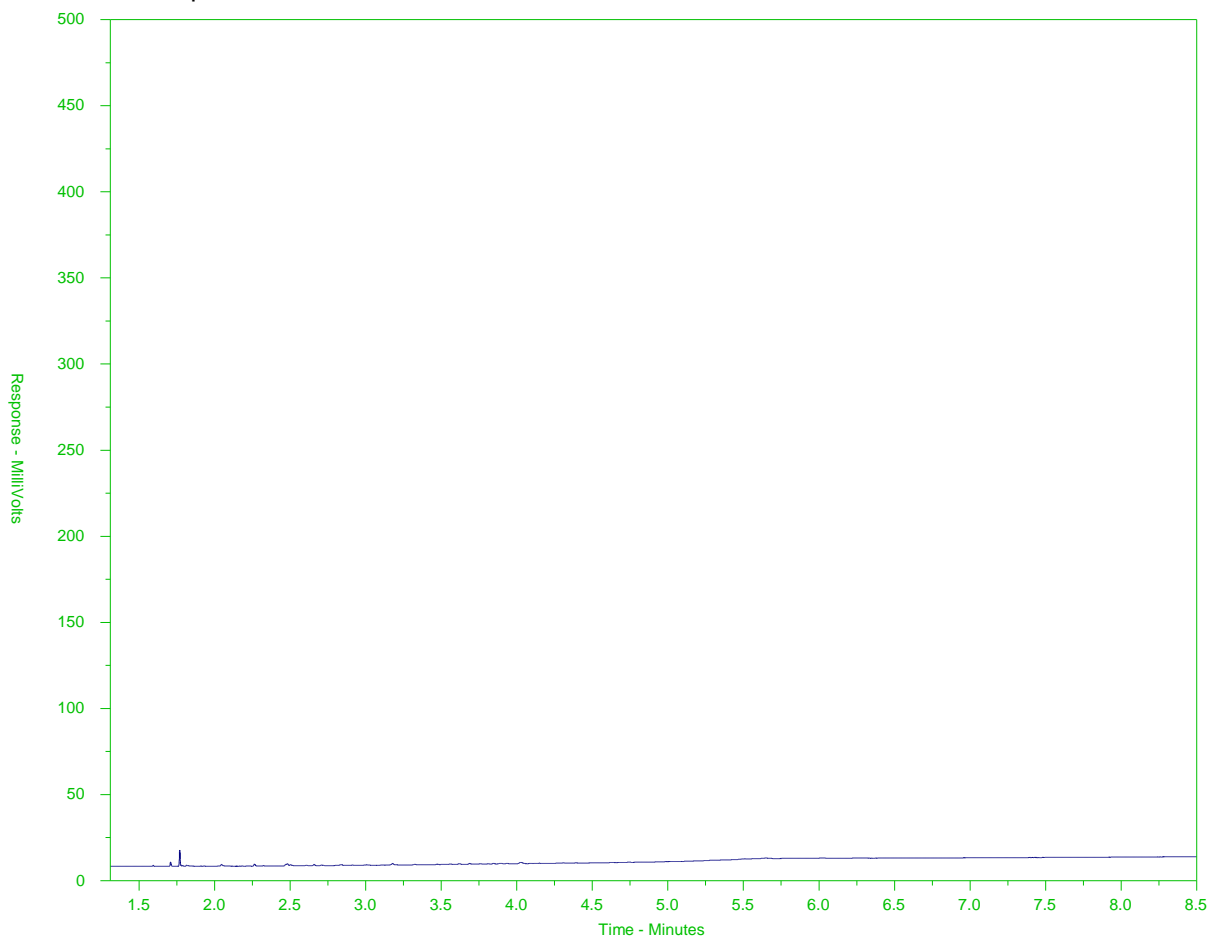
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-6
Client Sample ID: WT5-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

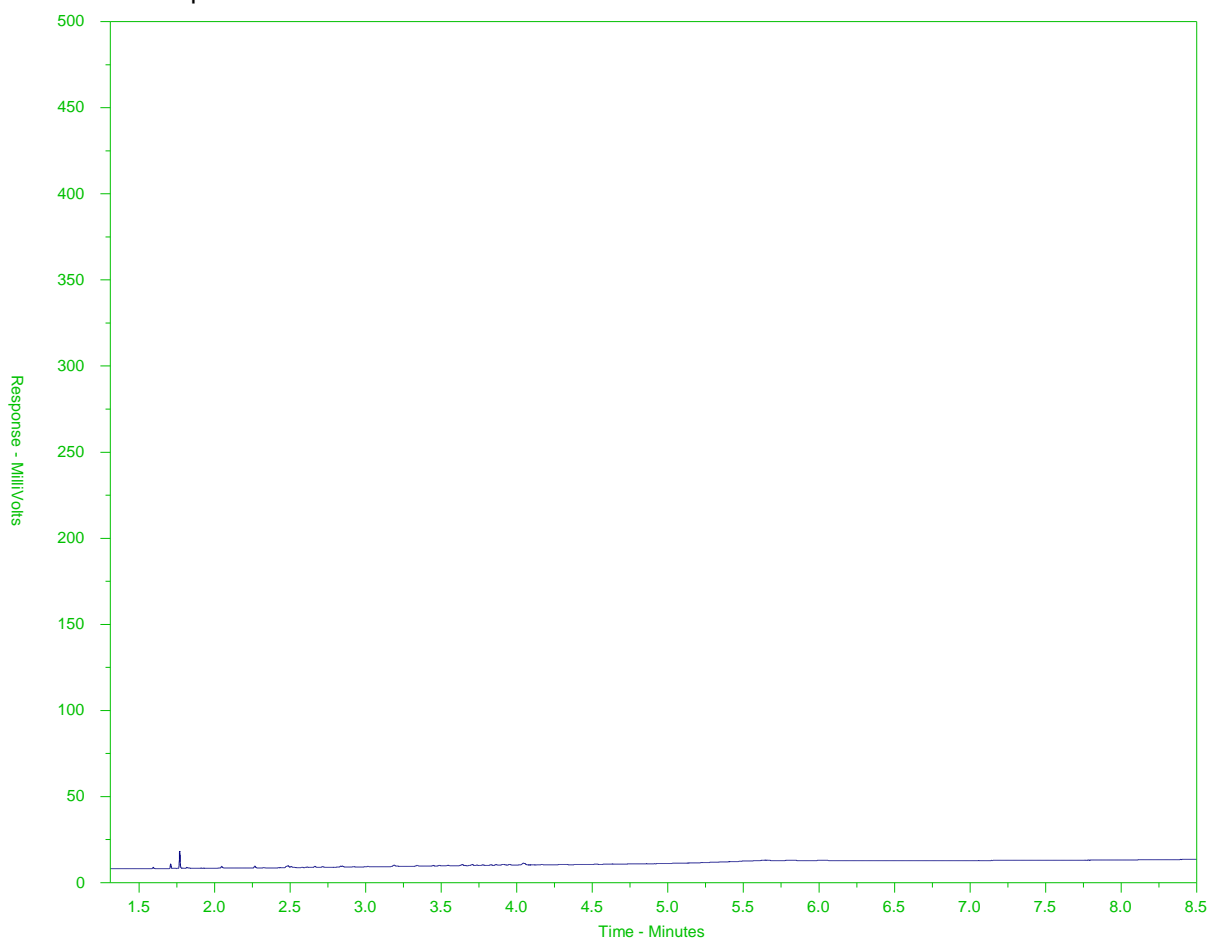
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-7
Client Sample ID: WT5-DEEP



F2		F3	F4	
nC10	nC16		nC34	nC50
174°C	287°C		481°C	575°C
346°F	549°F		898°F	1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →				

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

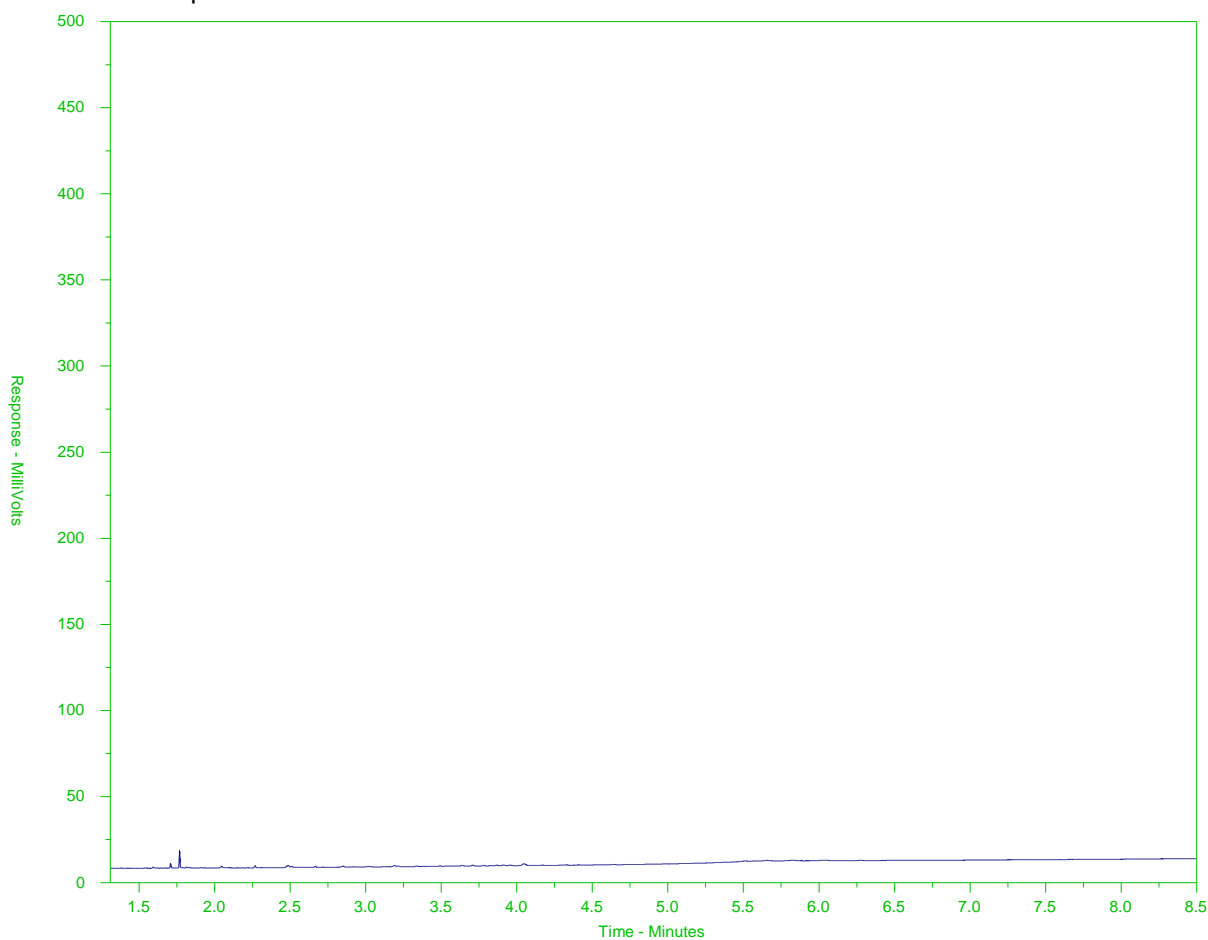
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-8
Client Sample ID: WT7-SURFACE



F2		F3		F4	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

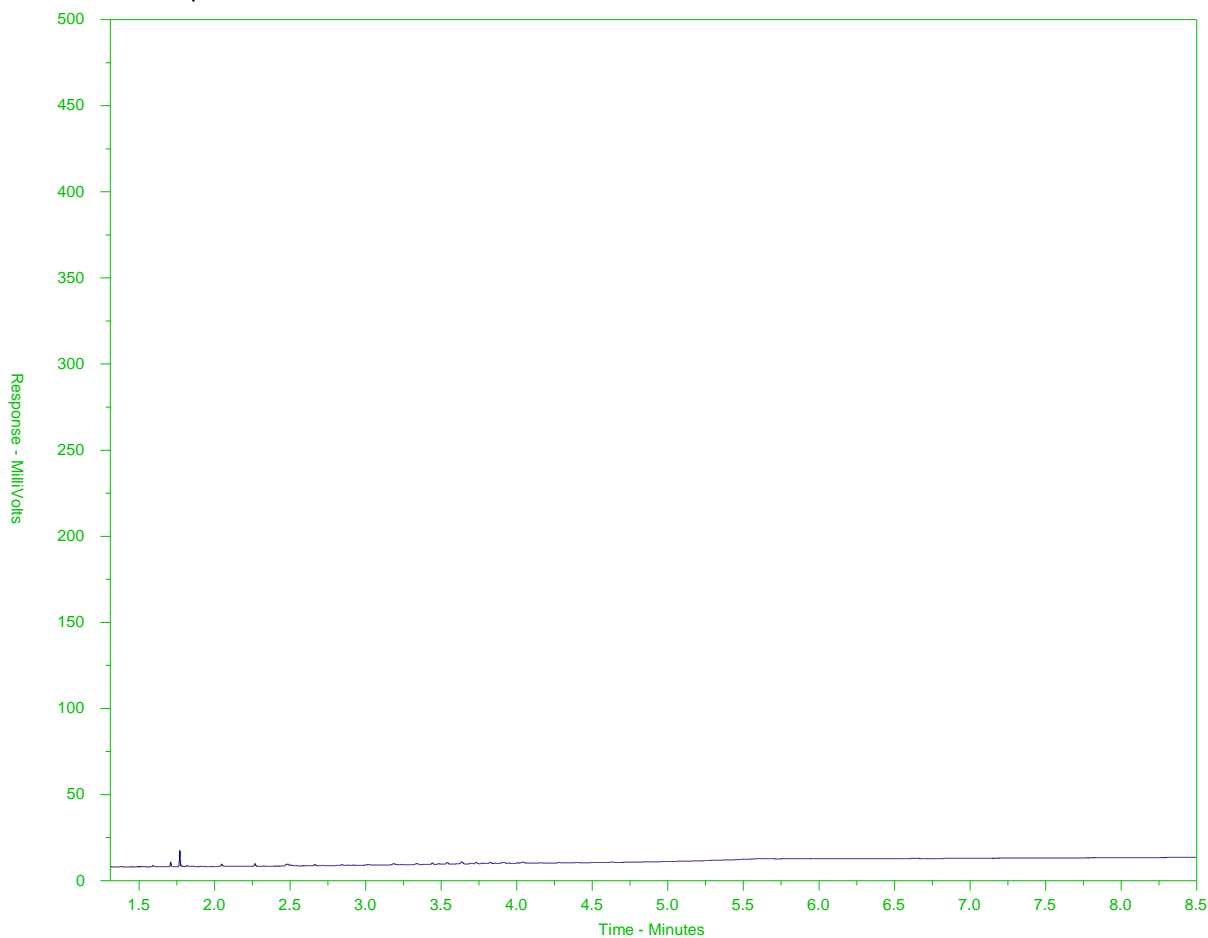
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-9
Client Sample ID: WT7-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

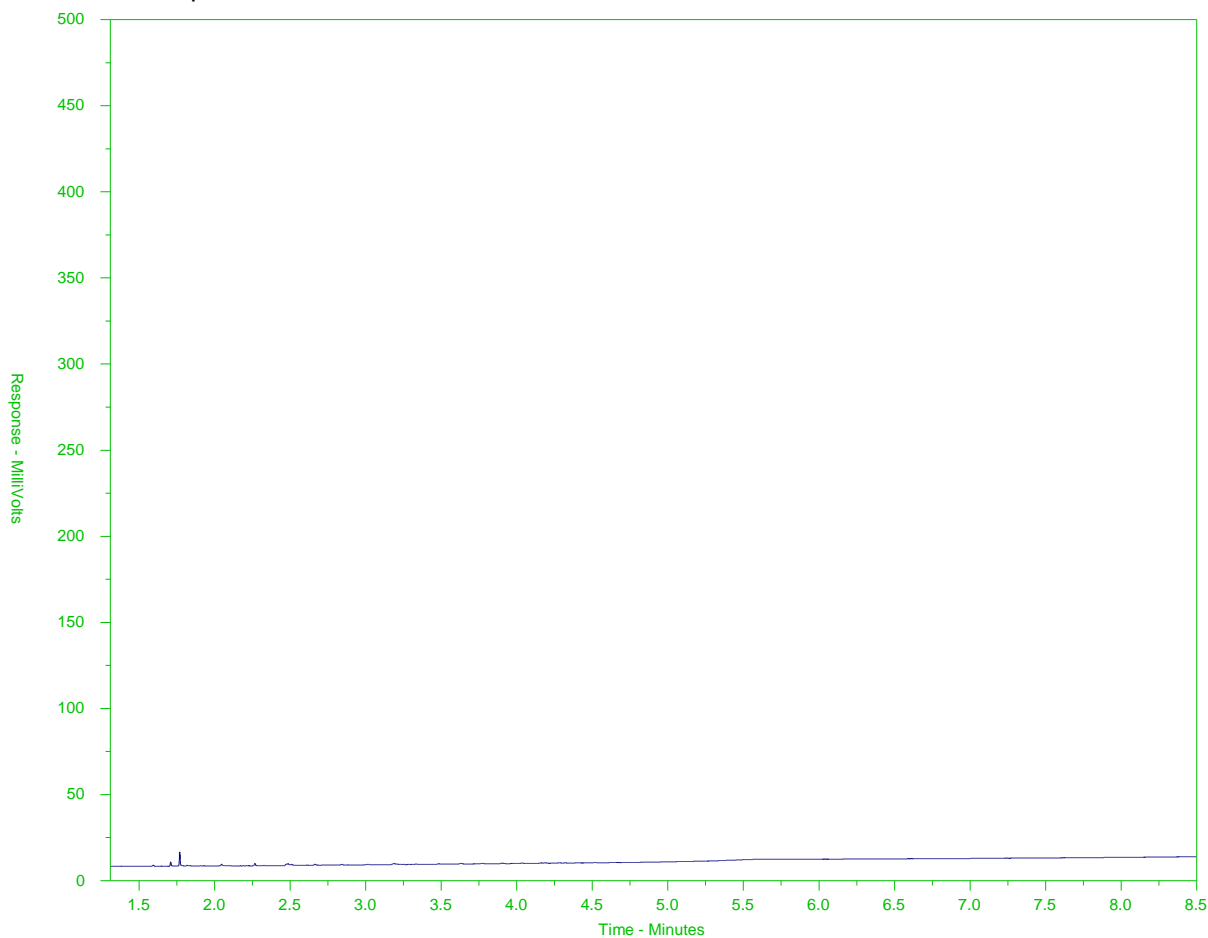
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-10
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

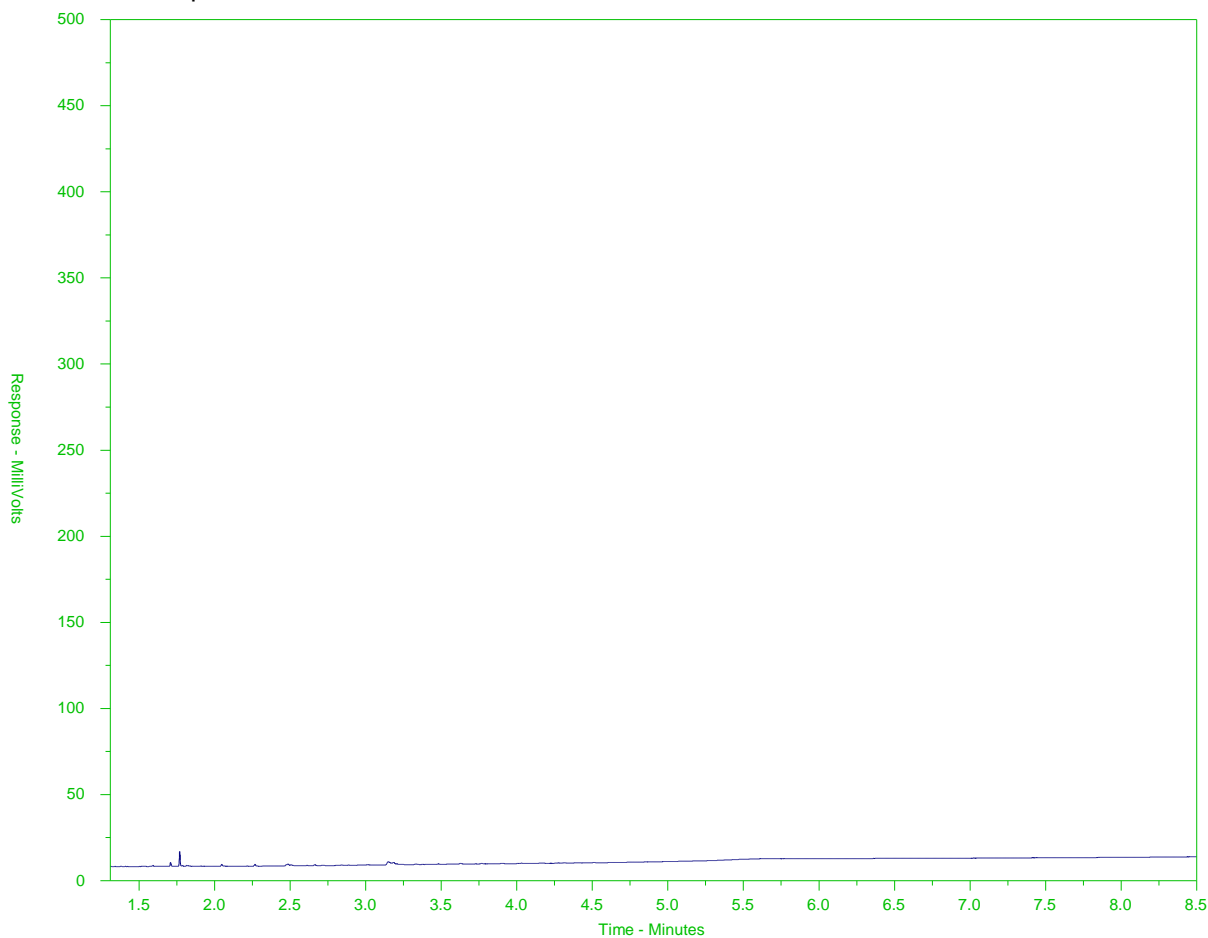
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2281691-C-11
Client Sample ID: FIELD BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2281691-COFC

COC Number: 15 -

Page of

Report To Contact and company name below will appear on the final report		Report Format / L		all E&P TATs with your AM - surcharges will apply	
Company:	STANTEC CONSULTING	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R] <input type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply	
Contact:	Tyler Joyce	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4] <input type="checkbox"/>	
Phone:	718-229-2278	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3] <input type="checkbox"/>	
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2] <input checked="" type="checkbox"/>	
Street:	500 - 4730 Kingsway	Email 1 or Fax:	tyler.joyce@stantec.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm	
City/Province:	Burnaby, BC	Email 2:	Amanda.Bell@stantec.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H 0C6	Email 3:	EDD@stantec.com	Analysis Request	
Invoice To:	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below:	
	Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			
Company:		Email 1 or Fax			
Contact:		Email 2			
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #	Q74015	AFE/Cost Center:	PO#123512431	601.200	
Job #:	123512431	Major/Minor Code:	Routing Code:		
PO / AFE:	TASK CODE: 601.200	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only)		ALS Contact:	Brent Mack	Sampler:	AB JJ
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers
	WT2	29-MAY-19	12:30	Water	00
	WT3		12:00	Water	00
	WT8		11:00	Water	00
	WT10		11:30	Water	00
	WT11		12:45	Water	00
	WTS - Surface		09:30	Sea Water	00
	WTS - Deep		09:45	Sea Water	00
	WT7 - Surface		10:15	Sea Water	00
	WT7 - Deep		10:00	Sea Water	00
	DUP			Water	00
	Field Blank		14:00	Water	00
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input checked="" type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
				15	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by:	Date:	Time:	Received by:	Date:	Time:
Amanda Bell	May 29, 2019	14:20		5/29	21:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2016 FRONT

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 25-JUL-19
Report Date: 02-AUG-19 16:38 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2317366
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431.601.200
C of C Numbers: 17-692649
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	36300	38600	36900	38900	
	Hardness (as CaCO3) (mg/L)	4420	4800	4410	4760	
	pH (pH)	8.03	7.99	8.03	8.00	
	Total Suspended Solids (mg/L)	2.1	4.0	2.6	4.2	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0079	0.0066	<0.0050	0.0089	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Phosphorus (P)-Total (mg/L)	0.0250	0.0520	0.952	0.0576	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0185	0.0457	<0.0050	0.0530	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00121	0.00136	0.00122	0.00136	
	Barium (Ba)-Total (mg/L)	0.0072	0.0094	0.0069	0.0096	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	3.01	3.20	3.19	3.31	
	Cadmium (Cd)-Total (mg/L)	0.000062	0.000068	0.000047	0.000069	
	Calcium (Ca)-Total (mg/L)	315	337	331	349	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	0.000054	<0.000050	0.000054	
	Copper (Cu)-Total (mg/L)	0.00103	<0.00050	0.00057	0.00057	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.022	0.043	<0.010	0.067	
	Lead (Pb)-Total (mg/L)	0.000088	0.000089	<0.000050	0.000094	
	Lithium (Li)-Total (mg/L)	0.115	0.131	0.128	0.132	
	Magnesium (Mg)-Total (mg/L)	882	926	901	985	
	Manganese (Mn)-Total (mg/L)	0.00468	0.00496	0.00145	0.00535	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00754	0.00839	0.00835	0.00857	
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00052	
	Phosphorus (P)-Total (mg/L)	<0.050	0.081	1.05	0.080	
	Potassium (K)-Total (mg/L)	297	294	288	325	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0814	0.0845	0.0810	0.0868	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	1.1	<1.0	1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	
Grouping	Analyte					
SEAWATER						
Total Metals	Sodium (Na)-Total (mg/L)	7010	7620	7130	7250	
	Strontium (Sr)-Total (mg/L)	5.25	5.53	5.52	5.72	
	Sulfur (S)-Total (mg/L)	557	608	545	597	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00189	0.00221	0.00214	0.00221	
	Vanadium (V)-Total (mg/L)	0.00141	0.00147	0.00138	0.00162	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	0.0098	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00120	0.00130	0.00119	0.00129	
	Barium (Ba)-Dissolved (mg/L)	0.0062	0.0081	0.0077	0.0081	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	2.86	3.18	3.03	3.14	
	Cadmium (Cd)-Dissolved (mg/L)	0.000052	0.000051	0.000054	0.000056	
	Calcium (Ca)-Dissolved (mg/L)	321	344	319	334	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00039	0.00036	0.00062	0.00035	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	0.012	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000062	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.113	0.131	0.119	0.118	
	Magnesium (Mg)-Dissolved (mg/L)	878	956	878	953	
	Manganese (Mn)-Dissolved (mg/L)	0.00222	0.00270	0.00370 ^{DTC}	0.00292	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00762	0.00856	0.00809	0.00837	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	1.16	<0.050	
	Potassium (K)-Dissolved (mg/L)	285	305	295	327	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0802	0.0854	0.0801	0.0853	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	6910	7390	7120	7550	
	Strontium (Sr)-Dissolved (mg/L)	5.26	5.72	5.47	5.78	
	Sulfur (S)-Dissolved (mg/L)	552	593	541	615	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00213	0.00219	0.00201	0.00221	
	Vanadium (V)-Dissolved (mg/L)	0.00131	0.00136	0.00132	0.00142	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0018	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-1 Water 25-JUL-19 12:18 WT2	L2317366-2 Water 25-JUL-19 11:55 WT3	L2317366-3 Water 25-JUL-19 13:45 WT8	L2317366-4 Water 25-JUL-19 14:09 WT10	L2317366-5 Water 25-JUL-19 12:30 WT11
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	214	254	249	233	244
	Hardness (as CaCO3) (mg/L)	78.3	103	102	90.0	108
	pH (pH)	8.17	8.23	7.95	8.13	7.92
	Total Suspended Solids (mg/L)	3.2	<3.0	120	9.8	<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0334	<0.0050	0.0128	0.0082	0.0155
	Nitrate (as N) (mg/L)	0.185	0.0163	1.37	1.16	0.175
	Nitrite (as N) (mg/L)	0.0036	0.0020	0.0036	0.0035	0.0038
	Phosphorus (P)-Total (mg/L)	0.0528	0.0670	0.127	0.0233	0.0373
Total Metals	Aluminum (Al)-Total (mg/L)	0.0438	0.0174	1.02	0.194	0.0164
	Antimony (Sb)-Total (mg/L)	0.00020	<0.00010	0.00012	<0.00010	0.00015
	Arsenic (As)-Total (mg/L)	0.00458	0.00501	0.00315	0.00149	0.00291
	Barium (Ba)-Total (mg/L)	0.0120	0.00535	0.199	0.0381	0.0162
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.076	0.016	0.019	0.016	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000148	<0.0000050	0.0000373	0.0000099	0.0000093
	Calcium (Ca)-Total (mg/L)	24.6	28.1	26.7	24.1	25.8
	Cesium (Cs)-Total (mg/L)	<0.000010	0.000013	0.000041	<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)	0.00013	<0.00010	0.00386	0.00166	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00015	<0.00010	0.00062	0.00014	<0.00010
	Copper (Cu)-Total (mg/L)	0.00063	<0.00050	0.00415	0.00091	0.00059
	Iron (Fe)-Total (mg/L)	1.46	0.015	1.62	0.393	0.039
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.00190	0.000326	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0014	0.0022	0.0015	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.32	9.60	8.85	7.99	7.72
	Manganese (Mn)-Total (mg/L)	0.0536	0.0132	0.117	0.0352	0.00763
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.000010 ^{DLM}	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00122	0.000952	0.000753	0.000587	0.000900
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	0.00168	0.00062	<0.00050
	Phosphorus (P)-Total (mg/L)	0.143	0.069	0.099	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.11	3.08	1.82	1.35	2.87
	Rubidium (Rb)-Total (mg/L)	0.00129	0.00081	0.00104	0.00055	0.00130
	Selenium (Se)-Total (mg/L)	0.000075	<0.000050	0.000667	0.000267	0.000211
	Silicon (Si)-Total (mg/L)	7.73	10.7	12.6	11.5	8.47
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	16.5	10.7	10.6	11.8	9.20
	Strontium (Sr)-Total (mg/L)	0.0774	0.0974	0.120	0.123	0.0939

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	L2317366-10 Water 25-JUL-19 11:56 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)					267
	Hardness (as CaCO3) (mg/L)					105
	pH (pH)					8.33
	Total Suspended Solids (mg/L)					<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					0.0468
	Nitrate (as N) (mg/L)					0.0510
	Nitrite (as N) (mg/L)					<0.0010
	Phosphorus (P)-Total (mg/L)					0.0687
Total Metals	Aluminum (Al)-Total (mg/L)					0.0099
	Antimony (Sb)-Total (mg/L)					<0.00010
	Arsenic (As)-Total (mg/L)					0.00499
	Barium (Ba)-Total (mg/L)					0.00525
	Beryllium (Be)-Total (mg/L)					<0.00010
	Bismuth (Bi)-Total (mg/L)					<0.000050
	Boron (B)-Total (mg/L)					0.017
	Cadmium (Cd)-Total (mg/L)					0.0000229
	Calcium (Ca)-Total (mg/L)					26.5
	Cesium (Cs)-Total (mg/L)					<0.000010
	Chromium (Cr)-Total (mg/L)					<0.00010
	Cobalt (Co)-Total (mg/L)					<0.00010
	Copper (Cu)-Total (mg/L)					<0.00050
	Iron (Fe)-Total (mg/L)					0.010
	Lead (Pb)-Total (mg/L)					<0.000050
	Lithium (Li)-Total (mg/L)					0.0012
	Magnesium (Mg)-Total (mg/L)					9.75
	Manganese (Mn)-Total (mg/L)					0.00824
	Mercury (Hg)-Total (mg/L)					<0.0000050
	Molybdenum (Mo)-Total (mg/L)					0.000868
	Nickel (Ni)-Total (mg/L)					<0.00050
	Phosphorus (P)-Total (mg/L)					0.082
	Potassium (K)-Total (mg/L)					2.90
	Rubidium (Rb)-Total (mg/L)					0.00074
	Selenium (Se)-Total (mg/L)					0.000056
	Silicon (Si)-Total (mg/L)					10.5
	Silver (Ag)-Total (mg/L)					<0.000010
	Sodium (Na)-Total (mg/L)					10.8
	Strontium (Sr)-Total (mg/L)					0.0898

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-11 Water 25-JUL-19 13:32 FIELD BLANK				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50				
	pH (pH)	5.98				
	Total Suspended Solids (mg/L)	<3.0				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.00010				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Cesium (Cs)-Total (mg/L)	<0.000010				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.050				
	Rubidium (Rb)-Total (mg/L)	<0.00020				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.10				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

02-AUG-19 16:38 (MT)

Version: FINAL

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-1 Water 25-JUL-19 12:18 WT2	L2317366-2 Water 25-JUL-19 11:55 WT3	L2317366-3 Water 25-JUL-19 13:45 WT8	L2317366-4 Water 25-JUL-19 14:09 WT10	L2317366-5 Water 25-JUL-19 12:30 WT11
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	1.60	4.34	4.89	4.39	5.82
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00131	0.00070	0.0351	0.00717	0.00058
	Tungsten (W)-Total (mg/L)	0.00023	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000043	0.000092	0.000455	0.000119	0.000080
	Vanadium (V)-Total (mg/L)	0.00111	<0.00050	0.00528	0.00199	0.00093
	Zinc (Zn)-Total (mg/L)	0.0229	<0.0030	0.0093	0.0036	0.0344
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	LAB	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0021	0.0030	0.0085	0.0103	0.0032
	Antimony (Sb)-Dissolved (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	0.00015
	Arsenic (As)-Dissolved (mg/L)	0.00162	0.00521	0.00116	0.00129	0.00282
	Barium (Ba)-Dissolved (mg/L)	0.00985	0.00530	0.0588	0.0276	0.0180
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.079	0.015	0.017	0.015	0.025
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	0.000082	<0.000050	0.000083
	Calcium (Ca)-Dissolved (mg/L)	22.5	25.5	26.6	23.6	29.7
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00096	0.00085	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00030	<0.00020	0.00054	0.00029	0.00048
	Iron (Fe)-Dissolved (mg/L)	0.075	<0.010	0.039	0.020	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0012	0.0016	0.0013	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.38	9.62	8.69	7.58	8.25
	Manganese (Mn)-Dissolved (mg/L)	0.0196	0.00129	0.0405	0.00875	0.00777
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00124	0.000897	0.000789	0.000565	0.000943
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.069	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	2.90	2.91	1.72	1.24	3.17
	Rubidium (Rb)-Dissolved (mg/L)	0.00125	0.00073	0.00059	0.00047	0.00149

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	L2317366-10 Water 25-JUL-19 11:56 DUP
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)						4.46
	Tellurium (Te)-Total (mg/L)						<0.00020
	Thallium (Tl)-Total (mg/L)						<0.000010
	Thorium (Th)-Total (mg/L)						<0.00010
	Tin (Sn)-Total (mg/L)						<0.00010
	Titanium (Ti)-Total (mg/L)						0.00031
	Tungsten (W)-Total (mg/L)						<0.00010
	Uranium (U)-Total (mg/L)						0.000084
	Vanadium (V)-Total (mg/L)						0.00055
	Zinc (Zn)-Total (mg/L)						<0.0030
	Zirconium (Zr)-Total (mg/L)						<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location						FIELD
	Dissolved Metals Filtration Location						FIELD
	Aluminum (Al)-Dissolved (mg/L)						0.0036
	Antimony (Sb)-Dissolved (mg/L)						<0.00010
	Arsenic (As)-Dissolved (mg/L)						0.00483
	Barium (Ba)-Dissolved (mg/L)						0.00511
	Beryllium (Be)-Dissolved (mg/L)						<0.00010
	Bismuth (Bi)-Dissolved (mg/L)						<0.000050
	Boron (B)-Dissolved (mg/L)						0.015
	Cadmium (Cd)-Dissolved (mg/L)						<0.0000050
	Calcium (Ca)-Dissolved (mg/L)						26.8
	Cesium (Cs)-Dissolved (mg/L)						<0.000010
	Chromium (Cr)-Dissolved (mg/L)						<0.00010
	Cobalt (Co)-Dissolved (mg/L)						<0.00010
	Copper (Cu)-Dissolved (mg/L)						<0.00020
	Iron (Fe)-Dissolved (mg/L)						0.047 ^{DTC}
	Lead (Pb)-Dissolved (mg/L)						0.000052
	Lithium (Li)-Dissolved (mg/L)						0.0012
	Magnesium (Mg)-Dissolved (mg/L)						9.31
	Manganese (Mn)-Dissolved (mg/L)						0.00228
	Mercury (Hg)-Dissolved (mg/L)						<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)						0.000931
	Nickel (Ni)-Dissolved (mg/L)						<0.00050
	Phosphorus (P)-Dissolved (mg/L)						0.066
	Potassium (K)-Dissolved (mg/L)						3.02
	Rubidium (Rb)-Dissolved (mg/L)						0.00080

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2317366-11 Water 25-JUL-19 13:32 FIELD BLANK				
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)	<0.50					
	Tellurium (Te)-Total (mg/L)	<0.00020					
	Thallium (Tl)-Total (mg/L)	<0.000010					
	Thorium (Th)-Total (mg/L)	<0.00010					
	Tin (Sn)-Total (mg/L)	<0.00010					
	Titanium (Ti)-Total (mg/L)	<0.00030					
	Tungsten (W)-Total (mg/L)	<0.00010					
	Uranium (U)-Total (mg/L)	<0.000010					
	Vanadium (V)-Total (mg/L)	<0.00050					
	Zinc (Zn)-Total (mg/L)	<0.0030					
	Zirconium (Zr)-Total (mg/L)	<0.00020					
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD					
	Dissolved Metals Filtration Location	FIELD					
	Aluminum (Al)-Dissolved (mg/L)	<0.0010					
	Antimony (Sb)-Dissolved (mg/L)	<0.00010					
	Arsenic (As)-Dissolved (mg/L)	<0.00010					
	Barium (Ba)-Dissolved (mg/L)	<0.00010					
	Beryllium (Be)-Dissolved (mg/L)	<0.00010					
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050					
	Boron (B)-Dissolved (mg/L)	<0.010					
	Cadmium (Cd)-Dissolved (mg/L)	0.0000084 ^{RRV}					
	Calcium (Ca)-Dissolved (mg/L)	<0.050					
	Cesium (Cs)-Dissolved (mg/L)	<0.000010					
	Chromium (Cr)-Dissolved (mg/L)	<0.00010					
	Cobalt (Co)-Dissolved (mg/L)	<0.00010					
	Copper (Cu)-Dissolved (mg/L)	<0.00020					
	Iron (Fe)-Dissolved (mg/L)	<0.010					
	Lead (Pb)-Dissolved (mg/L)	<0.000050					
	Lithium (Li)-Dissolved (mg/L)	<0.0010					
	Magnesium (Mg)-Dissolved (mg/L)	<0.0050					
	Manganese (Mn)-Dissolved (mg/L)	<0.00010					
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050					
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050					
	Nickel (Ni)-Dissolved (mg/L)	<0.00050					
	Phosphorus (P)-Dissolved (mg/L)	<0.050					
	Potassium (K)-Dissolved (mg/L)	<0.050					
	Rubidium (Rb)-Dissolved (mg/L)	<0.00020					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-1 Water 25-JUL-19 12:18 WT2	L2317366-2 Water 25-JUL-19 11:55 WT3	L2317366-3 Water 25-JUL-19 13:45 WT8	L2317366-4 Water 25-JUL-19 14:09 WT10	L2317366-5 Water 25-JUL-19 12:30 WT11
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	0.000465	0.000248	0.000191
	Silicon (Si)-Dissolved (mg/L)	7.92	10.4	11.1	11.3	8.16
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.2	11.1	10.4	11.1	9.72
	Strontium (Sr)-Dissolved (mg/L)	0.0800	0.0996	0.124	0.122	0.108
	Sulfur (S)-Dissolved (mg/L)	2.44	4.78	4.40	4.40	5.05
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	0.00014	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000042	0.000092	0.000126	0.000083	0.000090
	Vanadium (V)-Dissolved (mg/L)	0.00053	<0.00050	0.00128	0.00100	0.00077
	Zinc (Zn)-Dissolved (mg/L)	0.0102	0.0055	0.0013	<0.0010	0.0358
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	0.48	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	63.7	90.5	105.0	91.9	94.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-6 Seawater 25-JUL-19 09:40 WT5 - SURFACE	L2317366-7 Seawater 25-JUL-19 09:45 WT5 - DEEP	L2317366-8 Seawater 25-JUL-19 10:15 WT7 - SURFACE	L2317366-9 Seawater 25-JUL-19 10:00 WT7 - DEEP	L2317366-10 Water 25-JUL-19 11:56 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)					<0.000050
	Silicon (Si)-Dissolved (mg/L)					10.5
	Silver (Ag)-Dissolved (mg/L)					<0.000010
	Sodium (Na)-Dissolved (mg/L)					10.6
	Strontium (Sr)-Dissolved (mg/L)					0.0935
	Sulfur (S)-Dissolved (mg/L)					4.41
	Tellurium (Te)-Dissolved (mg/L)					<0.00020
	Thallium (Tl)-Dissolved (mg/L)					<0.000010
	Thorium (Th)-Dissolved (mg/L)					<0.00010
	Tin (Sn)-Dissolved (mg/L)					0.00011
	Titanium (Ti)-Dissolved (mg/L)					<0.00030
	Tungsten (W)-Dissolved (mg/L)					<0.00010
	Uranium (U)-Dissolved (mg/L)					0.000086
	Vanadium (V)-Dissolved (mg/L)					<0.00050
	Zinc (Zn)-Dissolved (mg/L)					0.0028
	Zirconium (Zr)-Dissolved (mg/L)					<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	93.6	89.3	100.9	101.8	118.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2317366-11 Water 25-JUL-19 13:32 FIELD BLANK				
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	<0.050				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	<0.050				
	Strontium (Sr)-Dissolved (mg/L)	<0.00020				
	Sulfur (S)-Dissolved (mg/L)	<0.50				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	<0.00010				
	Uranium (U)-Dissolved (mg/L)	<0.000010				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020				
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10				
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	93.5				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2317366-1, -11, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2317366-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2317366-1, -11, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2317366-2
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2317366-2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2317366-1, -11, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2317366-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2317366-1, -11, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2317366-2
Matrix Spike	Boron (B)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2317366-8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2317366-8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2317366-8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2317366-8
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2317366-8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2317366-8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2317366-8
Matrix Spike	Aluminum (Al)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L2317366-2
Matrix Spike	Calcium (Ca)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2317366-2
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2317366-2
Matrix Spike	Manganese (Mn)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Potassium (K)-Total	MS-B	L2317366-2
Matrix Spike	Silicon (Si)-Total	MS-B	L2317366-2
Matrix Spike	Sodium (Na)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2317366-2
Matrix Spike	Strontium (Sr)-Total	MS-B	L2317366-10, -11, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2317366-2
Matrix Spike	Boron (B)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2317366-6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2317366-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total	MS-B	L2317366-6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Reference Information

DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			

Reference Information

MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-HB-F-HMI-MS-VA	Seawater	Tot Metals in Seawater by CRC ICPMS (BC)	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.			
NA-D-CCMS-VA	Seawater	Diss. Sodium in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.			
Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.			
P-T-PRES-COL-VA	Seawater	Total P in Seawater by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			
It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

17-692649

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

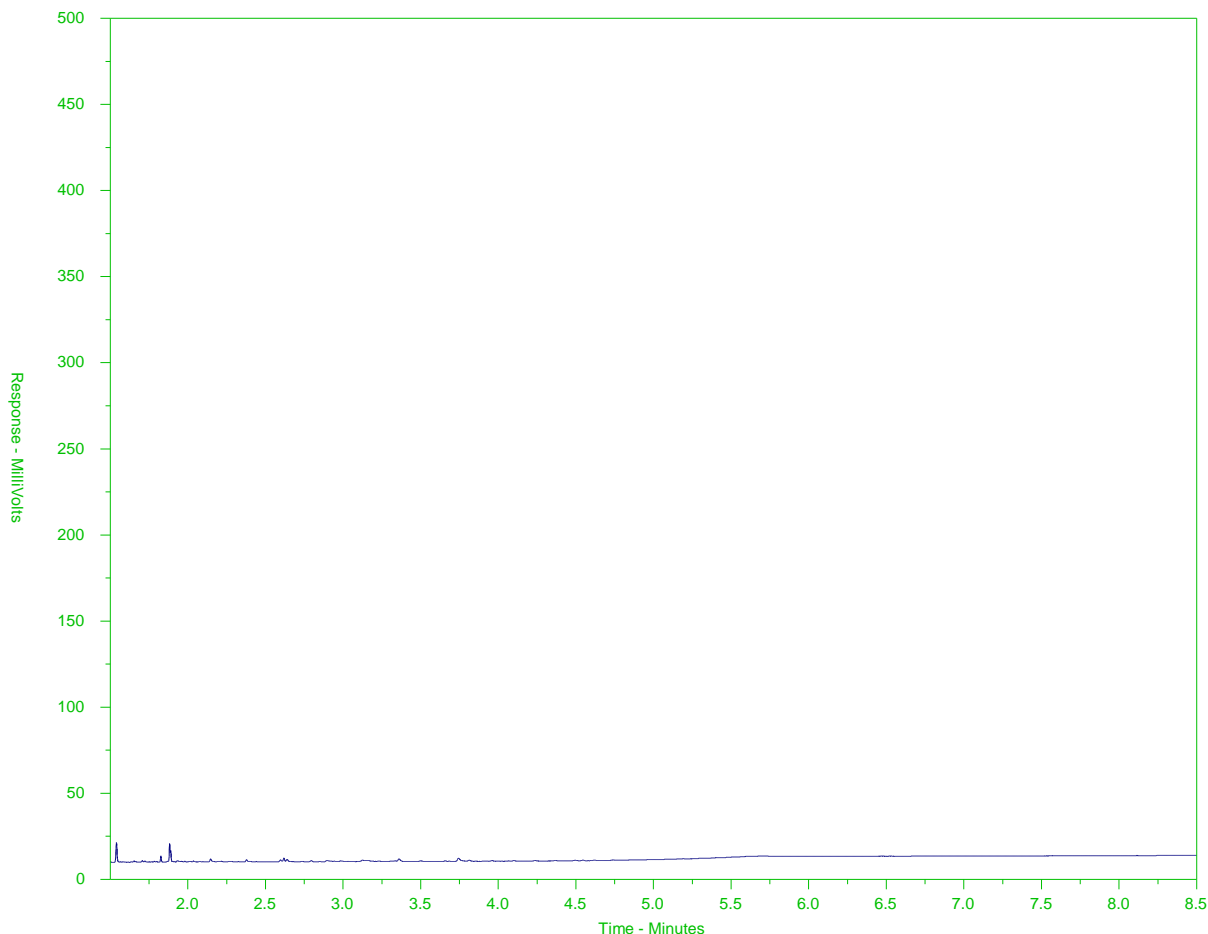
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-1
Client Sample ID: WT2



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

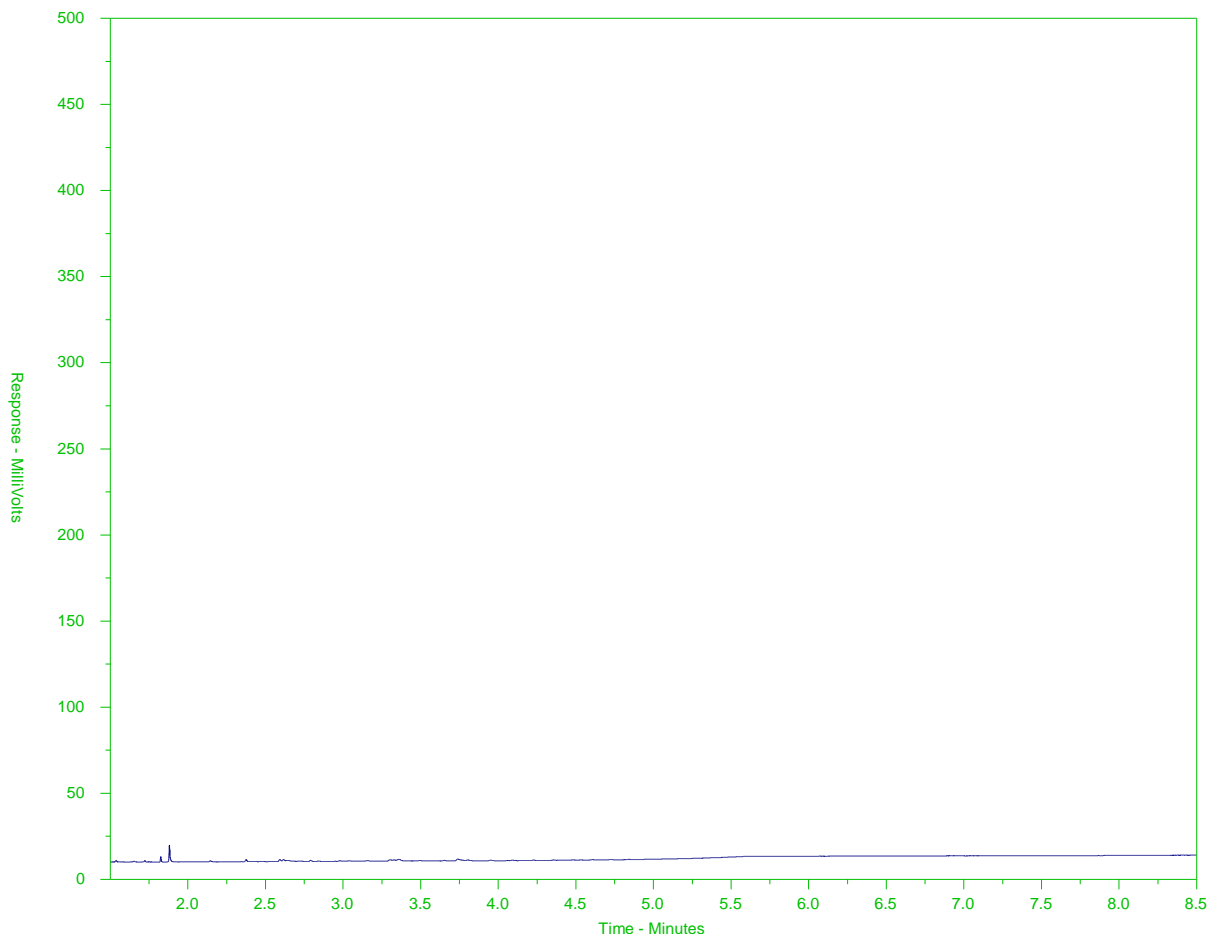
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-2
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

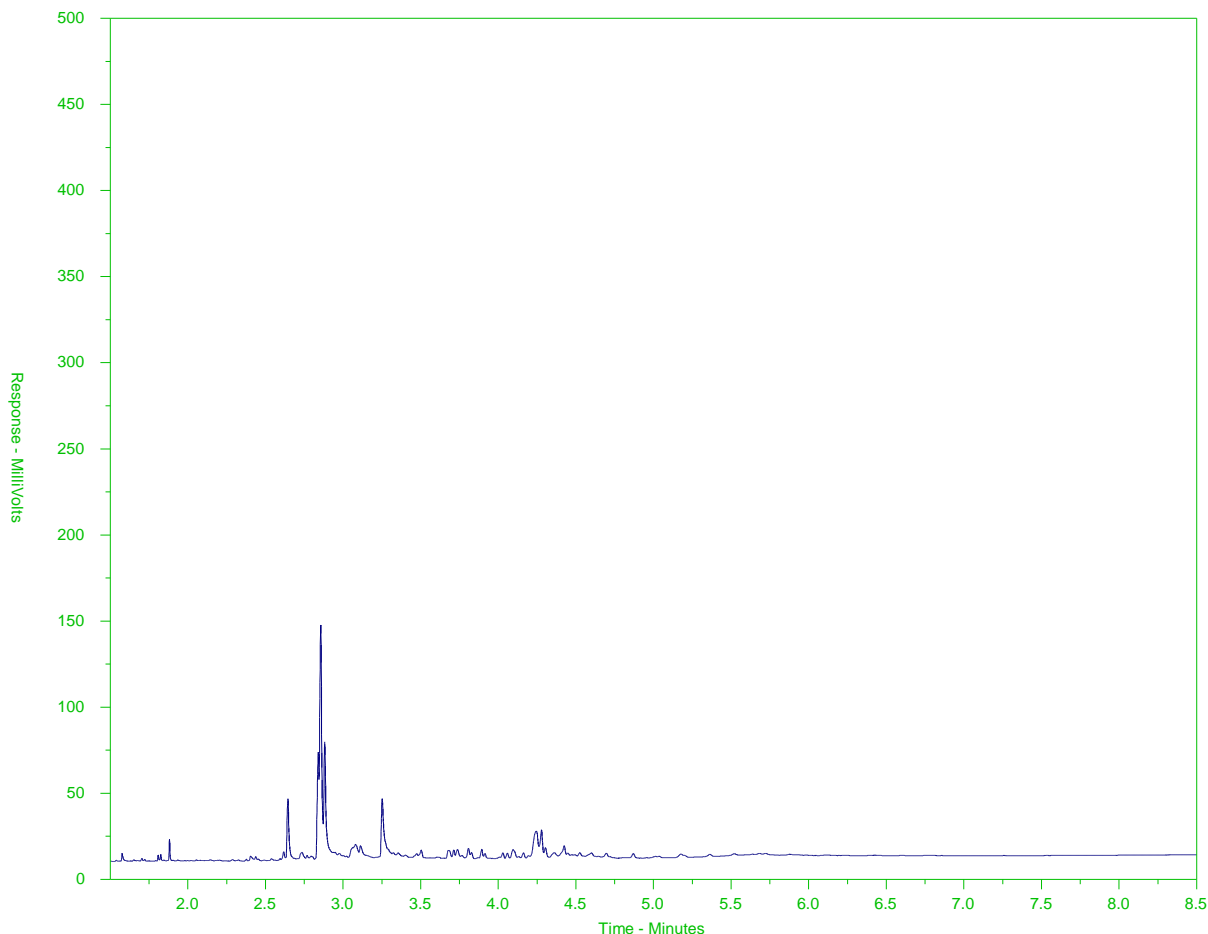
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-3
Client Sample ID: WT8



F2		F3		F4	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

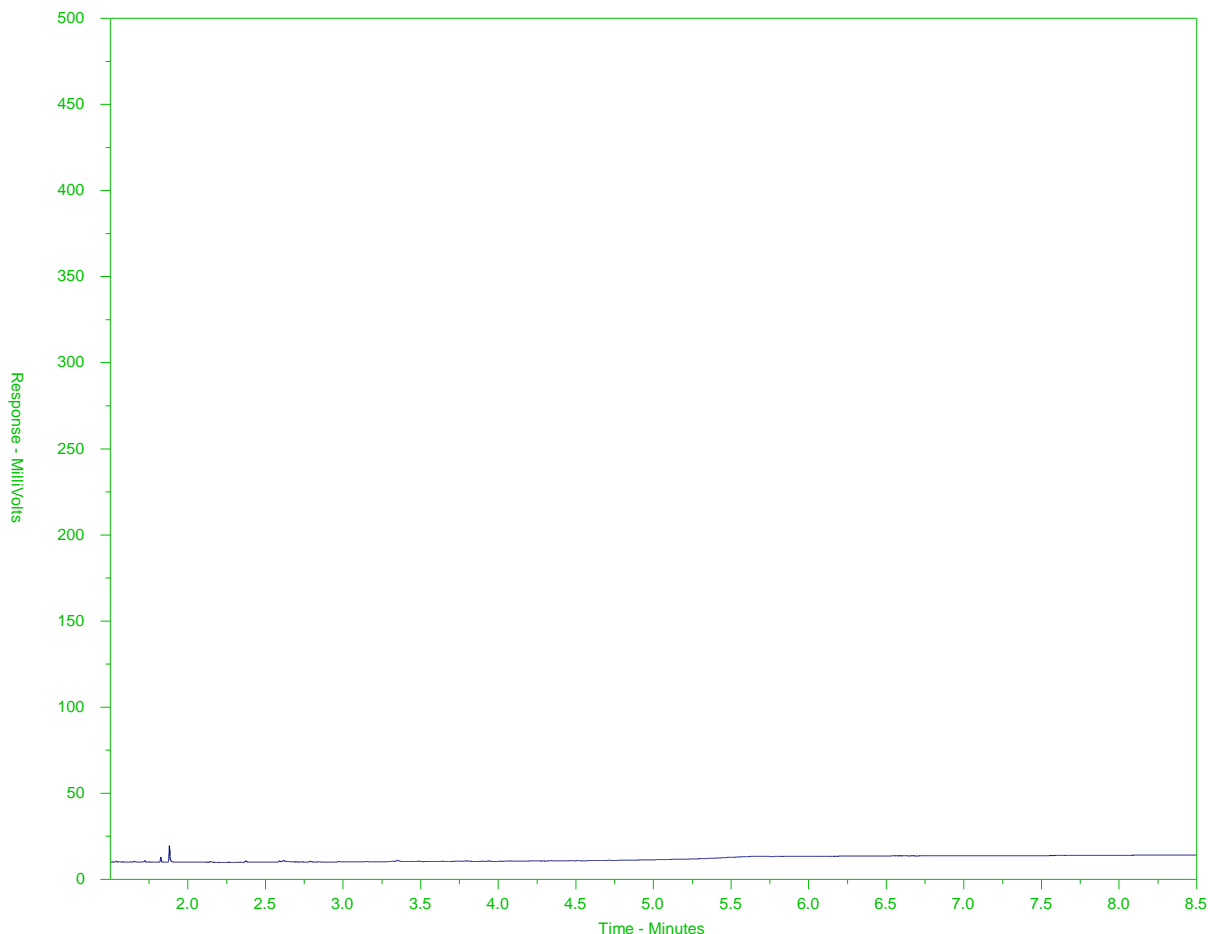
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-4
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

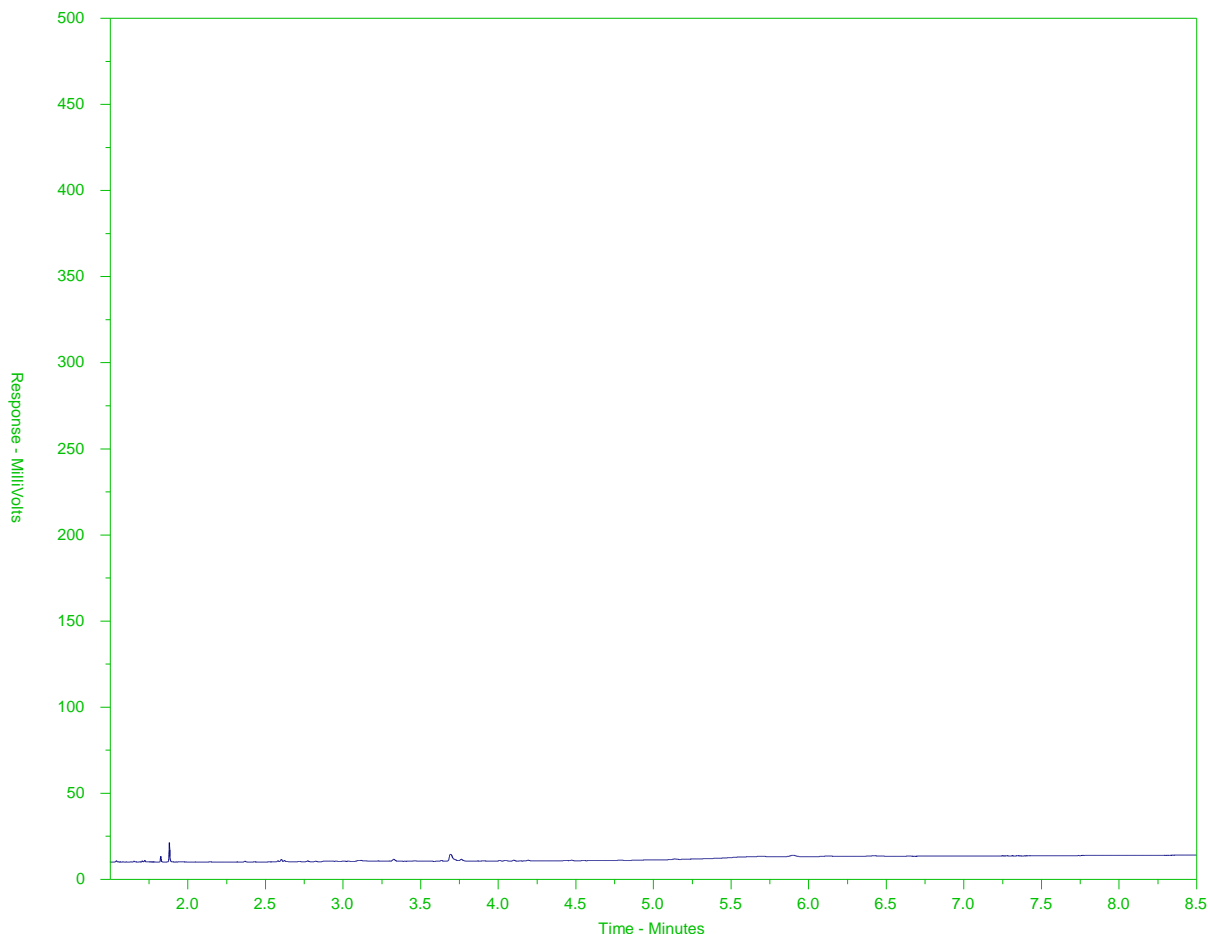
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-5
Client Sample ID: WT11



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

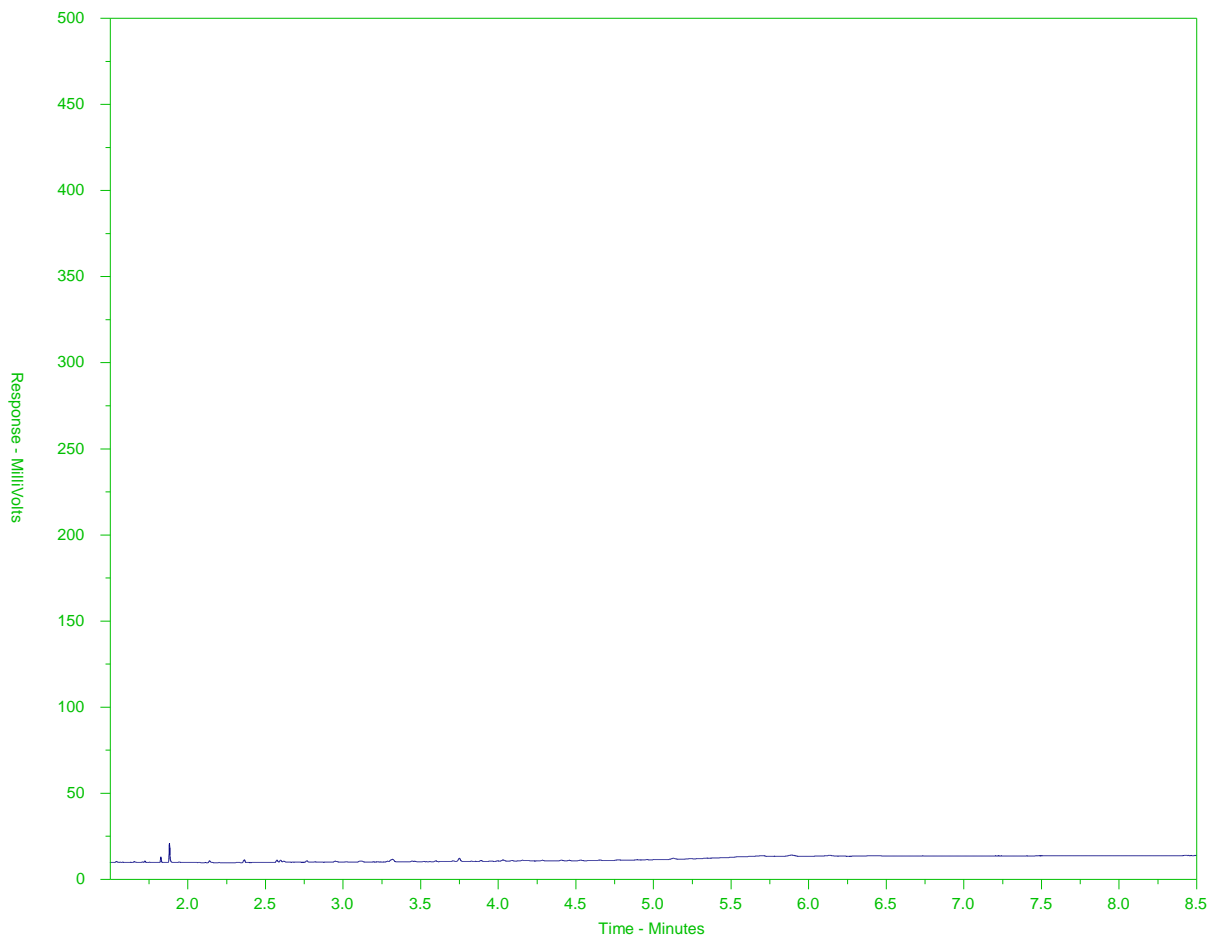
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-6
Client Sample ID: WT5 - SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

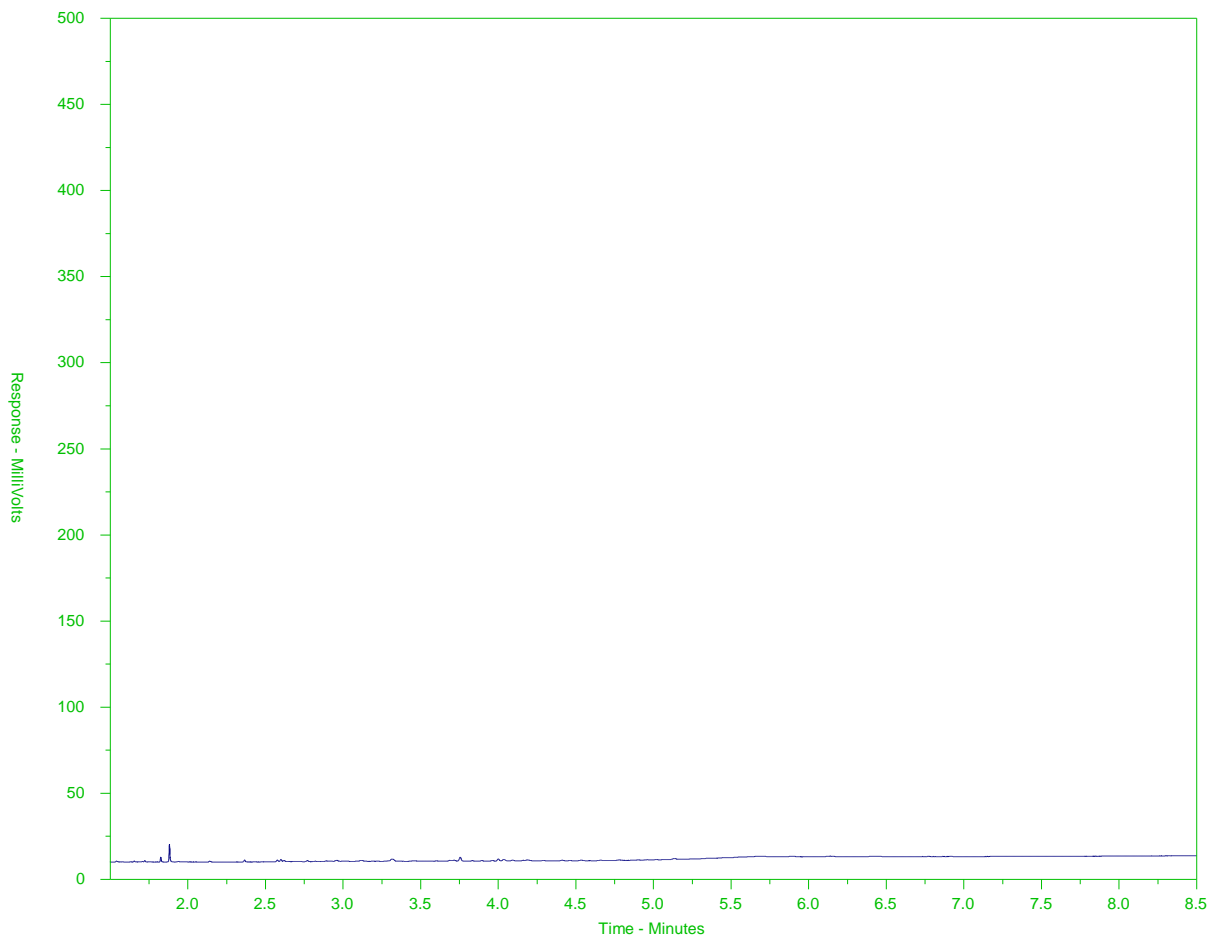
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-7
Client Sample ID: WT5 - DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

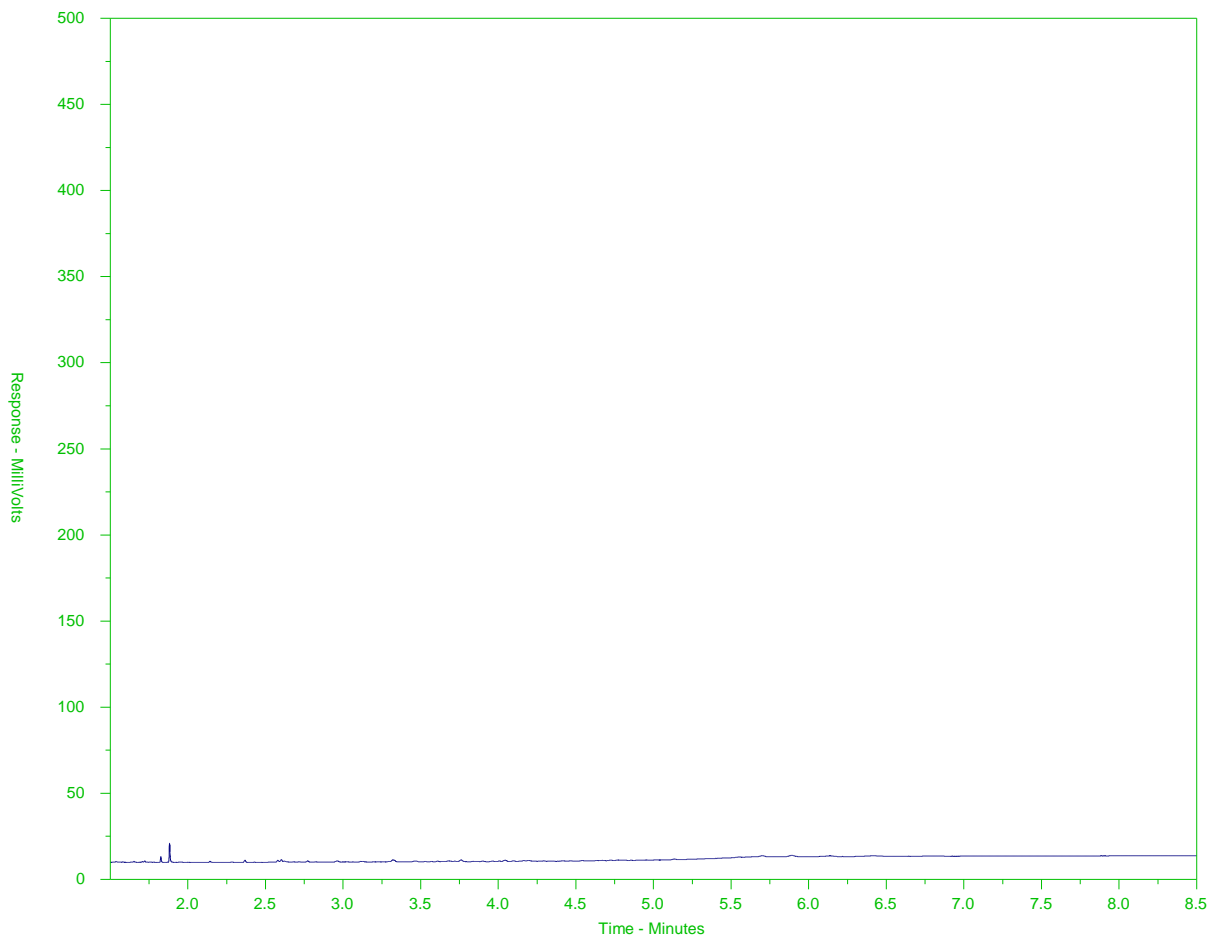
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-8
Client Sample ID: WT7 - SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

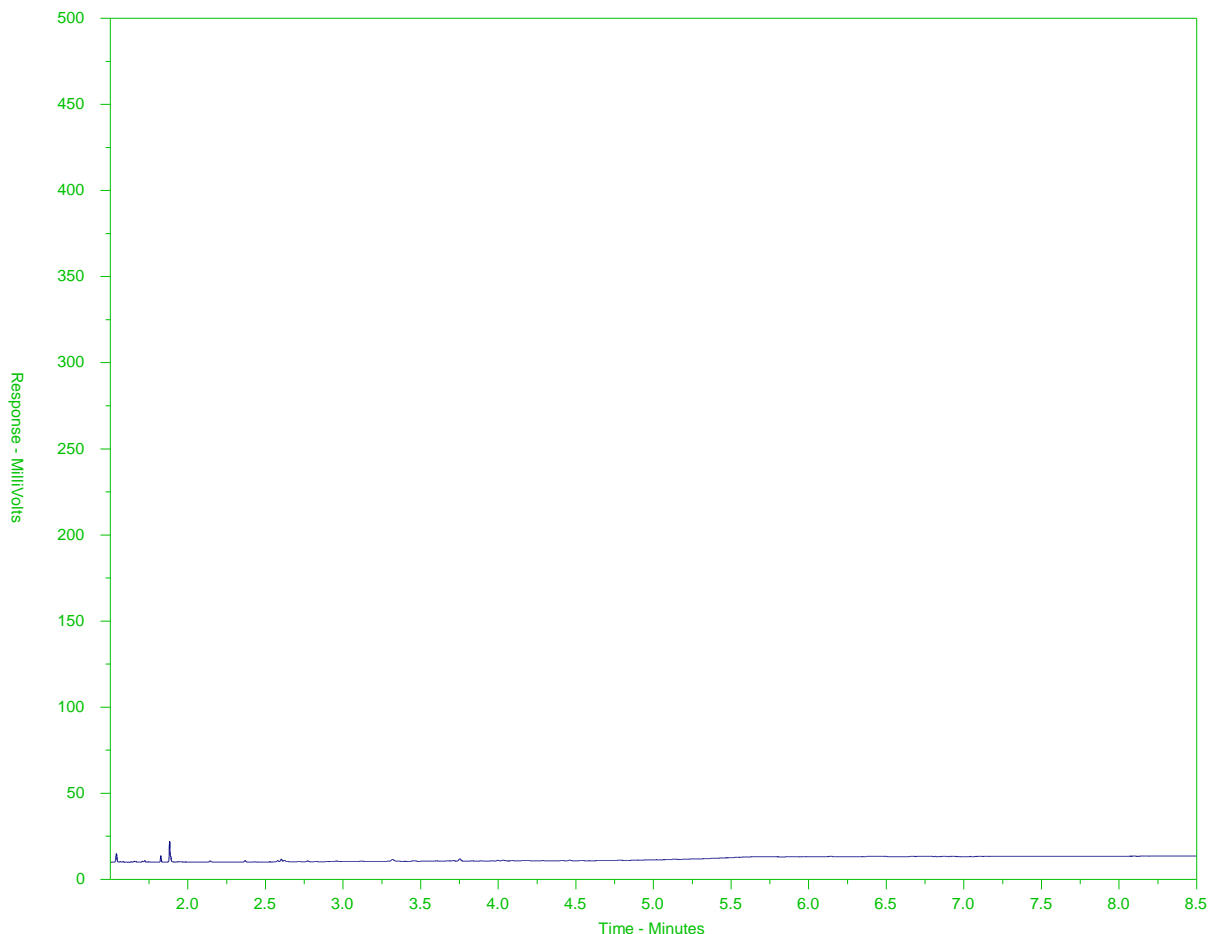
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-9
Client Sample ID: WT7 - DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

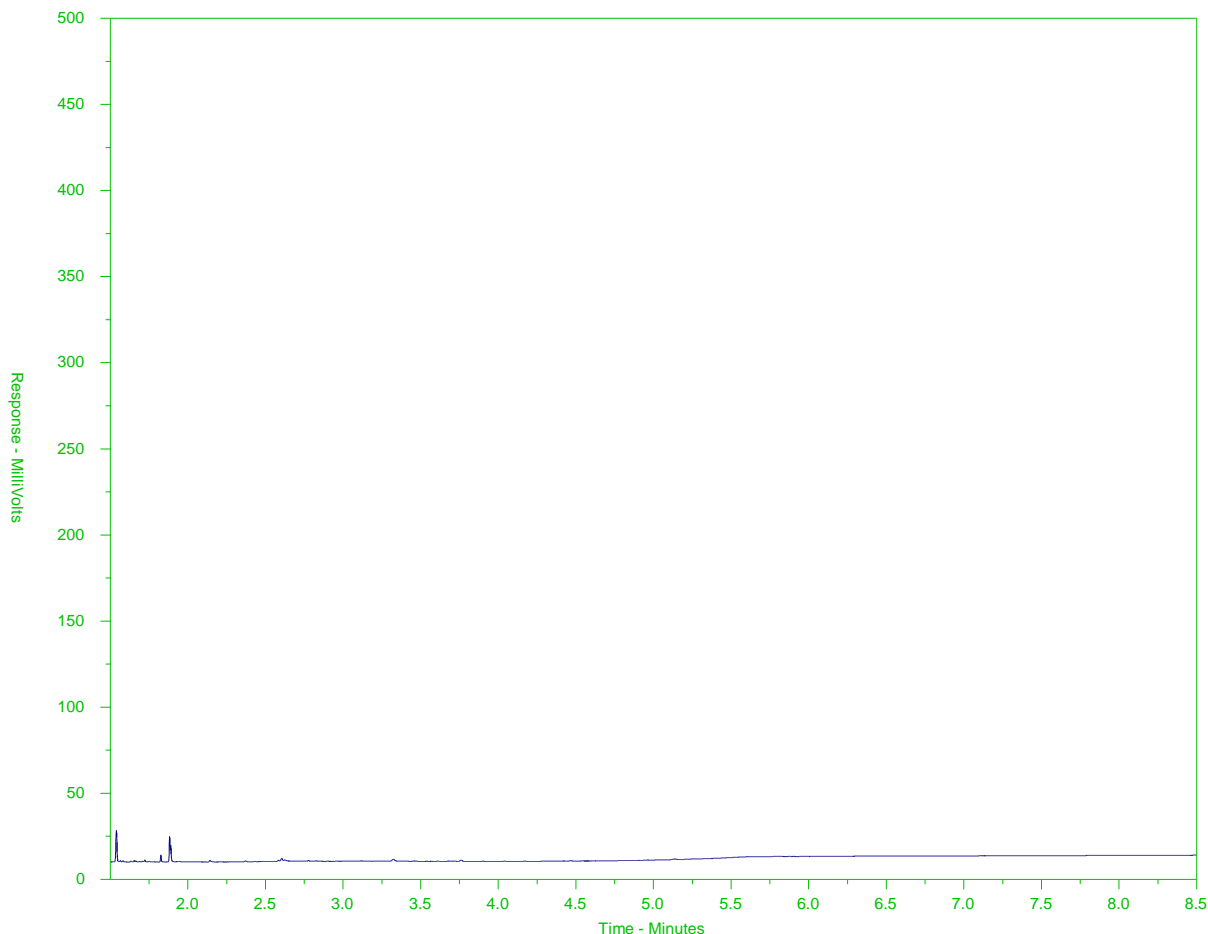
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-10
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

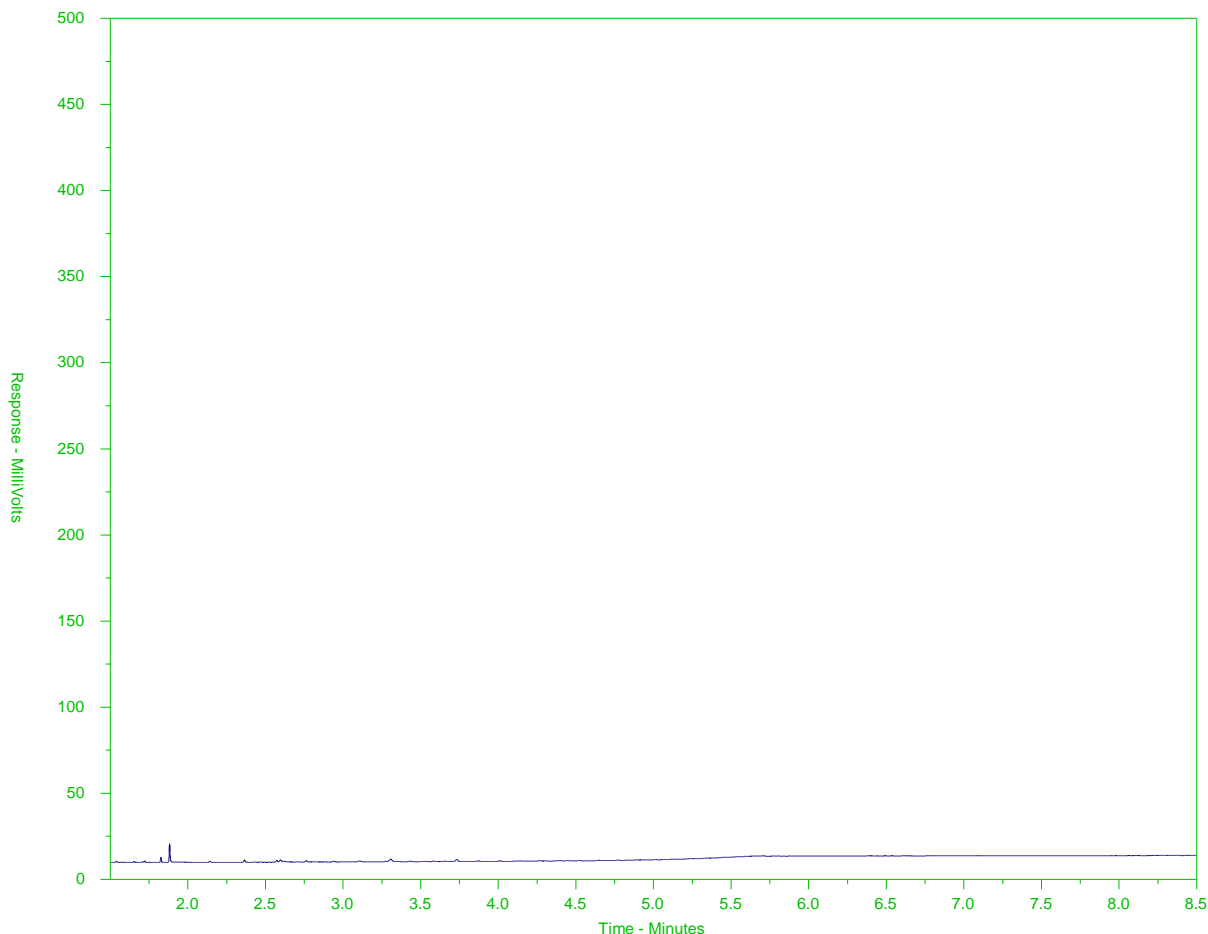
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2317366-C-11
Client Sample ID: FIELD BLANK



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Report To	Contact and company name below will appear on the final report	Report Format / L.						Contact your AM to confirm all E&P TATs (surcharges may apply)											
Company:	STANTEC CONSULTING LTD.	Select Report Format:	<input checked="" type="checkbox"/> PDF	<input checked="" type="checkbox"/> EXCEL	<input checked="" type="checkbox"/> EDD (DIGITAL)														
Contact:	TYLER JOYCE	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES		<input type="checkbox"/> NO														
Phone:	778-229-2278	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked								PRIORITY (Business Days)	Regular [R] <input checked="" type="checkbox"/>		Standard TAT if received by 3 pm - business days - no surcharges apply						
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL	<input type="checkbox"/> MAIL	<input type="checkbox"/> FAX			EMERGENCY		1 Business day [E-100%]									
Street:	500-4730 KINGSWAY	Email 1 or Fax:	Tyler.joyce@stantec.com						Date and Time Required for all E&P TATs:		dd-mm-yyyy hh:mm								
City/Province:	BURNABY, BC	Email 2:	Steve.chou@stantec.com						For tests that can not be performed according to the service level selected, you will be contacted.										
Postal Code:	V5H 0C6	Email 3:	Jill.ruth@stantec.com						Analysis Request										
Invoice To	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution						Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
	Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input type="checkbox"/> EMAIL	<input type="checkbox"/> MAIL	<input type="checkbox"/> FAX														
Company:		Email 1 or Fax:																	
Contact:		Email 2:																	
Project Information		Oil and Gas Required Fields (client use)																	
ALS Account # / Quote #: Q74015		A/E/Cost Center:			PO#:														
Job #: 123512431.601.200		Major/Minor Code:			Routing Code:														
PO / AFE:		Requisitioner:																	
LSD:		Location:																	
ALS Lab Work Order # (lab use only):		ALS Contact: Brent Mack	Sampler: Steve Chou Jill Ruth																
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	pH	Electrical Conductivity	Total Hardness	JSS Nitrate (as N)	Total Metals + Mercury	Dissolved Metals + Mercury	FQ-F4	F1	Nitrogenous Ammonia (as N)	OIL PHOSPHORUS TOTALS	SAMPLES ON HOLD	NUMBER OF CONTAINERS			
	WT2	25-JUL-19	12:18	WATER	X	X	X	X	X	X	X	X	X						
	WT3	25-JUL-19	11:55	WATER	X	X	X	X	X	X	X	X	X						
	WT8 (13:45)	25-JUL-19	#-55	WATER	X	X	X	X	X	X	X	X	X						
	WT10	25-JUL-19	14:09	WATER	X	X	X	X	X	X	X	X	X						
	WT11	25-JUL-19	12:30	WATER	X	X	X	X	X	X	X	X	X						
	WTS-SURFACE	25-JUL-19	9:40	SEA WATER	X	X	X	X	X	X	X	X	X						
	WTS-DEEP	25-JUL-19	9:45	SEA WATER	X	X	X	X	X	X	X	X	X						
	WT7-SURFACE	25-JUL-19	10:15	SEA WATER	X	X	X	X	X	X	X	X	X						
	WT7-DEEP	25-JUL-19	10:00	SEA WATER	X	X	X	X	X	X	X	X	X						
	DUP	25-JUL-19	11:56	water	X	X	X	X	X	X	X	X	X						
	FIELD BLANK	25-JUL-19	#-56	water	X	X	X	X	X	X	X	X	X						
			13:32																
Drinking Water (DW) Samples¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic CDC only)				SAMPLE CONDITION AS RECEIVED (lab use only)													
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		Any questions please contact Jill @ 604 366 5187 or Steve @ 604 396 6791				Frozen <input type="checkbox"/>		SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>											
Are samples for human consumption? use?						Ice Packs <input checked="" type="checkbox"/>		Ice Cubes <input checked="" type="checkbox"/>		Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>									
						Cooling Initiated <input type="checkbox"/>													
		INITIAL COOLER TEMPERATURES °C				FINAL SHIPMENT RECEPTION (lab use only)													
SHIPMENT RELEASE (client use) Released by: STEVE CHOU		Date: July 25, 2019	Time: 3:10am	Received by:		DATE: HA		RECEIVED BY:		TIME: 7/25		DATE:		TIME: 3:12pm					



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 01-AUG-19
Report Date: 12-AUG-19 15:15 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2321653
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431.601.200
C of C Numbers: 17-829397
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP			
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	34800	36000			
	Hardness (as CaCO3) (mg/L)	4660	4950			
	pH (pH)	7.99	7.94			
	Total Suspended Solids (mg/L)	<2.0	5.6			
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050	0.0125			
	Nitrate (as N) (mg/L)	<0.50	<0.50			
	Nitrite (as N) (mg/L)	<0.10	<0.10			
	Phosphorus (P)-Total (mg/L)	0.0332	0.0470			
Total Metals	Aluminum (Al)-Total (mg/L)	0.0089	0.0634			
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010			
	Arsenic (As)-Total (mg/L)	0.00124	0.00128			
	Barium (Ba)-Total (mg/L)	0.0079	0.0087			
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	2.51	2.54			
	Cadmium (Cd)-Total (mg/L)	0.000058	0.000069			
	Calcium (Ca)-Total (mg/L)	297	300			
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050			
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050			
	Cobalt (Co)-Total (mg/L)	<0.000050	0.000081			
	Copper (Cu)-Total (mg/L)	0.00079	0.00086			
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Total (mg/L)	0.013	0.094			
	Lead (Pb)-Total (mg/L)	0.000066	0.000143			
	Lithium (Li)-Total (mg/L)	0.119	0.113			
	Magnesium (Mg)-Total (mg/L)	790	818			
	Manganese (Mn)-Total (mg/L)	0.00346	0.00534			
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Total (mg/L)	0.00783	0.00802			
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050			
	Potassium (K)-Total (mg/L)	261	267			
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050			
	Rubidium (Rb)-Total (mg/L)	0.0759	0.0767			
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050			
	Silicon (Si)-Total (mg/L)	<1.0	<1.0			
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP			
Grouping	Analyte						
SEAWATER							
Total Metals	Sodium (Na)-Total (mg/L)	7680	7670				
	Strontium (Sr)-Total (mg/L)	5.20	5.50				
	Sulfur (S)-Total (mg/L)	701	756				
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050				
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050				
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050				
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010				
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050				
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010				
	Uranium (U)-Total (mg/L)	0.00226	0.00221				
	Vanadium (V)-Total (mg/L)	0.00165	0.00191				
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030				
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD				
	Dissolved Metals Filtration Location	FIELD	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050				
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010				
	Arsenic (As)-Dissolved (mg/L)	0.00138	0.00154				
	Barium (Ba)-Dissolved (mg/L)	0.0086	0.0096				
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050				
	Boron (B)-Dissolved (mg/L)	2.63	2.73				
	Cadmium (Cd)-Dissolved (mg/L)	0.000062	0.000067				
	Calcium (Ca)-Dissolved (mg/L)	312	333				
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050				
	Copper (Cu)-Dissolved (mg/L)	0.00077	0.00063				
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010				
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.120	0.114				
	Magnesium (Mg)-Dissolved (mg/L)	942	1000				
	Manganese (Mn)-Dissolved (mg/L)	0.00256	0.00437				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00799	0.00816				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP			
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050			
	Potassium (K)-Dissolved (mg/L)	286	312			
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050			
	Rubidium (Rb)-Dissolved (mg/L)	0.0833	0.0908			
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050			
	Silicon (Si)-Dissolved (mg/L)	<1.0	<50 ^{DLA}			
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010			
	Sodium (Na)-Dissolved (mg/L)	7050	7410			
	Strontium (Sr)-Dissolved (mg/L)	5.36	5.55			
	Sulfur (S)-Dissolved (mg/L)	767	819			
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050			
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050			
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050			
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010			
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050			
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010			
	Uranium (U)-Dissolved (mg/L)	0.00232	0.00234			
	Vanadium (V)-Dissolved (mg/L)	0.00149	0.00167			
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050			
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0010			
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-1 Water 01-AUG-19 11:37 WT2	L2321653-2 Water 01-AUG-19 10:45 WT3	L2321653-3 Water 01-AUG-19 12:30 WT8	L2321653-4 Water 01-AUG-19 12:55 WT10	L2321653-5 Water 01-AUG-19 11:15 WT11
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	223	265	260	231	244
	Hardness (as CaCO3) (mg/L)	82.2	106	103	92.5	107
	pH (pH)	8.27	8.26	8.10	8.06	7.73
	Total Suspended Solids (mg/L)	3.9	<3.0	17.5	17.7	<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0193	<0.0050	0.0051	0.0060	0.0059
	Nitrate (as N) (mg/L)	0.0898	0.0423	1.28	1.10	0.198
	Nitrite (as N) (mg/L)	0.0014	<0.0010	<0.0010	0.0020	0.0012
	Phosphorus (P)-Total (mg/L)	1.13 ^{RRV}	0.0648	0.0271	0.0569	0.0391
Total Metals	Aluminum (Al)-Total (mg/L)	0.111	0.0099	0.224	0.176	0.0261
	Antimony (Sb)-Total (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	0.00016
	Arsenic (As)-Total (mg/L)	0.00419	0.00509	0.00187	0.00165	0.00303
	Barium (Ba)-Total (mg/L)	0.0121	0.00520	0.0960	0.0369	0.0173
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.084	0.018	0.019	0.016	0.025
	Cadmium (Cd)-Total (mg/L)	0.0000217	<0.0000050	0.0000279	0.0000132	0.0000075
	Calcium (Ca)-Total (mg/L)	24.0	26.2	27.2	25.6	29.3
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	0.000012	<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)	0.00019	<0.00010	0.00148	0.00157	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00017	<0.00010	0.00020	0.00015	<0.00010
	Copper (Cu)-Total (mg/L)	0.00094	<0.00050	0.00175	0.00077	0.00057
	Iron (Fe)-Total (mg/L)	1.32	<0.010	0.428	0.478	0.049
	Lead (Pb)-Total (mg/L)	0.000231	<0.000050	0.000657	0.000286	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0013	0.0018	0.0015	<0.0010
	Magnesium (Mg)-Total (mg/L)	5.24	8.87	8.31	7.45	7.52
	Manganese (Mn)-Total (mg/L)	0.0570	0.00925	0.0560	0.0463	0.00880
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00122	0.000952	0.000746	0.000569	0.00101
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	0.00066	0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	0.130	0.084	0.065	<0.050	0.057
	Potassium (K)-Total (mg/L)	3.17	3.03	1.76	1.40	3.46
	Rubidium (Rb)-Total (mg/L)	0.00129	0.00086	0.00071	0.00059	0.00141
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	0.000419	0.000217	0.000208
	Silicon (Si)-Total (mg/L)	8.31	10.3	11.5	11.5	8.13
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	15.8	10.8	10.8	12.2	10.5
	Strontium (Sr)-Total (mg/L)	0.0851	0.0995	0.127	0.137	0.113

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP	L2321653-8 Water 01-AUG-19 11:15 DUP		
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)			246		
	Hardness (as CaCO3) (mg/L)			107		
	pH (pH)			7.74		
	Total Suspended Solids (mg/L)			<3.0		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)			0.0166		
	Nitrate (as N) (mg/L)			0.207		
	Nitrite (as N) (mg/L)			<0.0010		
	Phosphorus (P)-Total (mg/L)			0.0732		
Total Metals	Aluminum (Al)-Total (mg/L)			0.0208		
	Antimony (Sb)-Total (mg/L)			0.00016		
	Arsenic (As)-Total (mg/L)			0.00309		
	Barium (Ba)-Total (mg/L)			0.0180		
	Beryllium (Be)-Total (mg/L)			<0.00010		
	Bismuth (Bi)-Total (mg/L)			<0.000050		
	Boron (B)-Total (mg/L)			0.026		
	Cadmium (Cd)-Total (mg/L)			0.0000073		
	Calcium (Ca)-Total (mg/L)			31.5		
	Cesium (Cs)-Total (mg/L)			<0.000010		
	Chromium (Cr)-Total (mg/L)			<0.00010		
	Cobalt (Co)-Total (mg/L)			<0.00010		
	Copper (Cu)-Total (mg/L)			0.00056		
	Iron (Fe)-Total (mg/L)			0.048		
	Lead (Pb)-Total (mg/L)			<0.000050		
	Lithium (Li)-Total (mg/L)			<0.0010		
	Magnesium (Mg)-Total (mg/L)			7.66		
	Manganese (Mn)-Total (mg/L)			0.00884		
	Mercury (Hg)-Total (mg/L)			<0.0000050		
	Molybdenum (Mo)-Total (mg/L)			0.00101		
	Nickel (Ni)-Total (mg/L)			<0.00050		
	Phosphorus (P)-Total (mg/L)			0.071		
	Potassium (K)-Total (mg/L)			3.43		
	Rubidium (Rb)-Total (mg/L)			0.00144		
	Selenium (Se)-Total (mg/L)			0.000173		
	Silicon (Si)-Total (mg/L)			8.42		
	Silver (Ag)-Total (mg/L)			<0.000010		
	Sodium (Na)-Total (mg/L)			10.3		
	Strontium (Sr)-Total (mg/L)			0.116		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-1 Water 01-AUG-19 11:37 WT2	L2321653-2 Water 01-AUG-19 10:45 WT3	L2321653-3 Water 01-AUG-19 12:30 WT8	L2321653-4 Water 01-AUG-19 12:55 WT10	L2321653-5 Water 01-AUG-19 11:15 WT11
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	1.25	4.12	4.06	3.89	4.72
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	0.00018	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00378	0.00038	0.00720	0.00682	0.00101
	Tungsten (W)-Total (mg/L)	0.00028	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000041	0.000090	0.000243	0.000114	0.000098
	Vanadium (V)-Total (mg/L)	0.00131	<0.00050	0.00250	0.00182	0.00091
	Zinc (Zn)-Total (mg/L)	0.0285	<0.0030	0.0040	0.0046	0.0335
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0020	0.0029	0.0078	0.0095	0.0031
	Antimony (Sb)-Dissolved (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	0.00014
	Arsenic (As)-Dissolved (mg/L)	0.00165	0.00492	0.00119	0.00122	0.00286
	Barium (Ba)-Dissolved (mg/L)	0.00965	0.00510	0.0556	0.0294	0.0169
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.083	0.017	0.018	0.015	0.026
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	0.0000085	<0.0000050	0.0000077
	Calcium (Ca)-Dissolved (mg/L)	23.9	26.9	27.4	24.7	30.0
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00094	0.00088	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00026	<0.00020	0.00056	0.00031	0.00050
	Iron (Fe)-Dissolved (mg/L)	0.051	<0.010	0.019	0.028	0.016
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0013	0.0017	0.0013	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.48	9.55	8.44	7.50	7.69
	Manganese (Mn)-Dissolved (mg/L)	0.0139	0.00199	0.0116	0.0102	0.00774
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00116	0.000908	0.000724	0.000530	0.000999
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.057	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.12	3.00	1.80	1.36	3.29
	Rubidium (Rb)-Dissolved (mg/L)	0.00121	0.00074	0.00056	0.00045	0.00137

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP	L2321653-8 Water 01-AUG-19 11:15 DUP		
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)				4.86		
	Tellurium (Te)-Total (mg/L)				<0.00020		
	Thallium (Tl)-Total (mg/L)				<0.000010		
	Thorium (Th)-Total (mg/L)				<0.00010		
	Tin (Sn)-Total (mg/L)				<0.00010		
	Titanium (Ti)-Total (mg/L)				0.00089		
	Tungsten (W)-Total (mg/L)				<0.00010		
	Uranium (U)-Total (mg/L)				0.000096		
	Vanadium (V)-Total (mg/L)				0.00086		
	Zinc (Zn)-Total (mg/L)				0.0340		
	Zirconium (Zr)-Total (mg/L)				<0.00020		
Dissolved Metals	Dissolved Mercury Filtration Location				FIELD		
	Dissolved Metals Filtration Location				FIELD		
	Aluminum (Al)-Dissolved (mg/L)				0.0045		
	Antimony (Sb)-Dissolved (mg/L)				0.00014		
	Arsenic (As)-Dissolved (mg/L)				0.00287		
	Barium (Ba)-Dissolved (mg/L)				0.0169		
	Beryllium (Be)-Dissolved (mg/L)				<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)				<0.000050		
	Boron (B)-Dissolved (mg/L)				0.025		
	Cadmium (Cd)-Dissolved (mg/L)				0.0000115		
	Calcium (Ca)-Dissolved (mg/L)				29.6		
	Cesium (Cs)-Dissolved (mg/L)				<0.000010		
	Chromium (Cr)-Dissolved (mg/L)				<0.00010		
	Cobalt (Co)-Dissolved (mg/L)				<0.00010		
	Copper (Cu)-Dissolved (mg/L)				0.00366 ^{DTC}		
	Iron (Fe)-Dissolved (mg/L)				0.023		
	Lead (Pb)-Dissolved (mg/L)				0.000125		
	Lithium (Li)-Dissolved (mg/L)				<0.0010		
	Magnesium (Mg)-Dissolved (mg/L)				7.95		
	Manganese (Mn)-Dissolved (mg/L)				0.00791		
	Mercury (Hg)-Dissolved (mg/L)				<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)				0.000965		
	Nickel (Ni)-Dissolved (mg/L)				<0.00050		
	Phosphorus (P)-Dissolved (mg/L)				<0.050		
	Potassium (K)-Dissolved (mg/L)				3.30		
	Rubidium (Rb)-Dissolved (mg/L)				0.00136		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-1 Water 01-AUG-19 11:37 WT2	L2321653-2 Water 01-AUG-19 10:45 WT3	L2321653-3 Water 01-AUG-19 12:30 WT8	L2321653-4 Water 01-AUG-19 12:55 WT10	L2321653-5 Water 01-AUG-19 11:15 WT11
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050	0.000062	0.000417	0.000241	0.000197
	Silicon (Si)-Dissolved (mg/L)	8.54	10.7	11.5	11.3	8.32
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.7	10.8	10.8	11.9	10.2
	Strontium (Sr)-Dissolved (mg/L)	0.0799	0.0973	0.124	0.132	0.110
	Sulfur (S)-Dissolved (mg/L)	1.49	4.23	4.26	3.96	4.90
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	0.00020	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000039	0.000089	0.000122	0.000087	0.000095
	Vanadium (V)-Dissolved (mg/L)	0.00051	<0.00050	0.00129	0.00102	0.00075
	Zinc (Zn)-Dissolved (mg/L)	0.0101	0.0018	0.0015	<0.0010	0.0340
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.33 ^{DLIS}	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.33 ^{DLIS}	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.33 ^{DLIS}	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	104.0	86.2	95.3	87.9	91.6

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2321653-6 Seawater 01-AUG-19 09:35 WT5-SURFACE	L2321653-7 Seawater 01-AUG-19 09:25 WT5-DEEP	L2321653-8 Water 01-AUG-19 11:15 DUP		
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)			0.000161		
	Silicon (Si)-Dissolved (mg/L)			8.36		
	Silver (Ag)-Dissolved (mg/L)			<0.000010		
	Sodium (Na)-Dissolved (mg/L)			10.3		
	Strontium (Sr)-Dissolved (mg/L)			0.109		
	Sulfur (S)-Dissolved (mg/L)			4.80		
	Tellurium (Te)-Dissolved (mg/L)			<0.00020		
	Thallium (Tl)-Dissolved (mg/L)			<0.000010		
	Thorium (Th)-Dissolved (mg/L)			<0.00010		
	Tin (Sn)-Dissolved (mg/L)			0.00077 ^{DTC}		
	Titanium (Ti)-Dissolved (mg/L)			<0.00030		
	Tungsten (W)-Dissolved (mg/L)			<0.00010		
	Uranium (U)-Dissolved (mg/L)			0.000095		
	Vanadium (V)-Dissolved (mg/L)			0.00077		
	Zinc (Zn)-Dissolved (mg/L)			0.0355		
	Zirconium (Zr)-Dissolved (mg/L)			<0.00020		
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10		
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30		
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30		
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30		
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	91.5	88.2	93.3		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Conductivity	B	L2321653-6, -7
Method Blank	Zinc (Zn)-Total	B	L2321653-6, -7
Laboratory Control Sample	Bismuth (Bi)-Dissolved	MES	L2321653-6, -7
Laboratory Control Sample	Tellurium (Te)-Dissolved	MES	L2321653-6, -7
Laboratory Control Sample	Bismuth (Bi)-Total	MES	L2321653-6, -7
Laboratory Control Sample	Lead (Pb)-Total	MES	L2321653-6, -7
Laboratory Control Sample	Thallium (Tl)-Total	MES	L2321653-6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2321653-8
Matrix Spike	Boron (B)-Dissolved	MS-B	L2321653-8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2321653-8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2321653-8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2321653-8
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2321653-8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2321653-8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2321653-8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2321653-8
Matrix Spike	Boron (B)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Aluminum (Al)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Barium (Ba)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Boron (B)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Calcium (Ca)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Manganese (Mn)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Potassium (K)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Sodium (Na)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Strontium (Sr)-Total	MS-B	L2321653-1, -2, -3, -4, -5, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2321653-6, -7
Matrix Spike	Sodium (Na)-Total	MS-B	L2321653-6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLA	Detection Limit adjusted for required dilution
DLIS	Detection Limit Adjusted: Insufficient Sample
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
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.
RRV	Reported Result Verified By Repeat Analysis

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-C-PCT-VA	Seawater	Conductivity (Automated) (seawater)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).			

Reference Information

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-T-HB-F-HMI-MS-VA	Seawater	Tot Metals in Seawater by CRC ICPMS (BC)	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.			
NA-D-CCMS-VA	Seawater	Diss. Sodium in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample. Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.			
Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.			
P-T-PRES-COL-VA	Seawater	Total P in Seawater by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			
It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. 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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-829397

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

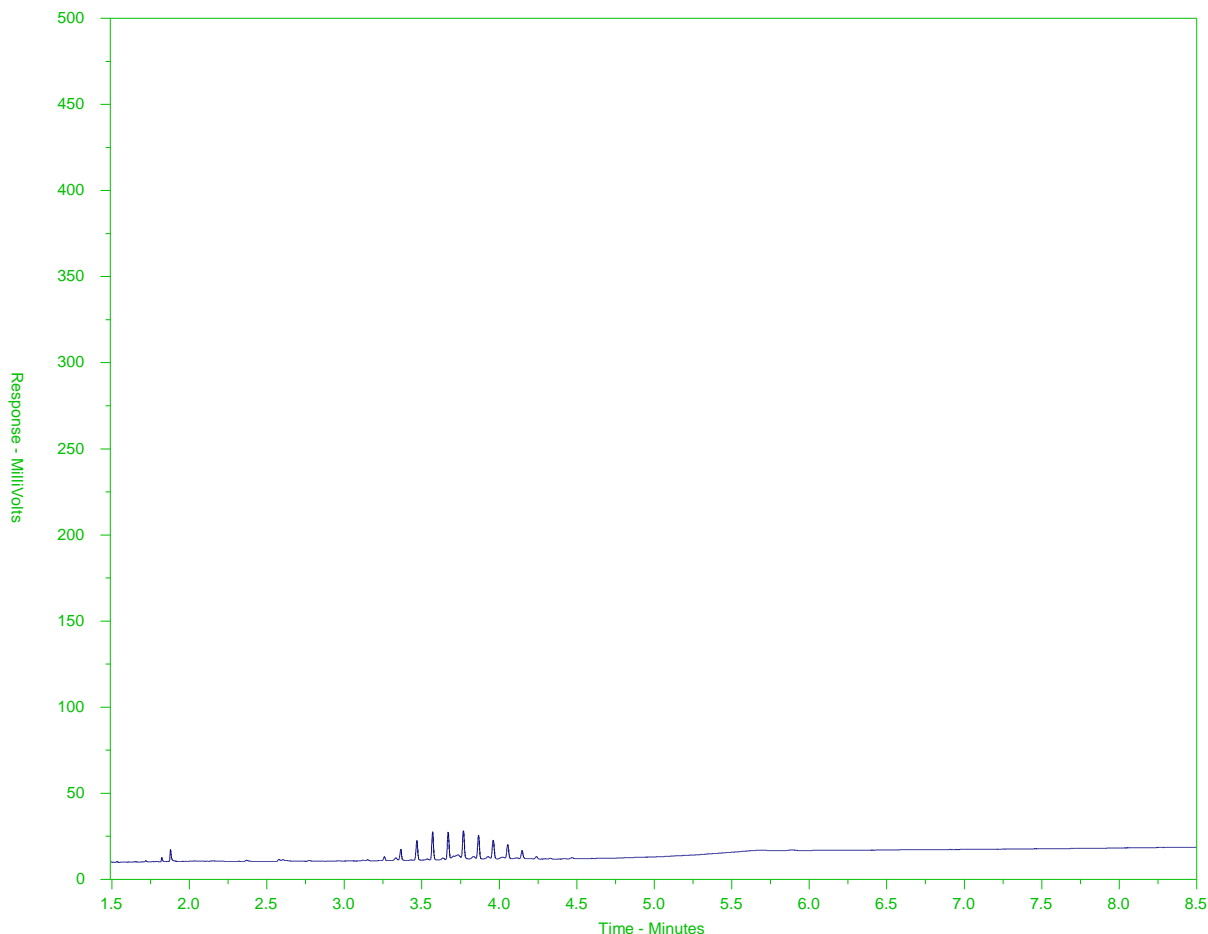
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-1
Client Sample ID: WT2



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

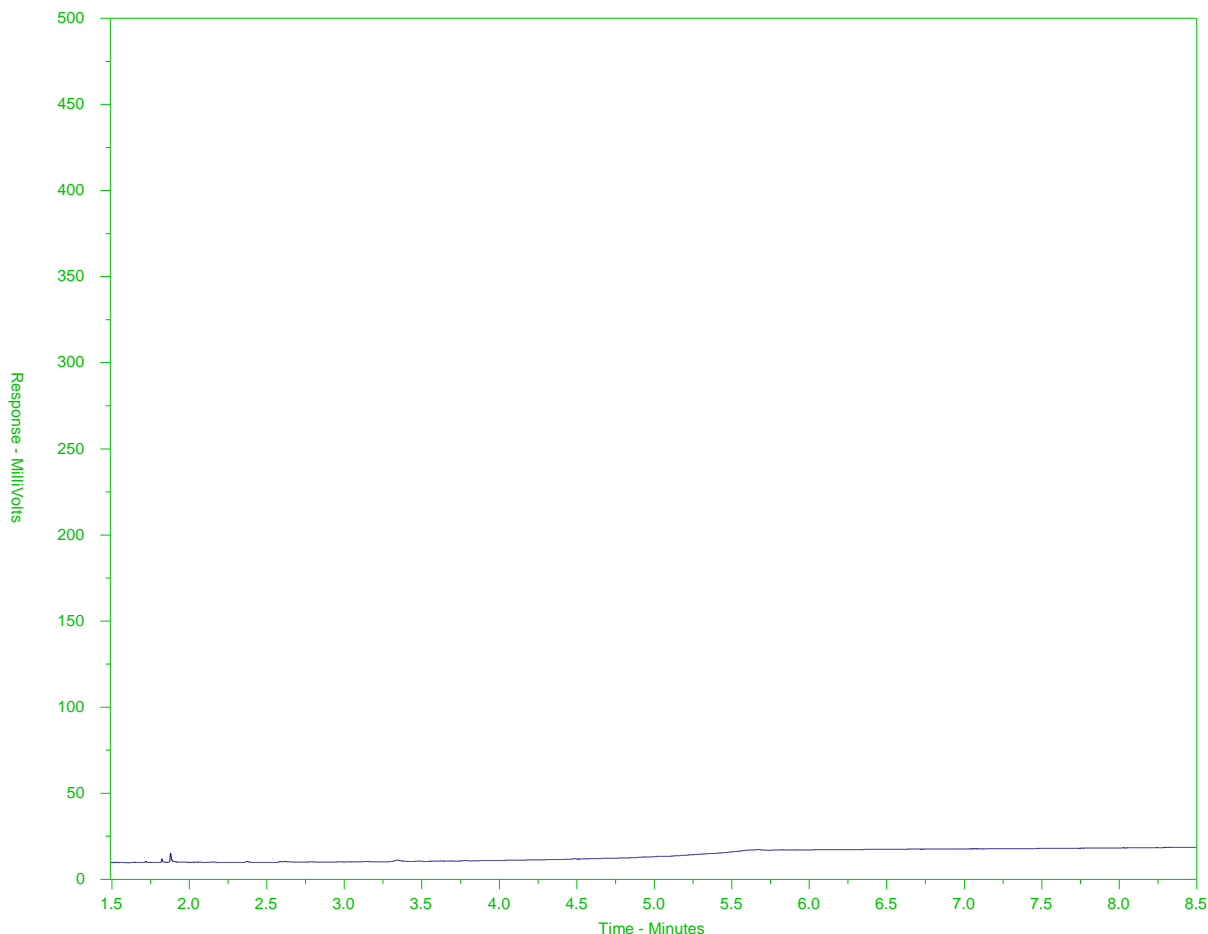
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-2
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

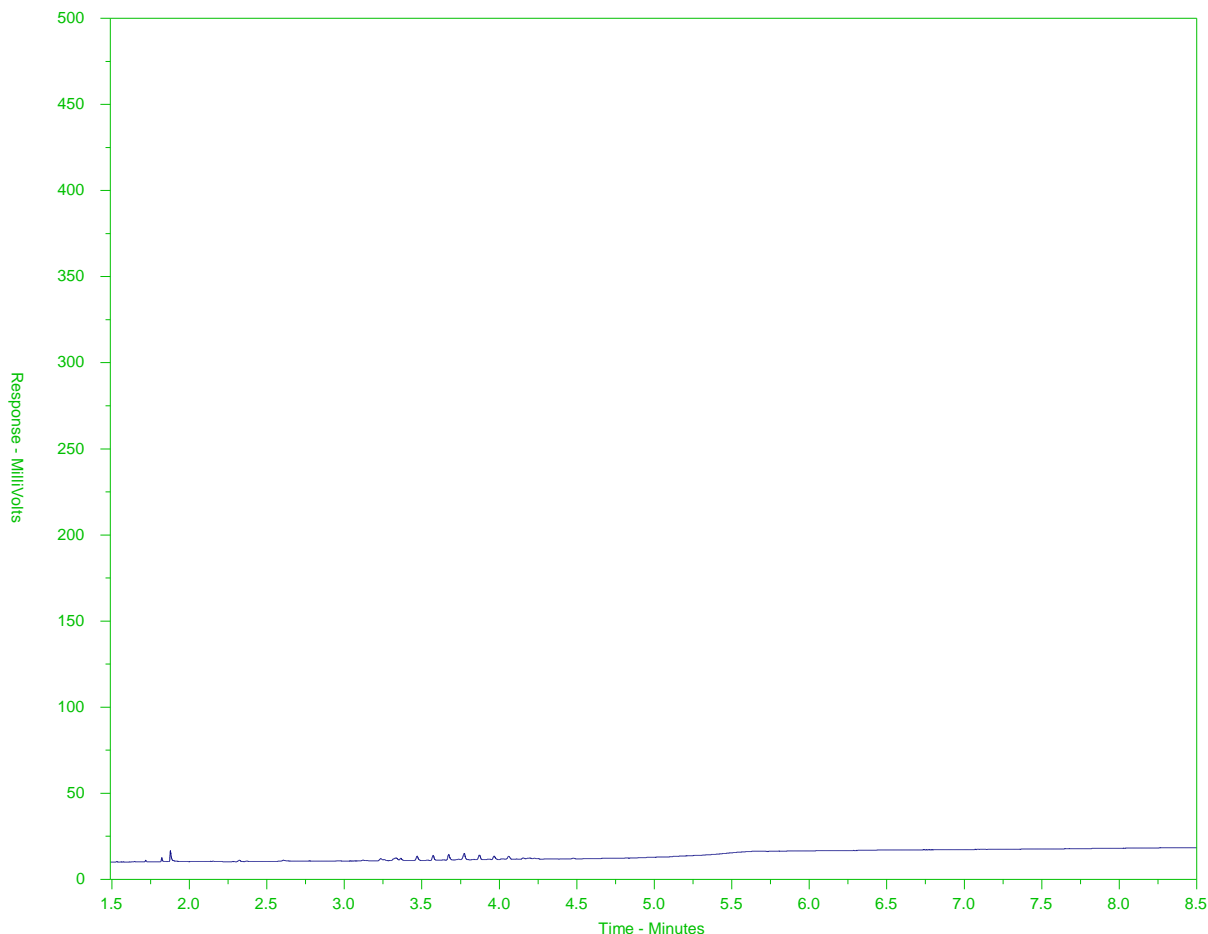
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-3
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

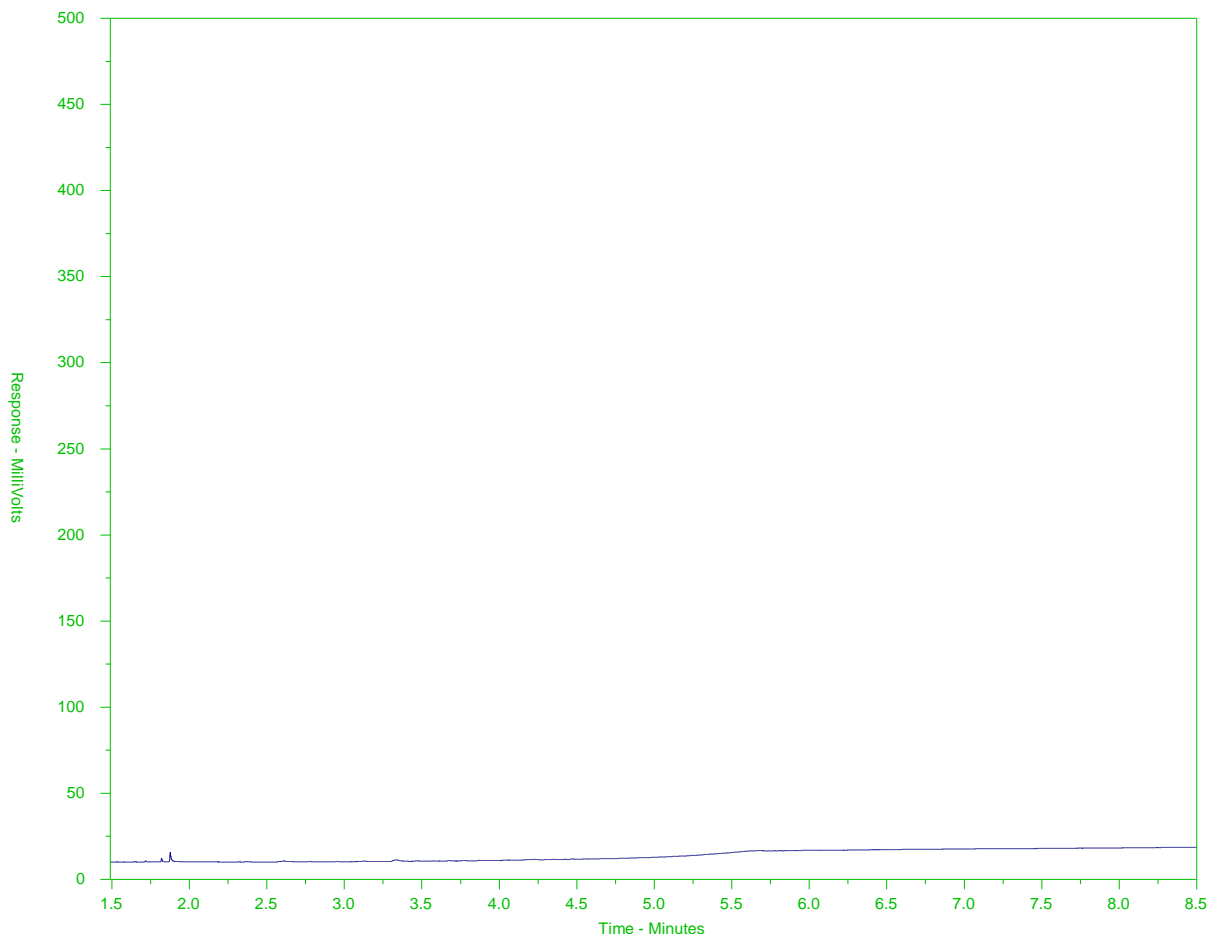
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-4
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

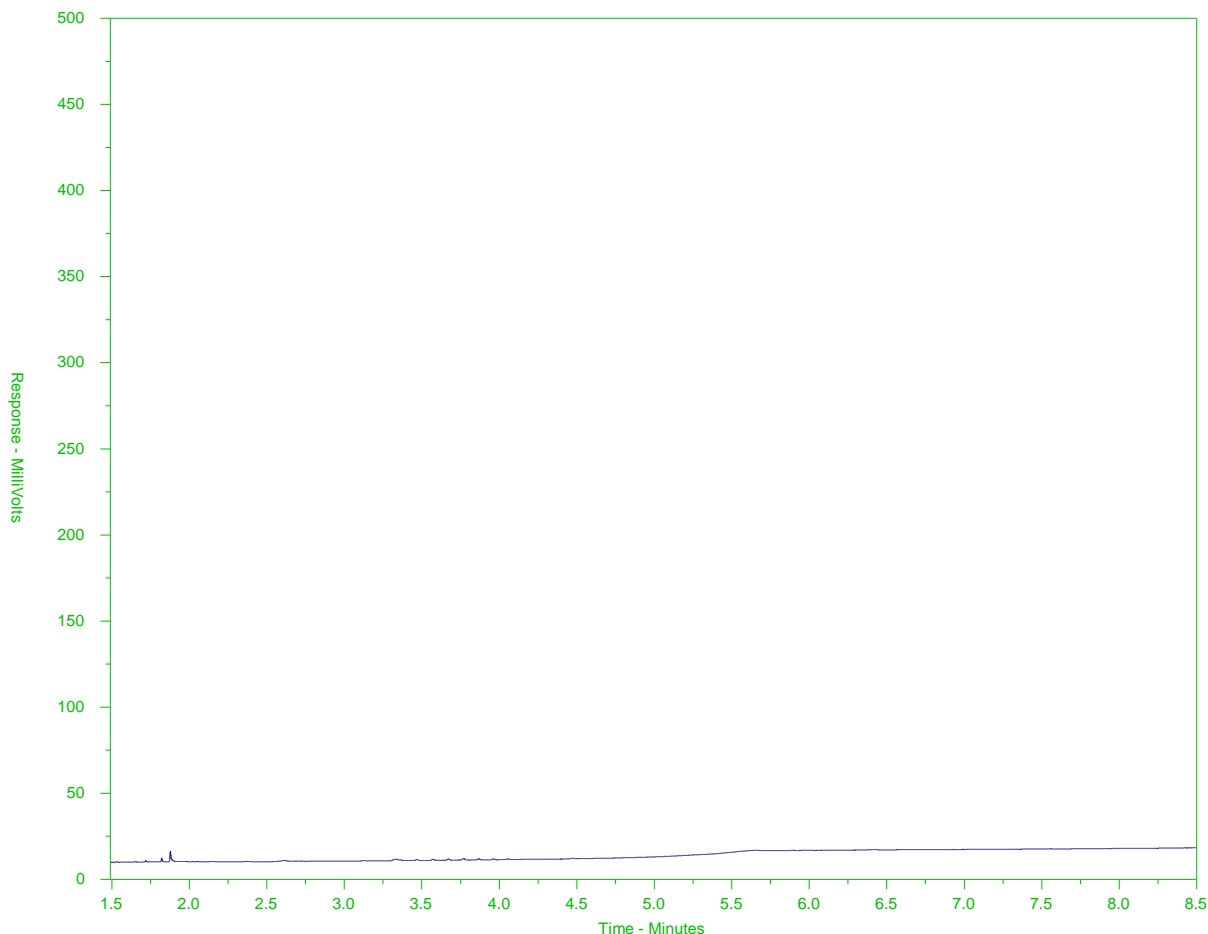
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-5
Client Sample ID: WT11



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

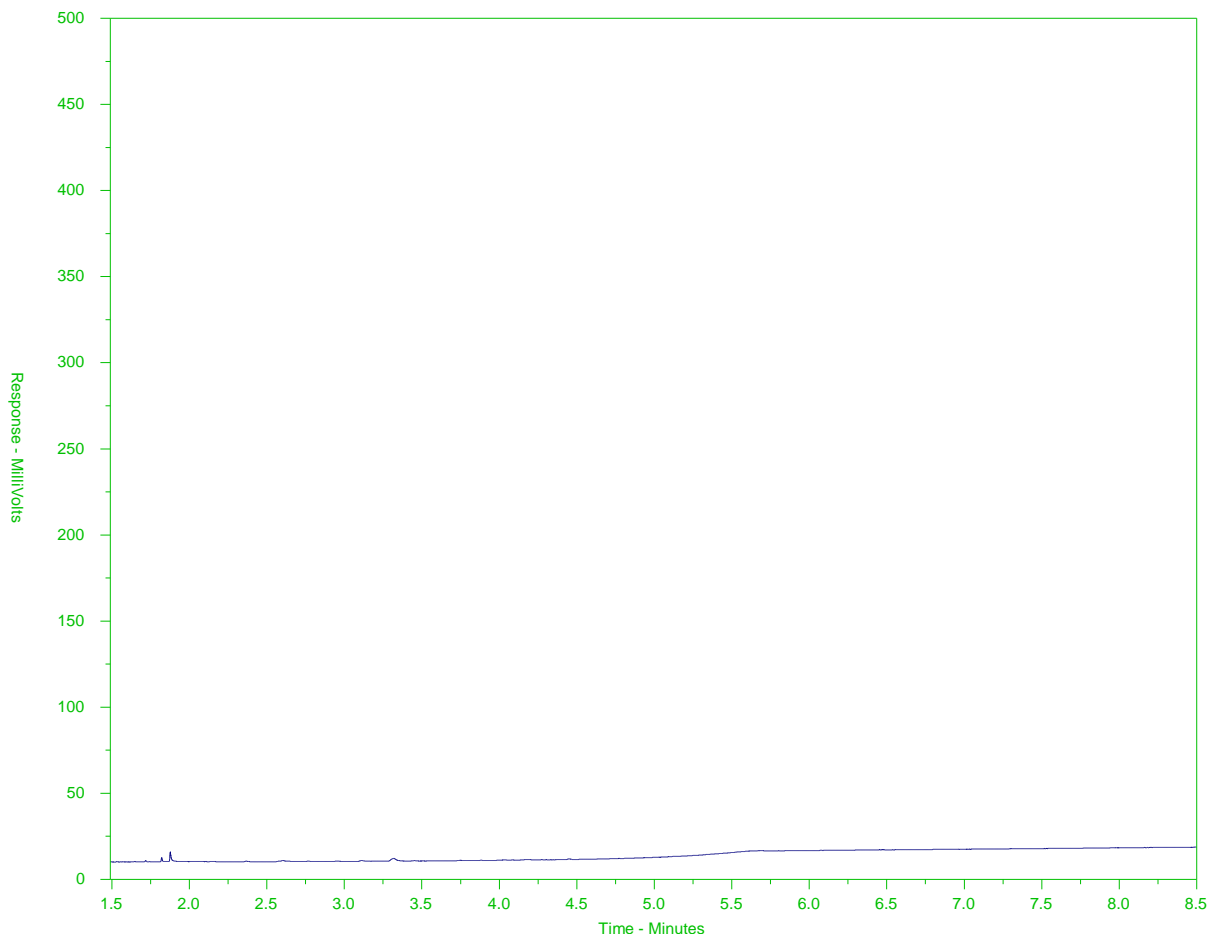
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-6
Client Sample ID: WT5-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

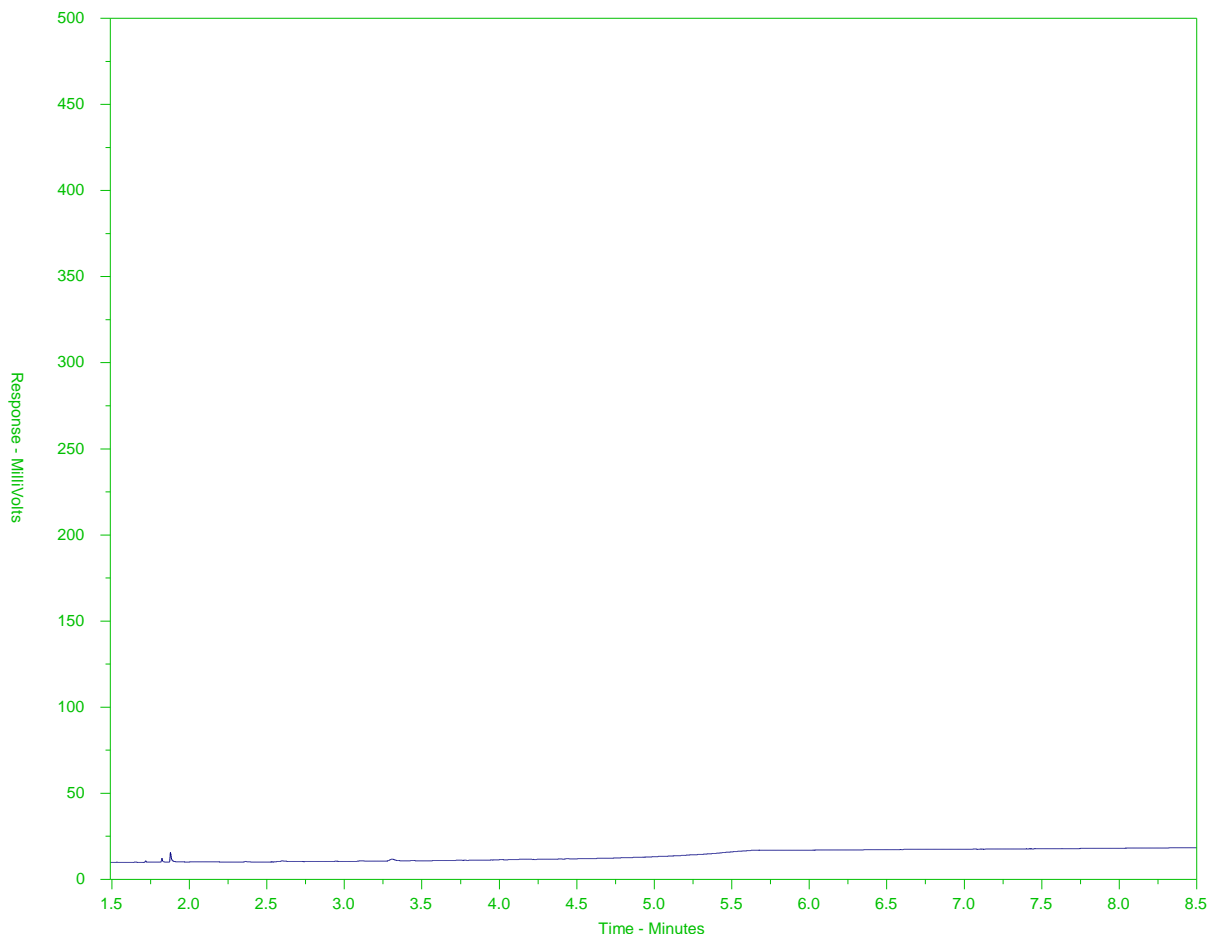
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-7
Client Sample ID: WT5-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

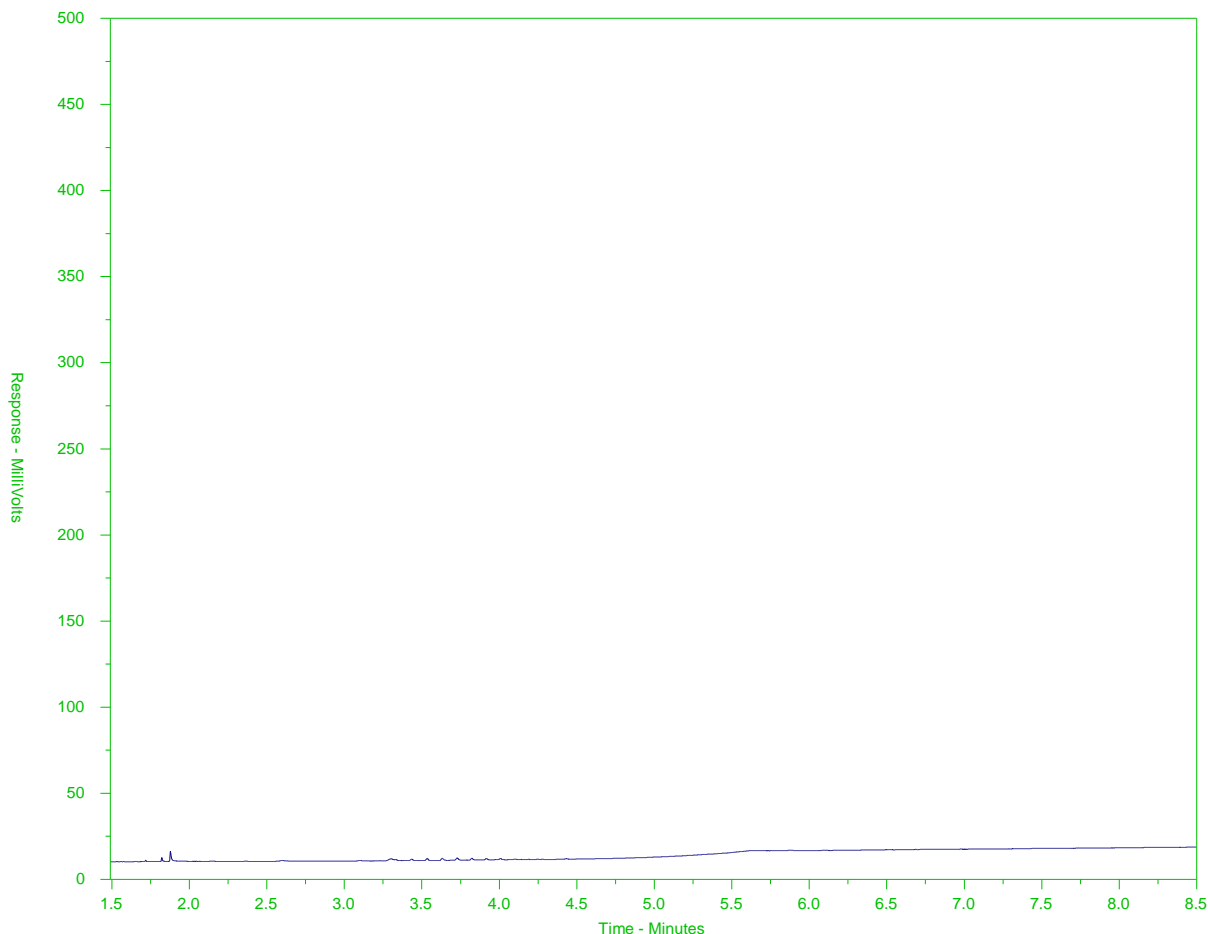
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2321653-C-8
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2321653-COFC

COC Number: 17 - 829397

Page of

www.alsglobal.com

[illegible]

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2010 FROM

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 23-AUG-19
Report Date: 05-SEP-19 17:28 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2335149
Project P.O. #: NOT SUBMITTED
Job Reference: 123512431.601.200
C of C Numbers: 17-82968
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Conductivity (uS/cm)	36900	36600	36100	36400	
	pH (pH)	7.94	7.95	7.96	7.95	
	Total Suspended Solids (mg/L)	2.2	2.4	2.1	2.8	
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0121	<0.0050	0.0141	<0.0050	
	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
	Phosphorus (P)-Total (mg/L)	0.0348	0.0381	0.0356	0.0341	
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0050	0.0085	0.0084	0.0115	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00142	0.00155	0.00148	0.00145	
	Barium (Ba)-Total (mg/L)	0.0087	0.0087	0.0089	0.0087	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	3.03	3.07	2.98	2.85	
	Cadmium (Cd)-Total (mg/L)	0.000056	0.000055	0.000062	0.000053	
	Calcium (Ca)-Total (mg/L)	289	285	301	293	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Total (mg/L)	0.00068	0.00075	0.00103	0.00073	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	<0.010	0.013	0.014	0.020	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000052	0.000057	
	Lithium (Li)-Total (mg/L)	0.123	0.124	0.126	0.121	
	Magnesium (Mg)-Total (mg/L)	754	757	750	737	
	Manganese (Mn)-Total (mg/L)	0.00224	0.00313	0.00342	0.00355	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00848	0.00836	0.00807	0.00810	
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	261	265	265	258	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0858	0.0874	0.0882	0.0876	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Total (mg/L)	8220	8090	8210	8420	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Total Metals	Strontium (Sr)-Total (mg/L)	5.70	5.59	5.55	5.43	
	Sulfur (S)-Total (mg/L)	687	698	675	658	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00209	0.00202	0.00196	0.00198	
	Vanadium (V)-Total (mg/L)	0.00139	0.00148	0.00147	0.00143	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	LAB	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00131	0.00121	0.00134	0.00133	
	Barium (Ba)-Dissolved (mg/L)	0.0084	0.0081	0.0088	0.0090	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	2.68	2.59	2.71	2.71	
	Cadmium (Cd)-Dissolved (mg/L)	0.000055	0.000062	0.000061	0.000054	
	Calcium (Ca)-Dissolved (mg/L)	303	295	315	318	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00043	0.00055	0.00069	0.00058	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.112	0.110	0.118	0.118	
	Magnesium (Mg)-Dissolved (mg/L)	836	811	853	861	
	Manganese (Mn)-Dissolved (mg/L)	0.00063	0.00192	0.00198	0.00194	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.000010 ^{DLM}	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00784	0.00800	0.00801	0.00824	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	291	292	310	318	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Dissolved (mg/L)	0.0759	0.0737	0.0797	0.0808	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	8990	8630	8850	8670	
	Strontium (Sr)-Dissolved (mg/L)	5.41	5.84	5.61	5.78	
	Sulfur (S)-Dissolved (mg/L)	712	743	782	810	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00216	0.00201	0.00204	0.00208	
	Vanadium (V)-Dissolved (mg/L)	0.00130	0.00128	0.00132	0.00129	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-1 Water 23-AUG-19 12:10 WT2	L2335149-2 Water 23-AUG-19 11:00 WT3	L2335149-3 Water 23-AUG-19 12:55 WT8	L2335149-4 Water 23-AUG-19 13:25 WT10	L2335149-5 Water 23-AUG-19 12:25 WT11
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	224	260	247	258	251
	Hardness (as CaCO3) (mg/L)	79.8	107	95.5	105	107
	pH (pH)	8.15	8.11	8.06	8.13	8.19
	Total Suspended Solids (mg/L)	3.2	<3.0	5.8	5.2	<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0154	0.0065	0.0091	0.0057	0.0091
	Nitrate (as N) (mg/L)	0.448	0.0765	1.05	1.27	0.258
	Nitrite (as N) (mg/L)	0.0018	<0.0010	0.0014	<0.0010	<0.0010
	Phosphorus (P)-Total (mg/L)	0.0676	0.0668	0.0195	0.0228	0.0376
Total Metals	Aluminum (Al)-Total (mg/L)	0.106	0.0076	0.0849	0.111	0.0216
	Antimony (Sb)-Total (mg/L)	0.00028	<0.00010	<0.00010	<0.00010	0.00015
	Arsenic (As)-Total (mg/L)	0.00409	0.00489	0.00131	0.00127	0.00287
	Barium (Ba)-Total (mg/L)	0.0123	0.00529	0.0333	0.0675	0.0177
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.073	0.016	0.015	0.018	0.025
	Cadmium (Cd)-Total (mg/L)	0.0000211	<0.0000050	0.0000079	0.0000095	0.0000222
	Calcium (Ca)-Total (mg/L)	23.3	26.6	25.5	28.8	30.2
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Total (mg/L)	0.00024	<0.00010	0.00128	0.00119	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00013	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00125	<0.00050	0.00053	0.00083	0.00066
	Iron (Fe)-Total (mg/L)	1.25	<0.010	0.192	0.153	0.057
	Lead (Pb)-Total (mg/L)	0.000494	<0.000050	0.000136	0.000140	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0013	0.0014	0.0017	<0.0010
	Magnesium (Mg)-Total (mg/L)	4.60	9.56	7.71	8.66	8.10
	Manganese (Mn)-Total (mg/L)	0.0364	0.00787	0.0230	0.0214	0.0107
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00138	0.000908	0.000538	0.000731	0.000911
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	0.117	0.087	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	3.11	2.89	1.40	1.77	3.35
	Rubidium (Rb)-Total (mg/L)	0.00145	0.00083	0.00051	0.00063	0.00151
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	0.000214	0.000399	0.000161
	Silicon (Si)-Total (mg/L)	8.31	11.1	11.7	12.2	8.80
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	0.000034
	Sodium (Na)-Total (mg/L)	18.8	10.5	12.3	10.8	10.0
	Strontium (Sr)-Total (mg/L)	0.0806	0.0951	0.136	0.129	0.109

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	L2335149-10 Water 23-AUG-19 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)					269
	Hardness (as CaCO3) (mg/L)					109
	pH (pH)					8.20
	Total Suspended Solids (mg/L)					<3.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)					<0.0050
	Nitrate (as N) (mg/L)					0.0702
	Nitrite (as N) (mg/L)					<0.0010
	Phosphorus (P)-Total (mg/L)					0.0681
Total Metals	Aluminum (Al)-Total (mg/L)					0.0139
	Antimony (Sb)-Total (mg/L)					<0.00010
	Arsenic (As)-Total (mg/L)					0.00485
	Barium (Ba)-Total (mg/L)					0.00526
	Beryllium (Be)-Total (mg/L)					<0.00010
	Bismuth (Bi)-Total (mg/L)					<0.000050
	Boron (B)-Total (mg/L)					0.016
	Cadmium (Cd)-Total (mg/L)					<0.0000050
	Calcium (Ca)-Total (mg/L)					27.5
	Cesium (Cs)-Total (mg/L)					<0.000010
	Chromium (Cr)-Total (mg/L)					<0.00010
	Cobalt (Co)-Total (mg/L)					<0.00010
	Copper (Cu)-Total (mg/L)					<0.00050
	Iron (Fe)-Total (mg/L)					<0.010
	Lead (Pb)-Total (mg/L)					<0.000050
	Lithium (Li)-Total (mg/L)					0.0013
	Magnesium (Mg)-Total (mg/L)					9.13
	Manganese (Mn)-Total (mg/L)					0.00674
	Mercury (Hg)-Total (mg/L)					<0.0000050
	Molybdenum (Mo)-Total (mg/L)					0.000920
	Nickel (Ni)-Total (mg/L)					<0.00050
	Phosphorus (P)-Total (mg/L)					0.070
	Potassium (K)-Total (mg/L)					2.83
	Rubidium (Rb)-Total (mg/L)					0.00079
	Selenium (Se)-Total (mg/L)					<0.000050
	Silicon (Si)-Total (mg/L)					11.2
	Silver (Ag)-Total (mg/L)					<0.000010
	Sodium (Na)-Total (mg/L)					10.4
	Strontium (Sr)-Total (mg/L)					0.0959

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-11 Water 23-AUG-19 FIELD BLANK				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50				
	pH (pH)	8.07				
	Total Suspended Solids (mg/L)	<3.0				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0079 ^{RRV}				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.00010				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Cesium (Cs)-Total (mg/L)	<0.000010				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.050				
	Rubidium (Rb)-Total (mg/L)	<0.00020				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.10				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-1 Water 23-AUG-19 12:10 WT2	L2335149-2 Water 23-AUG-19 11:00 WT3	L2335149-3 Water 23-AUG-19 12:55 WT8	L2335149-4 Water 23-AUG-19 13:25 WT10	L2335149-5 Water 23-AUG-19 12:25 WT11
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	1.78	4.54	4.53	5.43	5.15
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00016
	Titanium (Ti)-Total (mg/L)	0.00357	<0.00030	0.00322	0.00377	<0.0012 ^{DLM}
	Tungsten (W)-Total (mg/L)	0.00023	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000061	0.000090	0.000099	0.000162	0.000090
	Vanadium (V)-Total (mg/L)	0.00140	<0.00050	0.00137	0.00164	0.00080
	Zinc (Zn)-Total (mg/L)	0.0230	<0.0030	<0.0030	<0.0030	0.0385
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0032	0.0026	0.0107	0.0099	0.0031
	Antimony (Sb)-Dissolved (mg/L)	0.00023	<0.00010	<0.00010	<0.00010	0.00014
	Arsenic (As)-Dissolved (mg/L)	0.00216	0.00520	0.00123	0.00123	0.00293
	Barium (Ba)-Dissolved (mg/L)	0.00911	0.00526	0.0289	0.0571	0.0173
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.078	0.016	0.015	0.017	0.026
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.0000073	0.0000087
	Calcium (Ca)-Dissolved (mg/L)	23.6	27.4	25.7	27.8	29.6
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00082	0.00093	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00043	<0.00020	0.00031	0.00056	0.00049
	Iron (Fe)-Dissolved (mg/L)	0.021	<0.010	0.033	0.023	0.019
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0013	0.0013	0.0016	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.09	9.46	7.60	8.75	7.96
	Manganese (Mn)-Dissolved (mg/L)	0.00828	0.00181	0.0110	0.0118	0.00953
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00143	0.000962	0.000541	0.000756	0.000967
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.068	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.35	3.09	1.50	1.98	3.51
	Rubidium (Rb)-Dissolved (mg/L)	0.00130	0.00074	0.00049	0.00058	0.00146

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	L2335149-10 Water 23-AUG-19 DUP
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)						4.91
	Tellurium (Te)-Total (mg/L)						<0.00020
	Thallium (Tl)-Total (mg/L)						<0.000010
	Thorium (Th)-Total (mg/L)						<0.00010
	Tin (Sn)-Total (mg/L)						<0.00010
	Titanium (Ti)-Total (mg/L)						0.00033
	Tungsten (W)-Total (mg/L)						<0.00010
	Uranium (U)-Total (mg/L)						0.000094
	Vanadium (V)-Total (mg/L)						<0.00050
	Zinc (Zn)-Total (mg/L)						<0.0030
	Zirconium (Zr)-Total (mg/L)						<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location						FIELD
	Dissolved Metals Filtration Location						FIELD
	Aluminum (Al)-Dissolved (mg/L)						0.0027
	Antimony (Sb)-Dissolved (mg/L)						<0.00010
	Arsenic (As)-Dissolved (mg/L)						0.00507
	Barium (Ba)-Dissolved (mg/L)						0.00516
	Beryllium (Be)-Dissolved (mg/L)						<0.00010
	Bismuth (Bi)-Dissolved (mg/L)						<0.000050
	Boron (B)-Dissolved (mg/L)						0.016
	Cadmium (Cd)-Dissolved (mg/L)						<0.0000050
	Calcium (Ca)-Dissolved (mg/L)						28.1
	Cesium (Cs)-Dissolved (mg/L)						<0.000010
	Chromium (Cr)-Dissolved (mg/L)						<0.00010
	Cobalt (Co)-Dissolved (mg/L)						<0.00010
	Copper (Cu)-Dissolved (mg/L)						<0.00020
	Iron (Fe)-Dissolved (mg/L)						<0.010
	Lead (Pb)-Dissolved (mg/L)						<0.000050
	Lithium (Li)-Dissolved (mg/L)						0.0013
	Magnesium (Mg)-Dissolved (mg/L)						9.35
	Manganese (Mn)-Dissolved (mg/L)						0.00175
	Mercury (Hg)-Dissolved (mg/L)						<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)						0.000989
	Nickel (Ni)-Dissolved (mg/L)						<0.00050
	Phosphorus (P)-Dissolved (mg/L)						0.068
	Potassium (K)-Dissolved (mg/L)						3.01
	Rubidium (Rb)-Dissolved (mg/L)						0.00076

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2335149-11 Water 23-AUG-19 FIELD BLANK				
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)	<0.50					
	Tellurium (Te)-Total (mg/L)	<0.00020					
	Thallium (Tl)-Total (mg/L)	<0.000010					
	Thorium (Th)-Total (mg/L)	<0.00010					
	Tin (Sn)-Total (mg/L)	<0.00010					
	Titanium (Ti)-Total (mg/L)	<0.00030					
	Tungsten (W)-Total (mg/L)	<0.00010					
	Uranium (U)-Total (mg/L)	<0.000010					
	Vanadium (V)-Total (mg/L)	<0.00050					
	Zinc (Zn)-Total (mg/L)	<0.0030					
	Zirconium (Zr)-Total (mg/L)	<0.00020					
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD					
	Dissolved Metals Filtration Location	FIELD					
	Aluminum (Al)-Dissolved (mg/L)	<0.0010					
	Antimony (Sb)-Dissolved (mg/L)	<0.00010					
	Arsenic (As)-Dissolved (mg/L)	<0.00010					
	Barium (Ba)-Dissolved (mg/L)	<0.00010					
	Beryllium (Be)-Dissolved (mg/L)	<0.00010					
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050					
	Boron (B)-Dissolved (mg/L)	<0.010					
	Cadmium (Cd)-Dissolved (mg/L)	0.000210 ^{RRV}					
	Calcium (Ca)-Dissolved (mg/L)	<0.050					
	Cesium (Cs)-Dissolved (mg/L)	<0.000010					
	Chromium (Cr)-Dissolved (mg/L)	<0.00010					
	Cobalt (Co)-Dissolved (mg/L)	<0.00010					
	Copper (Cu)-Dissolved (mg/L)	<0.00020					
	Iron (Fe)-Dissolved (mg/L)	<0.010					
	Lead (Pb)-Dissolved (mg/L)	<0.000050					
	Lithium (Li)-Dissolved (mg/L)	<0.0010					
	Magnesium (Mg)-Dissolved (mg/L)	<0.0050					
	Manganese (Mn)-Dissolved (mg/L)	<0.00010					
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050					
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050					
	Nickel (Ni)-Dissolved (mg/L)	<0.00050					
	Phosphorus (P)-Dissolved (mg/L)	<0.050					
	Potassium (K)-Dissolved (mg/L)	<0.050					
	Rubidium (Rb)-Dissolved (mg/L)	<0.00020					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-1 Water 23-AUG-19 12:10 WT2	L2335149-2 Water 23-AUG-19 11:00 WT3	L2335149-3 Water 23-AUG-19 12:55 WT8	L2335149-4 Water 23-AUG-19 13:25 WT10	L2335149-5 Water 23-AUG-19 12:25 WT11
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	0.000076	<0.000050	0.000208	0.000398	0.000228
	Silicon (Si)-Dissolved (mg/L)	8.08	11.0	11.9	11.8	8.53
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	18.4	11.1	12.9	11.5	10.4
	Strontium (Sr)-Dissolved (mg/L)	0.0811	0.0980	0.140	0.133	0.113
	Sulfur (S)-Dissolved (mg/L)	1.63	4.67	4.75	5.49	5.23
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000057	0.000094	0.000091	0.000134	0.000089
	Vanadium (V)-Dissolved (mg/L)	0.00076	<0.00050	0.00106	0.00135	0.00077
	Zinc (Zn)-Dissolved (mg/L)	0.0064	0.0021	<0.0010	0.0015	0.0371
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	87.9	79.1	88.3	83.7	83.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-6 Water 23-AUG-19 09:45 WT5-SURFACE	L2335149-7 Water 23-AUG-19 09:25 WT5-DEEP	L2335149-8 Water 23-AUG-19 10:15 WT7-SURFACE	L2335149-9 Water 23-AUG-19 10:00 WT7-DEEP	L2335149-10 Water 23-AUG-19 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)					<0.000050
	Silicon (Si)-Dissolved (mg/L)					10.8
	Silver (Ag)-Dissolved (mg/L)					<0.000010
	Sodium (Na)-Dissolved (mg/L)					10.8
	Strontium (Sr)-Dissolved (mg/L)					0.0978
	Sulfur (S)-Dissolved (mg/L)					4.45
	Tellurium (Te)-Dissolved (mg/L)					<0.00020
	Thallium (Tl)-Dissolved (mg/L)					<0.000010
	Thorium (Th)-Dissolved (mg/L)					<0.00010
	Tin (Sn)-Dissolved (mg/L)					<0.00010
	Titanium (Ti)-Dissolved (mg/L)					<0.00030
	Tungsten (W)-Dissolved (mg/L)					<0.00010
	Uranium (U)-Dissolved (mg/L)					0.000093
	Vanadium (V)-Dissolved (mg/L)					<0.00050
	Zinc (Zn)-Dissolved (mg/L)					0.0022
	Zirconium (Zr)-Dissolved (mg/L)					<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	83.0	79.8	85.7	80.5	93.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2335149-11 Water 23-AUG-19 FIELD BLANK				
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	<0.050				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	<0.050				
	Strontium (Sr)-Dissolved (mg/L)	<0.00020				
	Sulfur (S)-Dissolved (mg/L)	<0.50				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	<0.00010				
	Uranium (U)-Dissolved (mg/L)	<0.000010				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020				
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10				
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	88.3				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L2335149-6	WT5-SURFACE	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass or PTFE container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Nitrate (as N)	B	L2335149-1, -10, -11, -2, -3, -4, -5
Laboratory Control Sample	F1 (C6-C10)	LCS-ND	L2335149-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2335149-11
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2335149-11
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2335149-11
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2335149-11
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2335149-11
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2335149-11
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2335149-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2335149-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2335149-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2335149-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sulfur (S)-Total	MS-B	L2335149-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Boron (B)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2335149-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2335149-7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2335149-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)

Reference Information

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

EC-C-PCT-VA Seawater Conductivity (Automated) (seawater) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-SCREEN-VA Seawater Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F1-HSFID-VA Water CCME F1 By Headspace with GCFID EPA 5021A/CCME CWS PHC (Pub# 1310)

This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.

F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.

F2-F4-ME-FID-VA Water CCME F2-F4 Hydrocarbons in Water CCME CWS-PHC, Pub #1310, Dec 2001

F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-DIS-C-CVAFS-VA Seawater Diss. Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-TOT-C-CVAFS-VA Seawater Total Mercury in Seawater by CVAFS PUGET SOUND PROTOCOLS, EPA 245.7

This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-D-F-HMI-CCMS-VA Seawater Diss. Metals in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

Reference Information

NA-D-CCMS-VA	Seawater	Diss. Sodium in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
NA-T-CCMS-VA	Seawater	Total Sodium in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NH3-F-VA	Seawater	Ammonia in Seawater by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-T-PRES-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.			
Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.			
P-T-PRES-COL-VA	Seawater	Total P in Seawater by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PH-C-PCT-VA	Seawater	pH by Meter (Automated) (seawater)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			
It is recommended that this analysis be conducted in the field.			
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
SI-D-CCMS-VA	Seawater	Diss. Silicon in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
SI-T-CCMS-VA	Seawater	Total Silicon in Seawater by CRC ICPMS	EPA 200.2/6020B (mod)
Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.			
TSS-C-VA	Seawater	Total Suspended Solids by Gravimetric	APHA 2540 D
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.			
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.			
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.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

Reference Information

VA

ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-82968

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lw - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

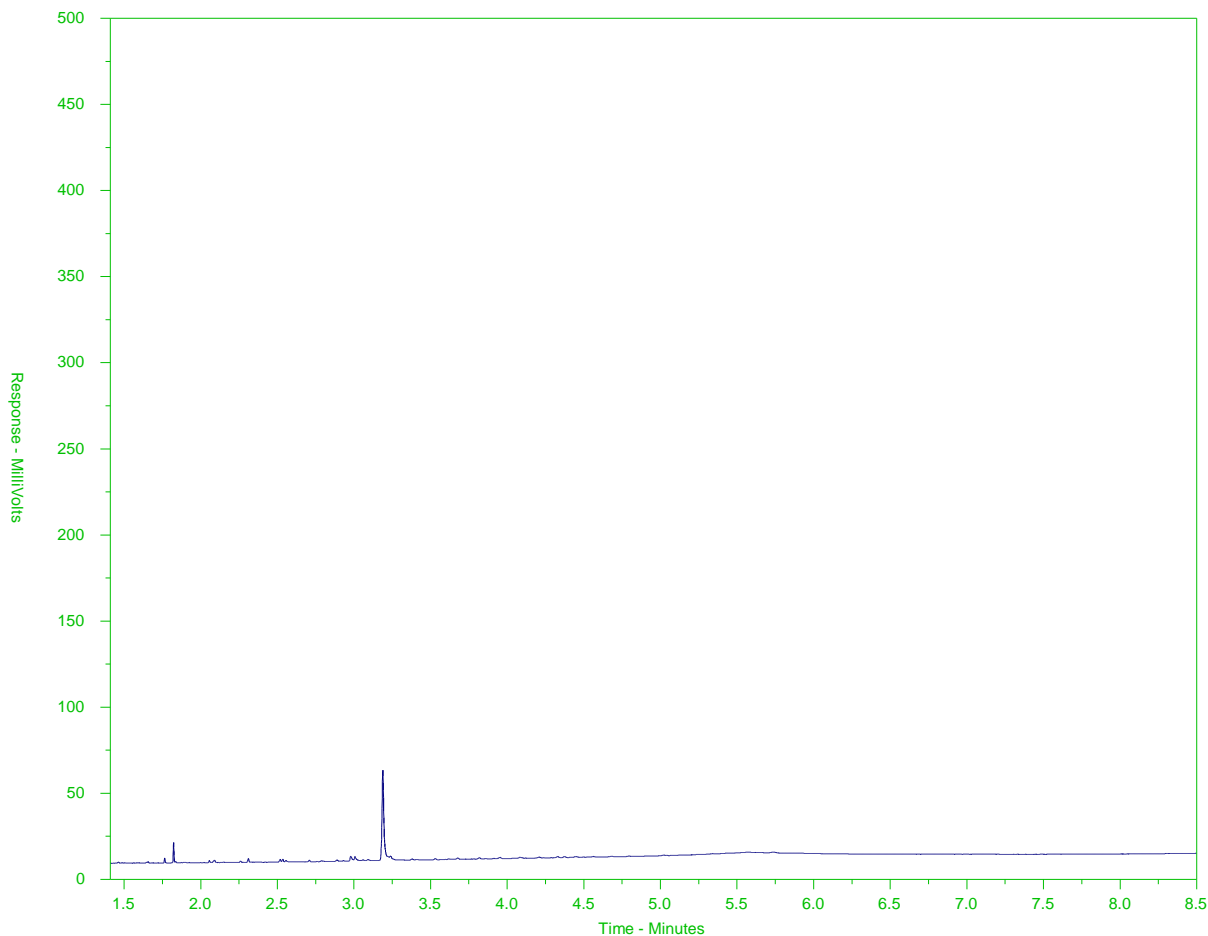
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-1
Client Sample ID: WT2



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

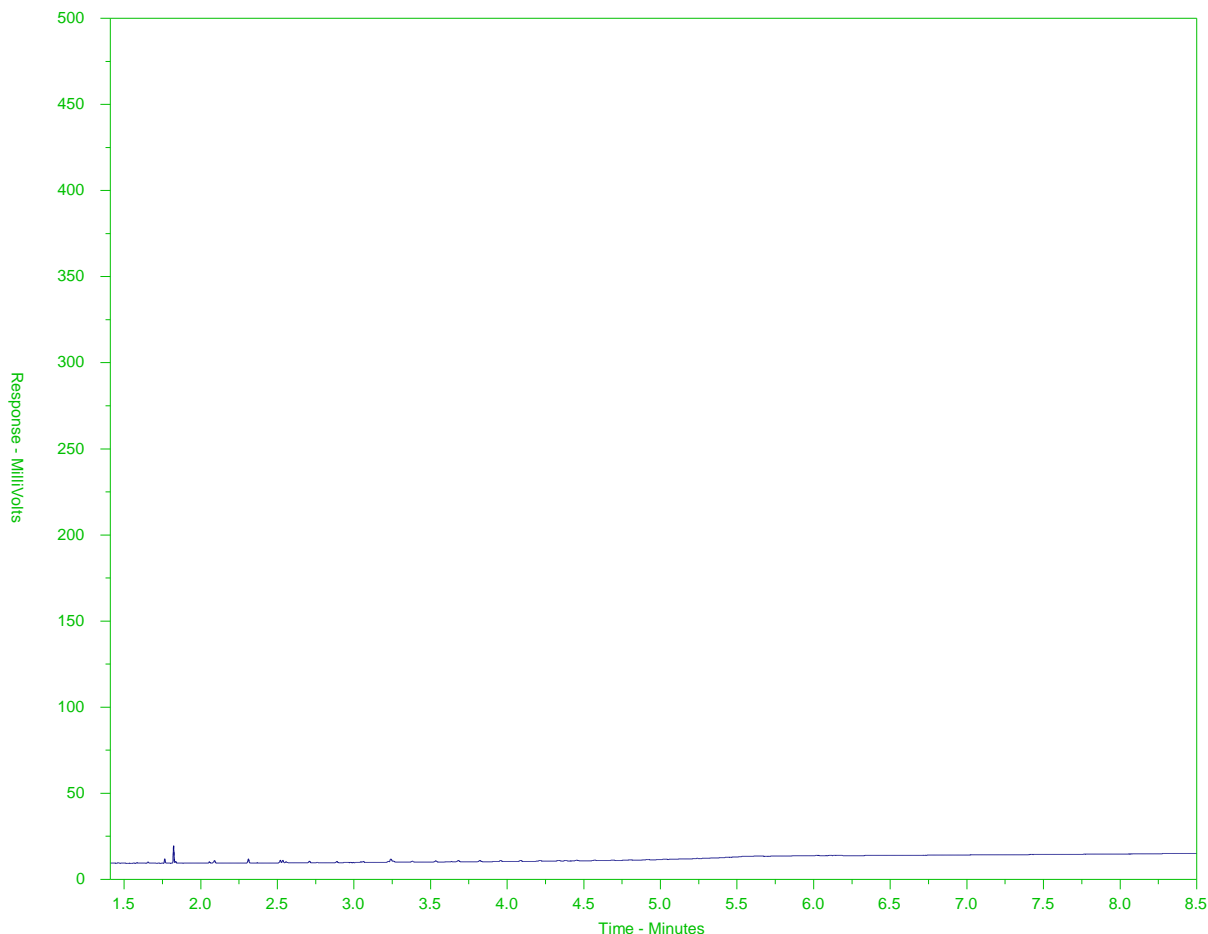
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-2
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

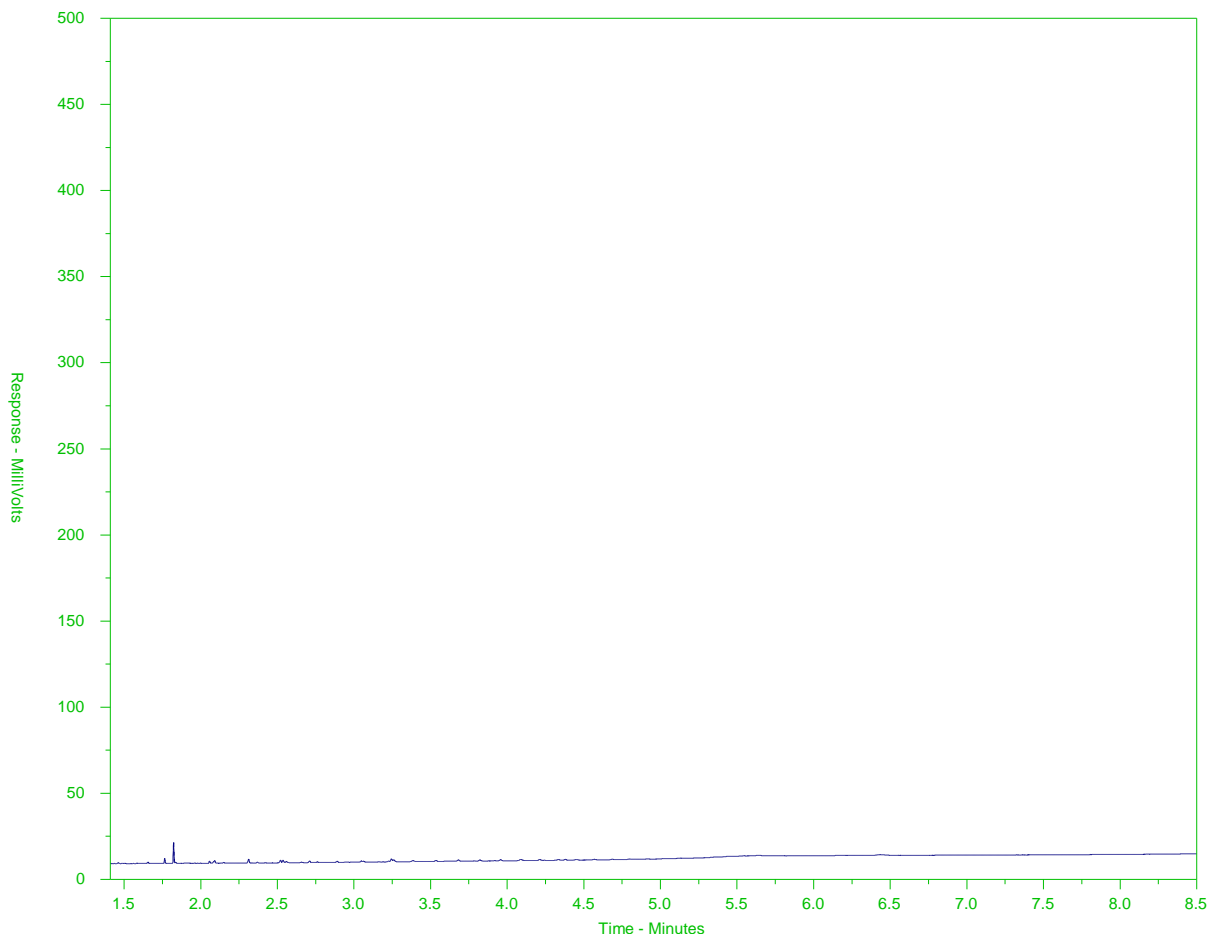
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-3
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

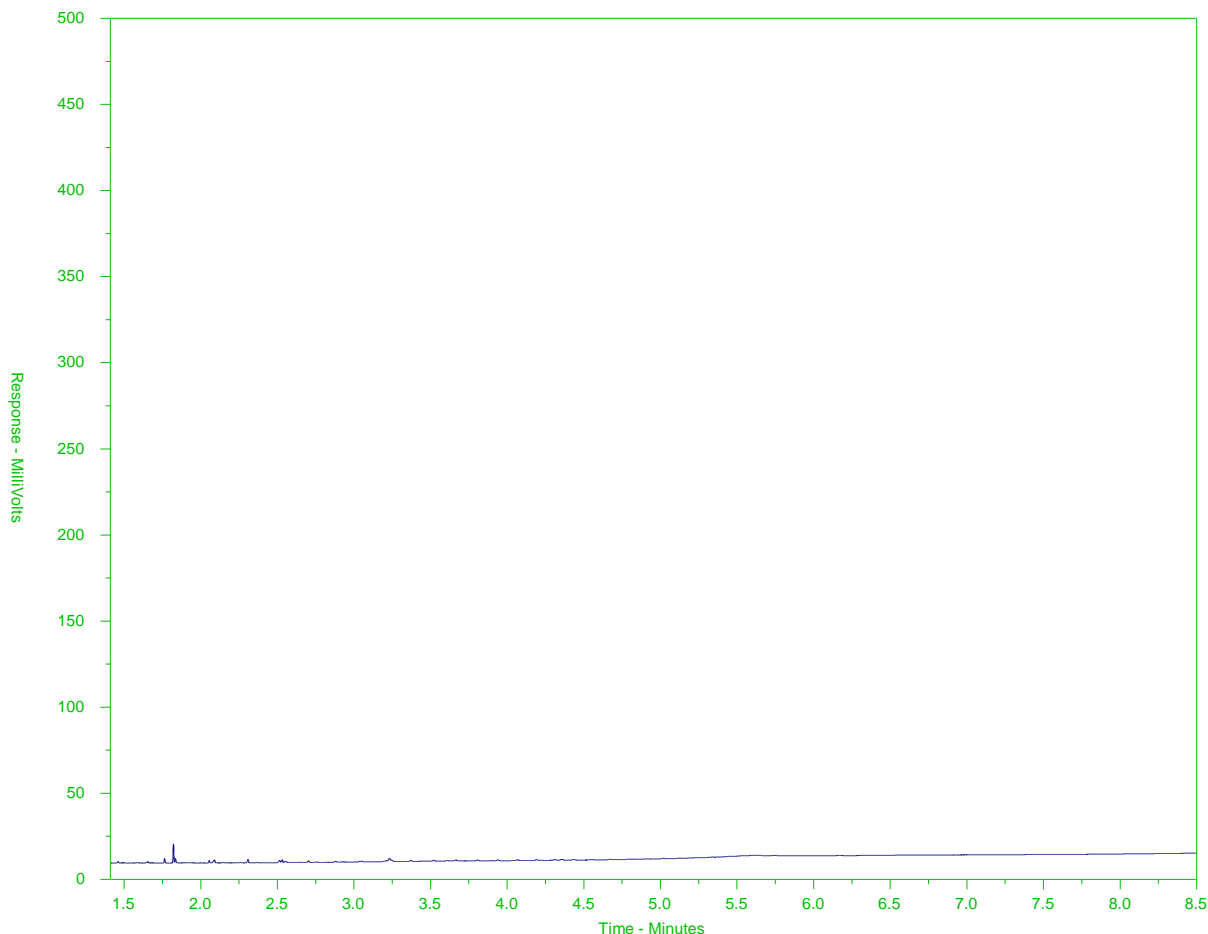
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-4
Client Sample ID: WT10



F2		F3		F4	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →		Motor Oils/ Lube Oils/ Grease			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

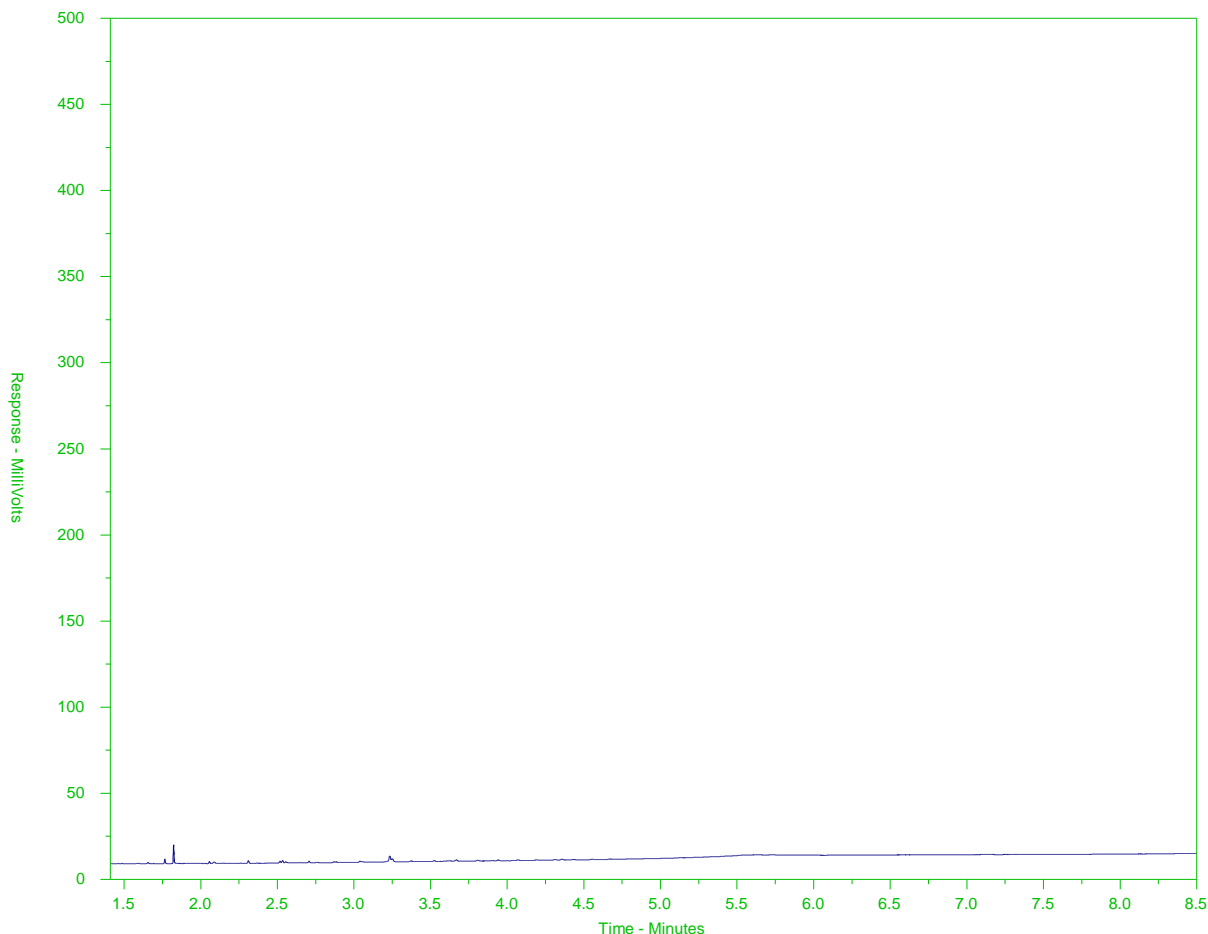
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-5
Client Sample ID: WT11



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

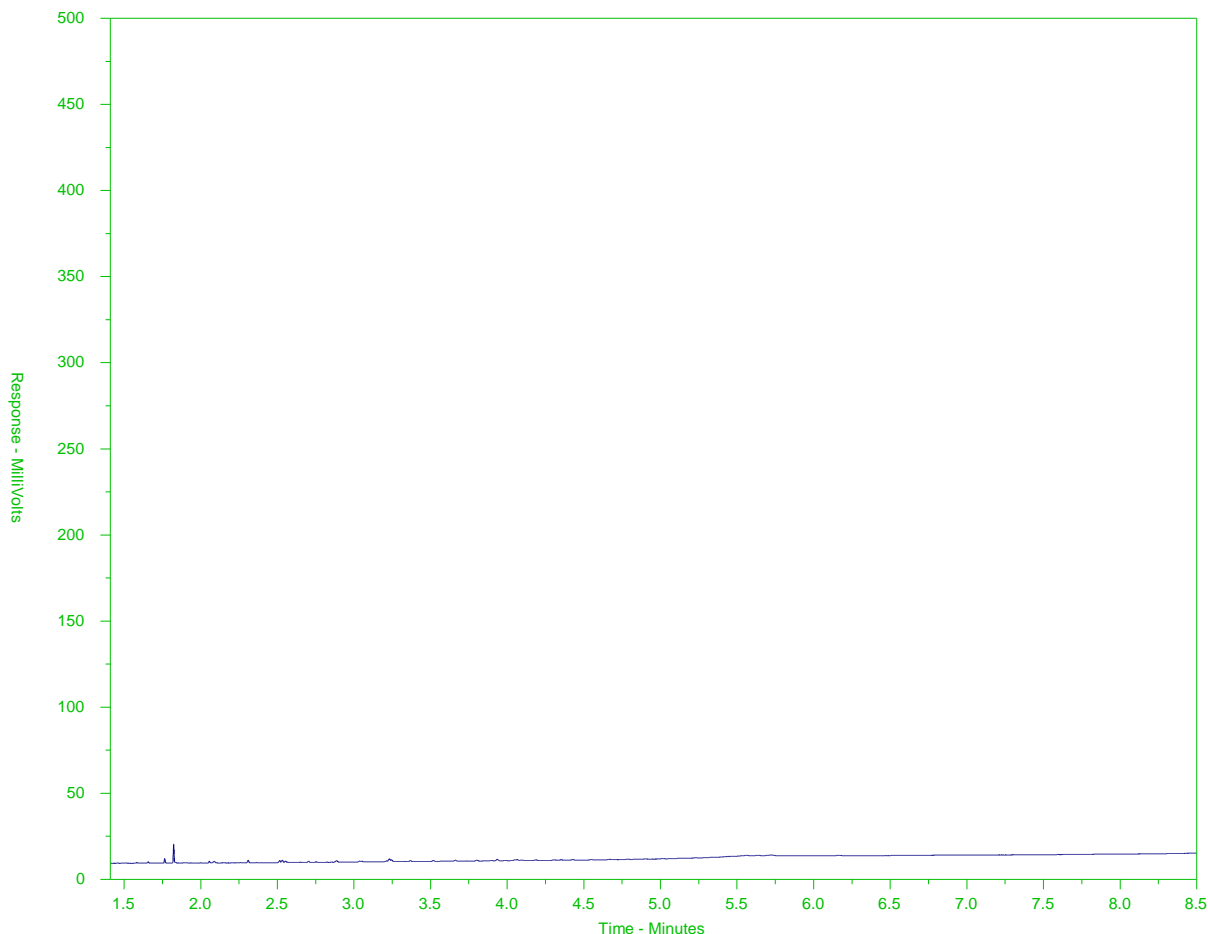
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-6
Client Sample ID: WT5-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

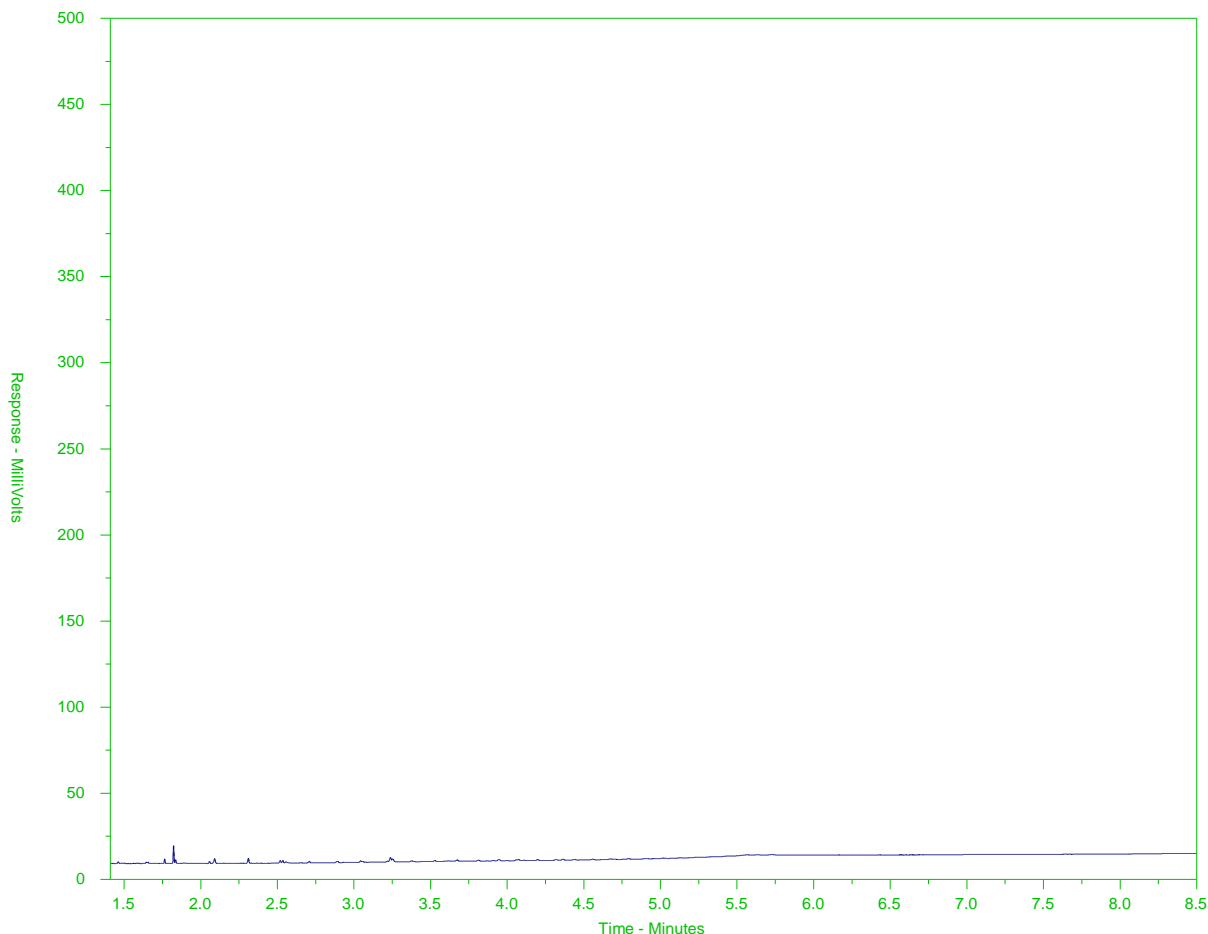
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-7
Client Sample ID: WT5-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

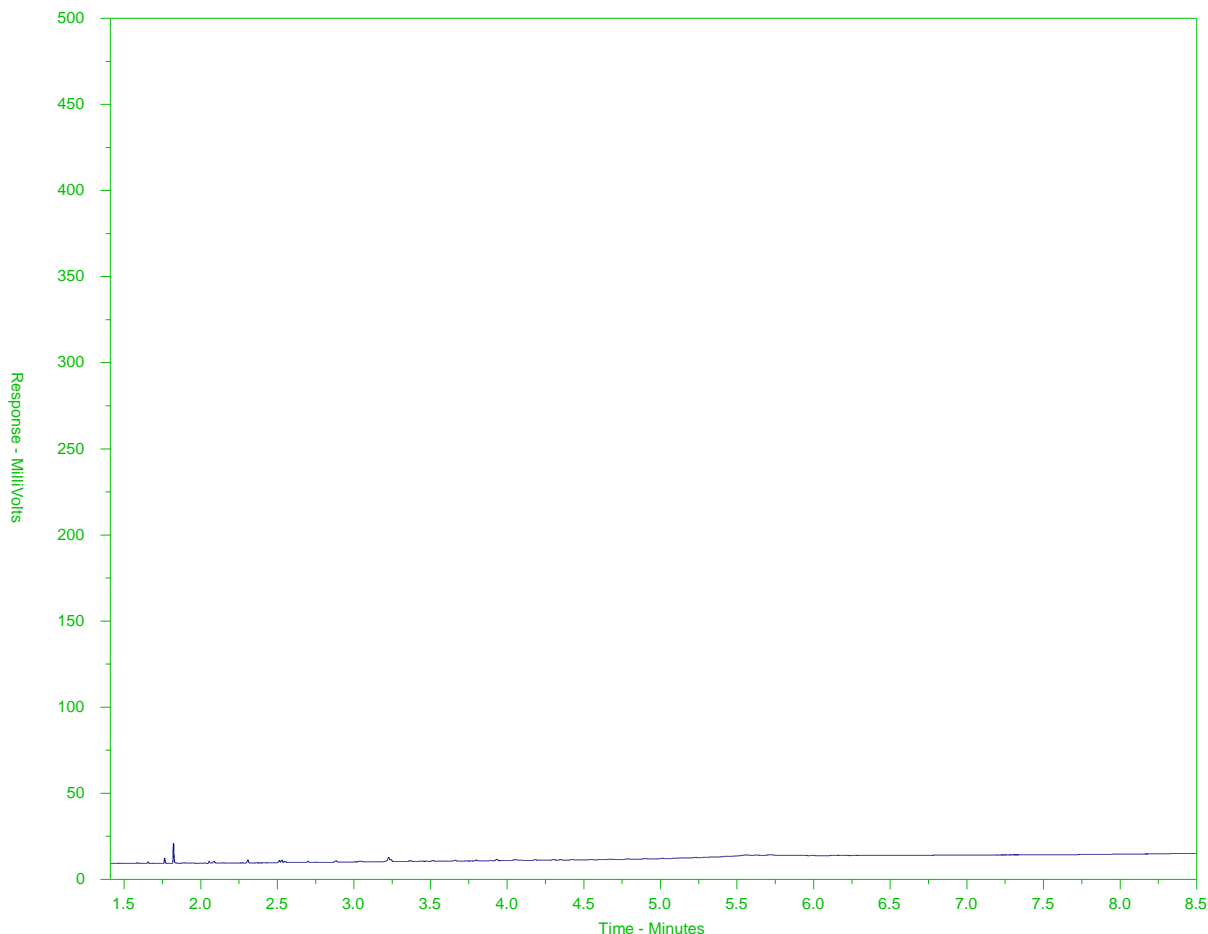
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-8
Client Sample ID: WT7-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

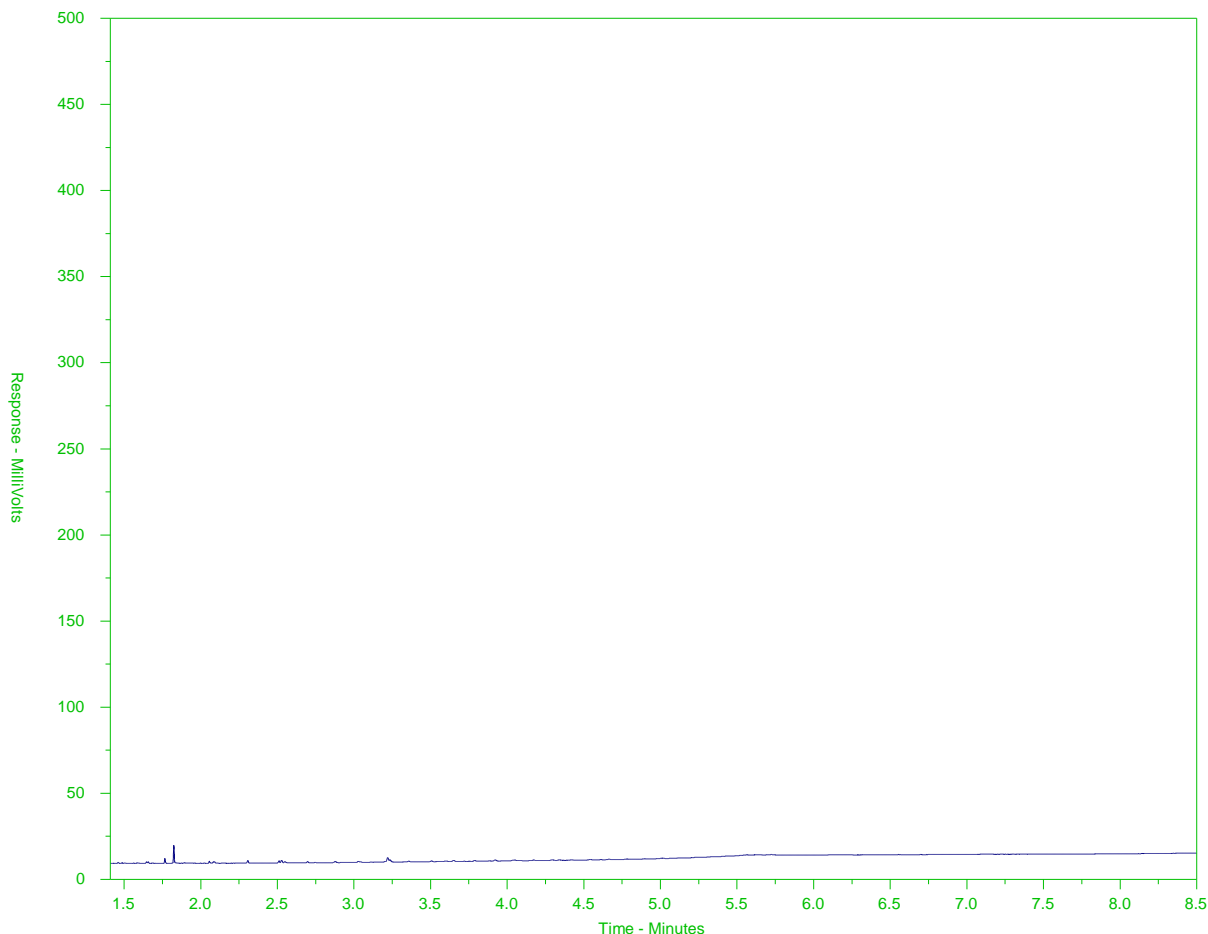
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-9
Client Sample ID: WT7-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

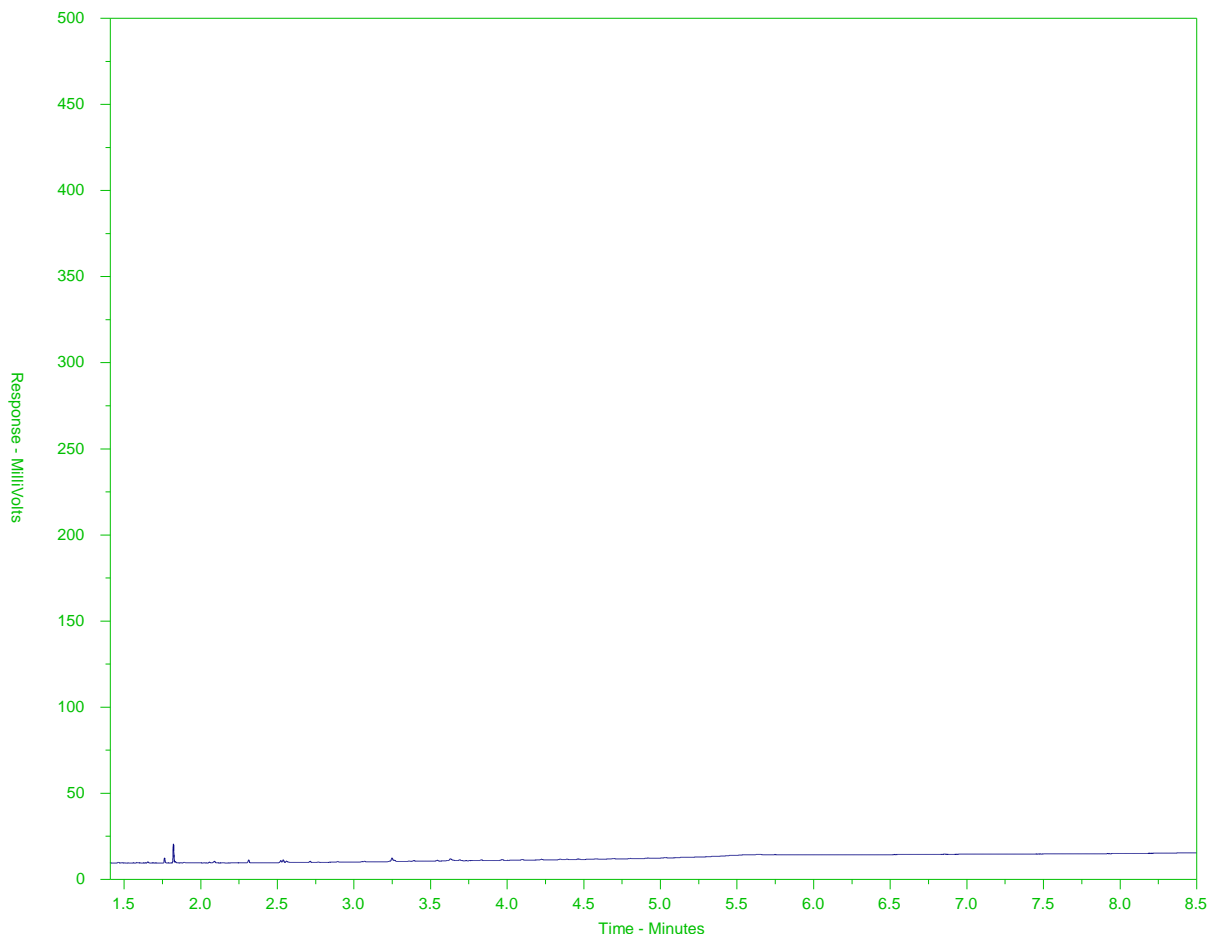
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-10
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

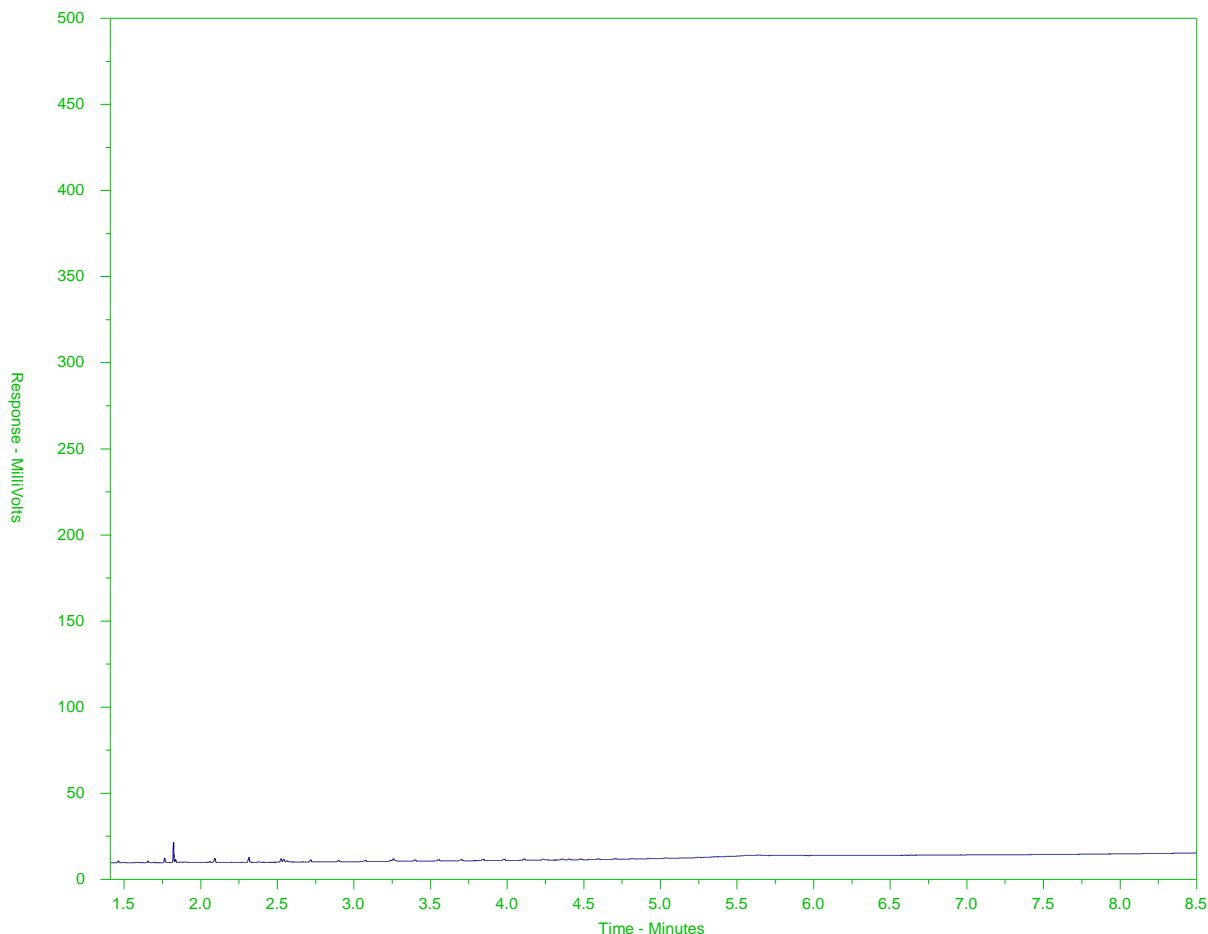
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2335149-C-11
Client Sample ID: FIELD BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Report To Contact and company name below will appear on the final report			Report Format / D			Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)																																																																																																																																																																						
Company: <u>STANTEC CONSULTING LTD.</u>			Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> (VIRTUAL)			Regular [R] <input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply																																																																																																																																																																						
Contact: <u>TYLER JOYCE</u>			Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td rowspan="3" style="width:5%; text-align:center; vertical-align:middle;">PRIORITY (Business Days)</td> <td>4 day [P4-20%]</td> <td><input type="checkbox"/></td> <td rowspan="3" style="width:5%; text-align:center; vertical-align:middle;">EMERGENCY</td> <td>1 Business day [E - 100%]</td> <td><input type="checkbox"/></td> </tr> <tr> <td>3 day [P3-25%]</td> <td><input type="checkbox"/></td> <td rowspan="2">Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]</td> <td><input type="checkbox"/></td> </tr> <tr> <td>2 day [P2-50%]</td> <td><input type="checkbox"/></td> </tr> </table>												PRIORITY (Business Days)	4 day [P4-20%]	<input type="checkbox"/>	EMERGENCY	1 Business day [E - 100%]	<input type="checkbox"/>	3 day [P3-25%]	<input type="checkbox"/>	Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]	<input type="checkbox"/>	2 day [P2-50%]	<input type="checkbox"/>																																																																																																																																															
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Phone: <u>778-229-2778</u>			Compare Results to Criteria on Report - provide details below if box checked <input type="checkbox"/>			Date and Time Required for all E&P TATs: dd-mm-yy hh:mm																																																																																																																																																																						
Company address below will appear on the final report			Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			For tests that can not be performed according to the service level selected, you will be contacted.																																																																																																																																																																						
Street: <u>500-4730 KINGSWAY</u>			Email 1 or Fax: <u>TYLER.JOYCE@STANTEC.COM</u>			<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="12" style="text-align:center;">Analysis Request</td> </tr> <tr> <td colspan="12" style="text-align:center;">Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below</td> </tr> <tr> <td rowspan="10" style="width:5%; text-align:center; vertical-align:middle;">NUMBER OF CONTAINERS</td> <td colspan="11"> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:10%;">PH, electrical conductivity, hardness, TSS</td> <td style="width:10%;">Nitrate (as N), nitrite (as N)</td> <td style="width:10%;">Total Metals + Mercury</td> <td style="width:10%;">Dissolved Metals + Mercury</td> <td style="width:10%;">F2-T4</td> <td style="width:10%;">F1</td> <td style="width:10%;">SURFACTANTS: Ammonia (as N), PHOSPHORUS (TOTAL)</td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> </tr> <tr> <td style="text-align:center;">F</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> </td> </tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>												Analysis Request												Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below												NUMBER OF CONTAINERS	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:10%;">PH, electrical conductivity, hardness, TSS</td> <td style="width:10%;">Nitrate (as N), nitrite (as N)</td> <td style="width:10%;">Total Metals + Mercury</td> <td style="width:10%;">Dissolved Metals + Mercury</td> <td style="width:10%;">F2-T4</td> <td style="width:10%;">F1</td> <td style="width:10%;">SURFACTANTS: Ammonia (as N), PHOSPHORUS (TOTAL)</td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> </tr> <tr> <td style="text-align:center;">F</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td style="text-align:center;">P</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>											PH, electrical conductivity, hardness, TSS	Nitrate (as N), nitrite (as N)	Total Metals + Mercury	Dissolved Metals + Mercury	F2-T4	F1	SURFACTANTS: Ammonia (as N), PHOSPHORUS (TOTAL)						F	P	P	P	P	P																																																																																																					
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City/Province: <u>BURNABY, BC</u>			Email 2: <u>STEVE.CHOU@STANTEC.COM</u>			SAMPLES ON HOLD																																																																																																																																																																						
Postal Code: <u>V5H 0C6</u>			Email 3: <u>CHRISTIAN.SMITH@STANTEC.COM</u>																																																																																																																																																																									
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Drinking Water (DW) Samples (client use)					Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)																																																																																																																																																																							
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO					Questions please call Steve C @ 604 396 6791																																																																																																																																																																							
Are samples for human consumption/ use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO																																																																																																																																																																												
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Released by: <u>STEVE CHOU</u> Date: <u>Aug 23, 2019</u> Time: <u>15:05</u>					Received by: Date: Time:					Received by: <u>HTA</u> Date: <u>8/23</u> Time: <u>5:10 pm</u>																																																																																																																																																																		



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 29-AUG-19
Report Date: 12-SEP-19 11:32 (MT)
Version: FINAL

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2338676
Project P.O. #: Task Code: 601.200
Job Reference: 123512431.601.200
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 09-SEP-19 11:38

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Physical Tests	Hardness (as CaCO ₃) (mg/L)	4930				
	Total Suspended Solids (mg/L)	<2.0	2.3	2.3	3.6	
Anions and Nutrients	Nitrate (as N) (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Nitrite (as N) (mg/L)	<0.10	<0.10	<0.10	<0.10	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0200	0.0249	0.0313	0.0676	
	Antimony (Sb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Total (mg/L)	0.00144	0.00155	0.00155	0.00158	
	Barium (Ba)-Total (mg/L)	0.0100	0.0101	0.0108	0.0108	
	Beryllium (Be)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	2.85	3.03	2.95	3.07	
	Cadmium (Cd)-Total (mg/L)	0.000060	0.000069	0.000061	0.000071	
	Calcium (Ca)-Total (mg/L)	292	315	304	317	
	Cesium (Cs)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Total (mg/L)	<0.000050	<0.000050	0.000052	0.000068	
	Copper (Cu)-Total (mg/L)	0.00100	0.00101	0.00131	0.00089	
	Gallium (Ga)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.025	0.033	0.035	0.079	
	Lead (Pb)-Total (mg/L)	0.000080	0.000076	0.000080	0.000112	
	Lithium (Li)-Total (mg/L)	0.124	0.126	0.115	0.129	
	Magnesium (Mg)-Total (mg/L)	906	942	937	982	
	Manganese (Mn)-Total (mg/L)	0.00335	0.00354	0.00454	0.00576	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	0.00841	0.00865	0.00897	0.00926	
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	0.053	<0.050	0.117	0.086	
	Potassium (K)-Total (mg/L)	273	298	302	319	
	Rhenium (Re)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Rubidium (Rb)-Total (mg/L)	0.0779	0.0809	0.0819	0.0869	
	Selenium (Se)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Total (mg/L)	<1.0	<1.0	<1.0	1.4	
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Total (mg/L)	7720	7580	7860	7920	
	Strontium (Sr)-Total (mg/L)	5.90	6.08	6.20	6.29	
	Sulfur (S)-Total (mg/L)	734	783	828	793	
	Tellurium (Te)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Total Metals	Thallium (Tl)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Total (mg/L)	0.00227	0.00221	0.00222	0.00247	
	Vanadium (V)-Total (mg/L)	<0.0020 ^{DLB}	<0.0020 ^{DLB}	<0.0020 ^{DLB}	<0.0025 ^{DLB}	
	Yttrium (Y)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Antimony (Sb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Arsenic (As)-Dissolved (mg/L)	0.00144	0.00141	0.00153	0.00148	
	Barium (Ba)-Dissolved (mg/L)	0.0091	0.0090	0.0100	0.0094	
	Beryllium (Be)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	2.86	2.96	2.98	3.11	
	Cadmium (Cd)-Dissolved (mg/L)	0.000063	0.000051	0.000055	0.000062	
	Calcium (Ca)-Dissolved (mg/L)	322	324	337	342	
	Cesium (Cs)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Cobalt (Co)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Copper (Cu)-Dissolved (mg/L)	0.00063	0.00064	0.00109	0.00046	
	Gallium (Ga)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	0.133	0.135	0.133	0.137	
	Magnesium (Mg)-Dissolved (mg/L)	1000	973	1020	1020	
	Manganese (Mn)-Dissolved (mg/L)	0.00252	0.00243	0.00350	0.00355	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00819	0.00827	0.00825	0.00897	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)	0.053	<0.050	0.058	0.059	
	Potassium (K)-Dissolved (mg/L)	311	312	321	328	
	Rhenium (Re)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	
Grouping	Analyte					
SEAWATER						
Dissolved Metals	Rubidium (Rb)-Dissolved (mg/L)	0.0894	0.0880	0.0909	0.0918	
	Selenium (Se)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Silicon (Si)-Dissolved (mg/L)	<1.0	<1.0	<1.0	1.0	
	Silver (Ag)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Sodium (Na)-Dissolved (mg/L)	8170	8300	8230	8270	
	Strontium (Sr)-Dissolved (mg/L)	5.84	5.94	6.16	6.62	
	Sulfur (S)-Dissolved (mg/L)	848	819	866	896	
	Tellurium (Te)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Thallium (Tl)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Thorium (Th)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Tin (Sn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Tungsten (W)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Uranium (U)-Dissolved (mg/L)	0.00228	0.00224	0.00227	0.00225	
	Vanadium (V)-Dissolved (mg/L)	0.00162	0.00156	0.00161	0.00170	
	Yttrium (Y)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	0.0013	0.0016	0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-1 Water 29-AUG-19 11:30 WT2	L2338676-2 Water 29-AUG-19 11:15 WT3	L2338676-3 Water 29-AUG-19 12:45 WT8	L2338676-4 Water 29-AUG-19 13:10 WT10	L2338676-5 Water 29-AUG-19 12:00 WT11
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	224	269	267	253	257
	Hardness (as CaCO3) (mg/L)	80.1	107	107	92.1	98.5
	pH (pH)	7.92	8.15	8.02	8.09	7.35
	Total Suspended Solids (mg/L)	45.0	<3.0	10.0	24.2	5.0
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0087	0.0202	0.0058	0.0077	<0.0050
	Nitrate (as N) (mg/L)	0.159	0.0520	1.29	1.15	0.244
	Nitrite (as N) (mg/L)	0.0016	<0.0010	<0.0010	0.0012	<0.0010
	Phosphorus (P)-Total (mg/L)	0.376 ^{RRV}	0.0672	0.0253	0.0369	0.0370
Total Metals	Aluminum (Al)-Total (mg/L)	0.251	0.0128	0.111	0.663	0.0211
	Antimony (Sb)-Total (mg/L)	0.00020	<0.00010	<0.00010	<0.00010	0.00015
	Arsenic (As)-Total (mg/L)	0.00538	0.00506	0.00131	0.00201	0.00307
	Barium (Ba)-Total (mg/L)	0.0146	0.00497	0.0612	0.0472	0.0163
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.079	0.016	0.017	0.015	0.026
	Cadmium (Cd)-Total (mg/L)	0.0000192	<0.0000050	0.0000072	0.0000246	0.0000154
	Calcium (Ca)-Total (mg/L)	22.5	26.7	27.4	25.9	29.4
	Cesium (Cs)-Total (mg/L)	0.000014	<0.000010	<0.000010	0.000033	<0.000010
	Chromium (Cr)-Total (mg/L)	0.00038	<0.00010	0.00122	0.00260	0.00017
	Cobalt (Co)-Total (mg/L)	0.00022	<0.00010	<0.00010	0.00052	<0.00010
	Copper (Cu)-Total (mg/L)	0.00151	<0.00050	0.00078	0.00172	0.00062
	Iron (Fe)-Total (mg/L)	2.33	<0.010	0.173	1.22	0.055
	Lead (Pb)-Total (mg/L)	0.000511	<0.000050	0.000168	0.000897	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	0.0013	0.0018	0.0017	<0.0010
	Magnesium (Mg)-Total (mg/L)	4.97	9.29	8.50	7.62	7.62
	Manganese (Mn)-Total (mg/L)	0.0536	0.00808	0.0234	0.0894	0.00727
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00122	0.000901	0.000723	0.000540	0.000971
	Nickel (Ni)-Total (mg/L)	<0.00050 ^{RRV}	<0.00050	<0.00050	0.00151	<0.00050
	Phosphorus (P)-Total (mg/L)	0.231	0.084	<0.050	0.106	0.053
	Potassium (K)-Total (mg/L)	3.06	2.95	1.74	1.39	3.33
	Rubidium (Rb)-Total (mg/L)	0.00126	0.00074	0.00063	0.00072	0.00143
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	0.000370	0.000261	0.000175
	Silicon (Si)-Total (mg/L)	8.72	10.9	12.2	12.4	8.65
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	14.1	10.2	10.2	11.4	9.84
	Strontium (Sr)-Total (mg/L)	0.0838	0.0972	0.135	0.139	0.110

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	L2338676-10 Water 29-AUG-19 DUP
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	38600	38600	38900	40300	270
	Hardness (as CaCO3) (mg/L)					107
	pH (pH)	7.86	7.91	7.91	7.89	8.00
	Total Suspended Solids (mg/L)					3.8
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	0.0107	0.0056	<0.0050	0.0176	<0.0050
	Nitrate (as N) (mg/L)					0.0505
	Nitrite (as N) (mg/L)					<0.0010
	Phosphorus (P)-Total (mg/L)	0.0397	0.0402	0.0783	0.0688	0.0672
Total Metals	Aluminum (Al)-Total (mg/L)					0.0072
	Antimony (Sb)-Total (mg/L)					<0.00010
	Arsenic (As)-Total (mg/L)					0.00493
	Barium (Ba)-Total (mg/L)					0.00490
	Beryllium (Be)-Total (mg/L)					<0.00010
	Bismuth (Bi)-Total (mg/L)					<0.000050
	Boron (B)-Total (mg/L)					0.015
	Cadmium (Cd)-Total (mg/L)					<0.0000050
	Calcium (Ca)-Total (mg/L)					27.1
	Cesium (Cs)-Total (mg/L)					<0.000010
	Chromium (Cr)-Total (mg/L)					<0.00010
	Cobalt (Co)-Total (mg/L)					<0.00010
	Copper (Cu)-Total (mg/L)					<0.00050
	Iron (Fe)-Total (mg/L)					<0.010
	Lead (Pb)-Total (mg/L)					<0.000050
	Lithium (Li)-Total (mg/L)					0.0013
	Magnesium (Mg)-Total (mg/L)					9.38
	Manganese (Mn)-Total (mg/L)					0.00820
	Mercury (Hg)-Total (mg/L)					<0.0000050
	Molybdenum (Mo)-Total (mg/L)					0.000891
	Nickel (Ni)-Total (mg/L)					<0.00050
	Phosphorus (P)-Total (mg/L)					0.089
	Potassium (K)-Total (mg/L)					2.98
	Rubidium (Rb)-Total (mg/L)					0.00080
	Selenium (Se)-Total (mg/L)					<0.000050
	Silicon (Si)-Total (mg/L)					10.9
	Silver (Ag)-Total (mg/L)					<0.000010
	Sodium (Na)-Total (mg/L)					10.2
	Strontium (Sr)-Total (mg/L)					0.0987

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-11 Water 29-AUG-19 FIELD BLANK				
Grouping	Analyte					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50				
	pH (pH)	5.73				
	Total Suspended Solids (mg/L)	<3.0				
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	<0.00010				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.0000050				
	Calcium (Ca)-Total (mg/L)	<0.050				
	Cesium (Cs)-Total (mg/L)	<0.000010				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0010				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.00010				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.050				
	Potassium (K)-Total (mg/L)	<0.050				
	Rubidium (Rb)-Total (mg/L)	<0.00020				
	Selenium (Se)-Total (mg/L)	<0.000050				
	Silicon (Si)-Total (mg/L)	<0.10				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-1 Water 29-AUG-19 11:30 WT2	L2338676-2 Water 29-AUG-19 11:15 WT3	L2338676-3 Water 29-AUG-19 12:45 WT8	L2338676-4 Water 29-AUG-19 13:10 WT10	L2338676-5 Water 29-AUG-19 12:00 WT11
Grouping	Analyte					
WATER						
Total Metals	Sulfur (S)-Total (mg/L)	1.50	4.39	4.34	4.30	4.62
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	0.00025	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00700	<0.00030	0.00411	0.0250	0.00077
	Tungsten (W)-Total (mg/L)	0.00027	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000054	0.000095	0.000156	0.000153	0.000096
	Vanadium (V)-Total (mg/L)	0.00162	<0.00050	0.00162	0.00307	0.00078
	Zinc (Zn)-Total (mg/L)	0.0443	<0.0030	<0.0030	0.0103	0.0334
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0026	0.0035	0.0078	0.0097	0.0029
	Antimony (Sb)-Dissolved (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	0.00013
	Arsenic (As)-Dissolved (mg/L)	0.00155	0.00524	0.00117	0.00129	0.00331
	Barium (Ba)-Dissolved (mg/L)	0.0102	0.00535	0.0589	0.0305	0.0175
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	0.083	0.016	0.018	0.014	0.023
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	0.0000080	<0.000050	0.0000106
	Calcium (Ca)-Dissolved (mg/L)	23.0	26.7	28.1	23.3	25.8
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00093	0.00088	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00033	<0.00020	0.00045	0.00026	0.00050
	Iron (Fe)-Dissolved (mg/L)	0.016	<0.010	0.028	0.028	0.012
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	0.0012	0.0017	0.0012	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	5.51	9.76	8.92	8.21	8.25
	Manganese (Mn)-Dissolved (mg/L)	0.00973	0.00167	0.0258	0.0118	0.00723
	Mercury (Hg)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)	0.00119	0.000905	0.000654	0.000491	0.000801
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	0.064	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	3.24	3.05	1.83	1.42	3.54
	Rubidium (Rb)-Dissolved (mg/L)	0.00129	0.00080	0.00065	0.00040	0.00159

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	L2338676-10 Water 29-AUG-19 DUP
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)						4.34
	Tellurium (Te)-Total (mg/L)						<0.00020
	Thallium (Tl)-Total (mg/L)						<0.000010
	Thorium (Th)-Total (mg/L)						<0.00010
	Tin (Sn)-Total (mg/L)						<0.00010
	Titanium (Ti)-Total (mg/L)						<0.00030
	Tungsten (W)-Total (mg/L)						<0.00010
	Uranium (U)-Total (mg/L)						0.000091
	Vanadium (V)-Total (mg/L)						<0.00050
	Zinc (Zn)-Total (mg/L)						<0.0030
	Zirconium (Zr)-Total (mg/L)						<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location						FIELD
	Dissolved Metals Filtration Location						FIELD
	Aluminum (Al)-Dissolved (mg/L)						0.0032
	Antimony (Sb)-Dissolved (mg/L)						<0.00010
	Arsenic (As)-Dissolved (mg/L)						0.00525
	Barium (Ba)-Dissolved (mg/L)						0.00525
	Beryllium (Be)-Dissolved (mg/L)						<0.00010
	Bismuth (Bi)-Dissolved (mg/L)						<0.000050
	Boron (B)-Dissolved (mg/L)						0.016
	Cadmium (Cd)-Dissolved (mg/L)						<0.000050
	Calcium (Ca)-Dissolved (mg/L)						27.2
	Cesium (Cs)-Dissolved (mg/L)						<0.000010
	Chromium (Cr)-Dissolved (mg/L)						<0.00010
	Cobalt (Co)-Dissolved (mg/L)						<0.00010
	Copper (Cu)-Dissolved (mg/L)						<0.00020
	Iron (Fe)-Dissolved (mg/L)						<0.010
	Lead (Pb)-Dissolved (mg/L)						<0.000050
	Lithium (Li)-Dissolved (mg/L)						0.0012
	Magnesium (Mg)-Dissolved (mg/L)						9.50
	Manganese (Mn)-Dissolved (mg/L)						0.00180
	Mercury (Hg)-Dissolved (mg/L)						<0.000050
	Molybdenum (Mo)-Dissolved (mg/L)						0.000905
	Nickel (Ni)-Dissolved (mg/L)						<0.00050
	Phosphorus (P)-Dissolved (mg/L)						0.076
	Potassium (K)-Dissolved (mg/L)						3.04
	Rubidium (Rb)-Dissolved (mg/L)						0.00082

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2338676-11 Water 29-AUG-19 FIELD BLANK				
Grouping	Analyte						
WATER							
Total Metals	Sulfur (S)-Total (mg/L)	<0.50					
	Tellurium (Te)-Total (mg/L)	<0.00020					
	Thallium (Tl)-Total (mg/L)	<0.000010					
	Thorium (Th)-Total (mg/L)	<0.00010					
	Tin (Sn)-Total (mg/L)	<0.00010					
	Titanium (Ti)-Total (mg/L)	<0.00030					
	Tungsten (W)-Total (mg/L)	<0.00010					
	Uranium (U)-Total (mg/L)	<0.000010					
	Vanadium (V)-Total (mg/L)	<0.00050					
	Zinc (Zn)-Total (mg/L)	<0.0030					
	Zirconium (Zr)-Total (mg/L)	<0.00020					
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD					
	Dissolved Metals Filtration Location	FIELD					
	Aluminum (Al)-Dissolved (mg/L)	<0.0010					
	Antimony (Sb)-Dissolved (mg/L)	<0.00010					
	Arsenic (As)-Dissolved (mg/L)	<0.00010					
	Barium (Ba)-Dissolved (mg/L)	<0.00010					
	Beryllium (Be)-Dissolved (mg/L)	<0.00010					
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050					
	Boron (B)-Dissolved (mg/L)	<0.010					
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050					
	Calcium (Ca)-Dissolved (mg/L)	<0.050					
	Cesium (Cs)-Dissolved (mg/L)	<0.000010					
	Chromium (Cr)-Dissolved (mg/L)	<0.00010					
	Cobalt (Co)-Dissolved (mg/L)	<0.00010					
	Copper (Cu)-Dissolved (mg/L)	<0.00020					
	Iron (Fe)-Dissolved (mg/L)	<0.010					
	Lead (Pb)-Dissolved (mg/L)	<0.000050					
	Lithium (Li)-Dissolved (mg/L)	<0.0010					
	Magnesium (Mg)-Dissolved (mg/L)	<0.0050					
	Manganese (Mn)-Dissolved (mg/L)	<0.00010					
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050					
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050					
	Nickel (Ni)-Dissolved (mg/L)	<0.00050					
	Phosphorus (P)-Dissolved (mg/L)	<0.050					
	Potassium (K)-Dissolved (mg/L)	<0.050					
	Rubidium (Rb)-Dissolved (mg/L)	<0.00020					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-1 Water 29-AUG-19 11:30 WT2	L2338676-2 Water 29-AUG-19 11:15 WT3	L2338676-3 Water 29-AUG-19 12:45 WT8	L2338676-4 Water 29-AUG-19 13:10 WT10	L2338676-5 Water 29-AUG-19 12:00 WT11
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	0.000051	<0.000050	0.000346	0.000208	0.000203
	Silicon (Si)-Dissolved (mg/L)	8.01	10.5	11.7	11.5	8.57
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	15.7	10.8	11.4	11.9	11.0
	Strontium (Sr)-Dissolved (mg/L)	0.0776	0.0972	0.122	0.122	0.0925
	Sulfur (S)-Dissolved (mg/L)	1.35	4.28	4.64	4.32	5.00
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	0.00016	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000039	0.000085	0.000113	0.000076	0.000075
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	0.00124	0.00095	0.00069
	Zinc (Zn)-Dissolved (mg/L)	0.0113	0.0014	0.0016	<0.0010	0.0341
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	88.7	95.4	86.2	87.8	92.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-6 Seawater 29-AUG-19 09:55 WT5-SURFACE	L2338676-7 Seawater 29-AUG-19 09:45 WT5-DEEP	L2338676-8 Seawater 29-AUG-19 10:20 WT7-SURFACE	L2338676-9 Seawater 29-AUG-19 10:10 WT7-DEEP	L2338676-10 Water 29-AUG-19 DUP
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)					<0.000050
	Silicon (Si)-Dissolved (mg/L)					10.5
	Silver (Ag)-Dissolved (mg/L)					<0.000010
	Sodium (Na)-Dissolved (mg/L)					10.5
	Strontium (Sr)-Dissolved (mg/L)					0.0957
	Sulfur (S)-Dissolved (mg/L)					4.35
	Tellurium (Te)-Dissolved (mg/L)					<0.00020
	Thallium (Tl)-Dissolved (mg/L)					<0.000010
	Thorium (Th)-Dissolved (mg/L)					<0.00010
	Tin (Sn)-Dissolved (mg/L)					<0.00010
	Titanium (Ti)-Dissolved (mg/L)					<0.00030
	Tungsten (W)-Dissolved (mg/L)					<0.00010
	Uranium (U)-Dissolved (mg/L)					0.000087
	Vanadium (V)-Dissolved (mg/L)					<0.00050
	Zinc (Zn)-Dissolved (mg/L)					0.0019
	Zirconium (Zr)-Dissolved (mg/L)					<0.00020
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F3 (C16-C34) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	F4 (C34-C50) (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	88.6	85.8	88.3	92.6	93.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2338676-11 Water 29-AUG-19 FIELD BLANK				
Grouping	Analyte					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.000050				
	Silicon (Si)-Dissolved (mg/L)	<0.050				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	<0.050				
	Strontium (Sr)-Dissolved (mg/L)	<0.00020				
	Sulfur (S)-Dissolved (mg/L)	<0.50				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	<0.00010				
	Uranium (U)-Dissolved (mg/L)	<0.000010				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020				
Volatile Organic Compounds	F1 (C6-C10) (mg/L)	0.10				
Hydrocarbons	F2 (C10-C16) (mg/L)	<0.30				
	F3 (C16-C34) (mg/L)	<0.30				
	F4 (C34-C50) (mg/L)	<0.30				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	89.5				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Laboratory Control Sample	F1 (C6-C10)	LCS-ND	L2338676-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Vanadium (V)-Total	MB-LOR	L2338676-6, -7, -8, -9
Laboratory Control Sample	Bismuth (Bi)-Dissolved	MES	L2338676-1, -10, -11, -2, -3, -4, -5
Laboratory Control Sample	Thorium (Th)-Dissolved	MES	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Boron (B)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Aluminum (Al)-Total	MS-B	L2338676-1
Matrix Spike	Barium (Ba)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L2338676-1
Matrix Spike	Iron (Fe)-Total	MS-B	L2338676-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2338676-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L2338676-1
Matrix Spike	Sodium (Na)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L2338676-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L2338676-1, -10, -11, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L2338676-1
Matrix Spike	Boron (B)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Potassium (K)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Rubidium (Rb)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L2338676-6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L2338676-10, -11, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLB	Detection Limit Raised. Analyte detected at comparable level in Method Blank.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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.

Reference Information

RRV

Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-C-NO2-IC-VA	Seawater	Nitrite in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-C-NO3-IC-VA	Seawater	Nitrate in Seawater by IC	EPA 300.1 (mod)
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.			
F1-HSFID-VA	Water	CCME F1 By Headspace with GCFID	EPA 5021A/CCME CWS PHC (Pub# 1310)
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10), the sample undergoes a headspace purge prior to analysis by GC/FID.			
F1 (C6-C10): Sum of all hydrocarbons that elute between nC6 and nC10.			
F2-F4-ME-FID-VA	Water	CCME F2-F4 Hydrocarbons in Water	CCME CWS-PHC, Pub #1310, Dec 2001
F2-F4 is extracted from water using a hexane micro-extraction technique. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Tier 1 Method, CCME, Dec 2001.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HARDNESS-CALC-VA	Seawater	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-DIS-C-CVAFS-VA	Seawater	Diss. Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.			
HG-TOT-C-CVAFS-VA	Seawater	Total Mercury in Seawater by CVAFS	PUGET SOUND PROTOCOLS, EPA 245.7
This analysis is carried out using procedures adapted from "Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment, and Tissue Samples" prepared for the United States Environmental Protection Agency and the Puget Sound Water Quality Authority, 1995. The procedure involves a cold-oxidation of the acidified seawater sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-D-F-HMI-CCMS-VA	Seawater	Diss. Metals in Seawater by CRC ICPMS	APHA 3030B/EPA 6020B (mod)
Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS (HMI Mode).			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-HB-F-HMI-MS-VA Seawater Tot Metals in Seawater by CRC ICPMS (BC) EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS (HMI Mode). This method is compliant with digestion requirements of the British Columbia Environmental Laboratory Manual.

NA-D-CCMS-VA Seawater Diss. Sodium in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

NA-T-CCMS-VA Seawater Total Sodium in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SI-D-CCMS-VA Seawater Diss. Silicon in Seawater by CRC ICPMS APHA 3030B/EPA 6020B (mod)

Seawater samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

SI-T-CCMS-VA Seawater Total Silicon in Seawater by CRC ICPMS EPA 200.2/6020B (mod)

Seawater samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

TSS-C-VA Seawater Total Suspended Solids by Gravimetric APHA 2540 D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) is determined by filtering a sample through a glass fibre filter. TSS is determined by drying the filter at 104 degrees celsius.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

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.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
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Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

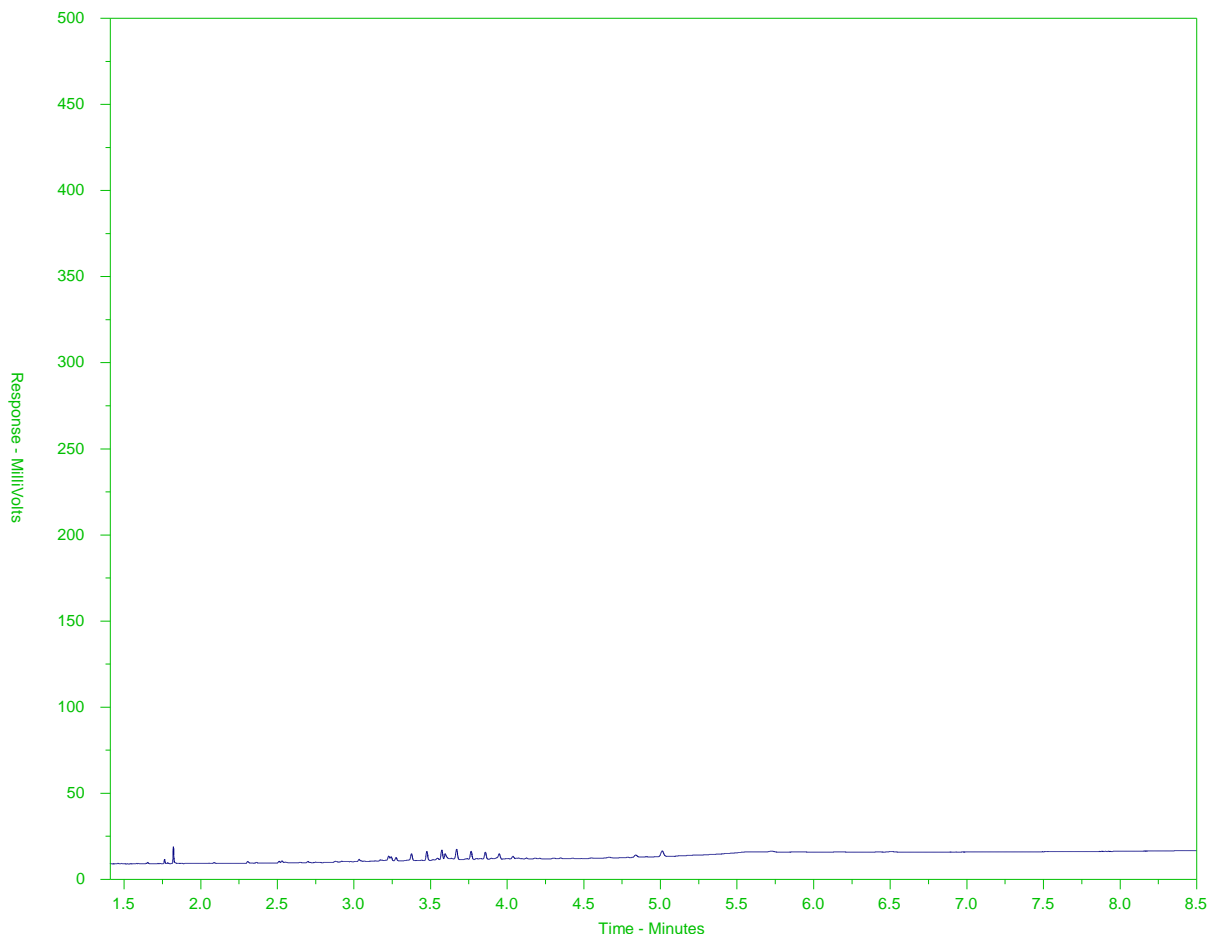
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-1
Client Sample ID: WT2



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

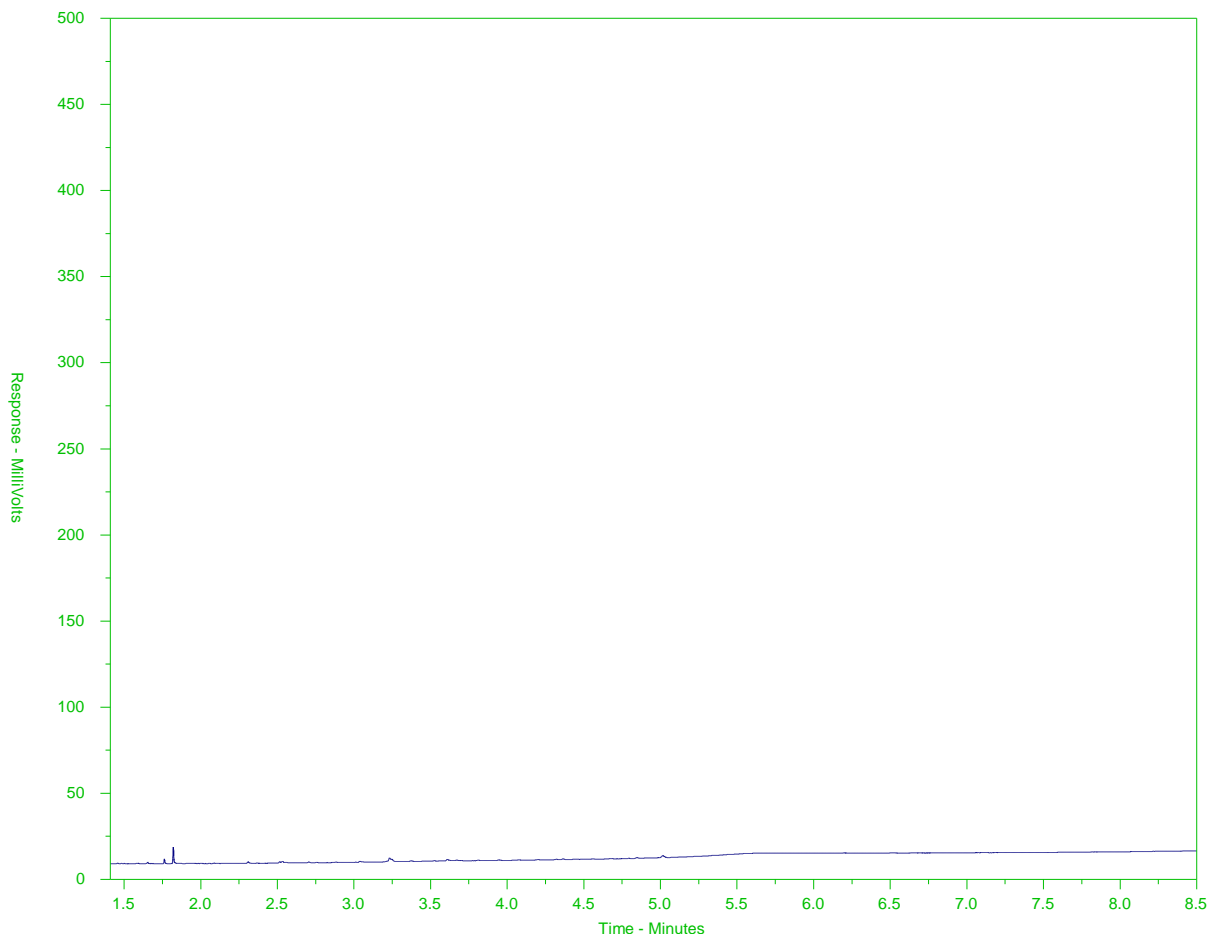
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-2
Client Sample ID: WT3



← F2 →		← F3 →		← F4 →	
nC10	nC16	nC34		nC50	
174°C	287°C	481°C		575°C	
346°F	549°F	898°F		1067°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

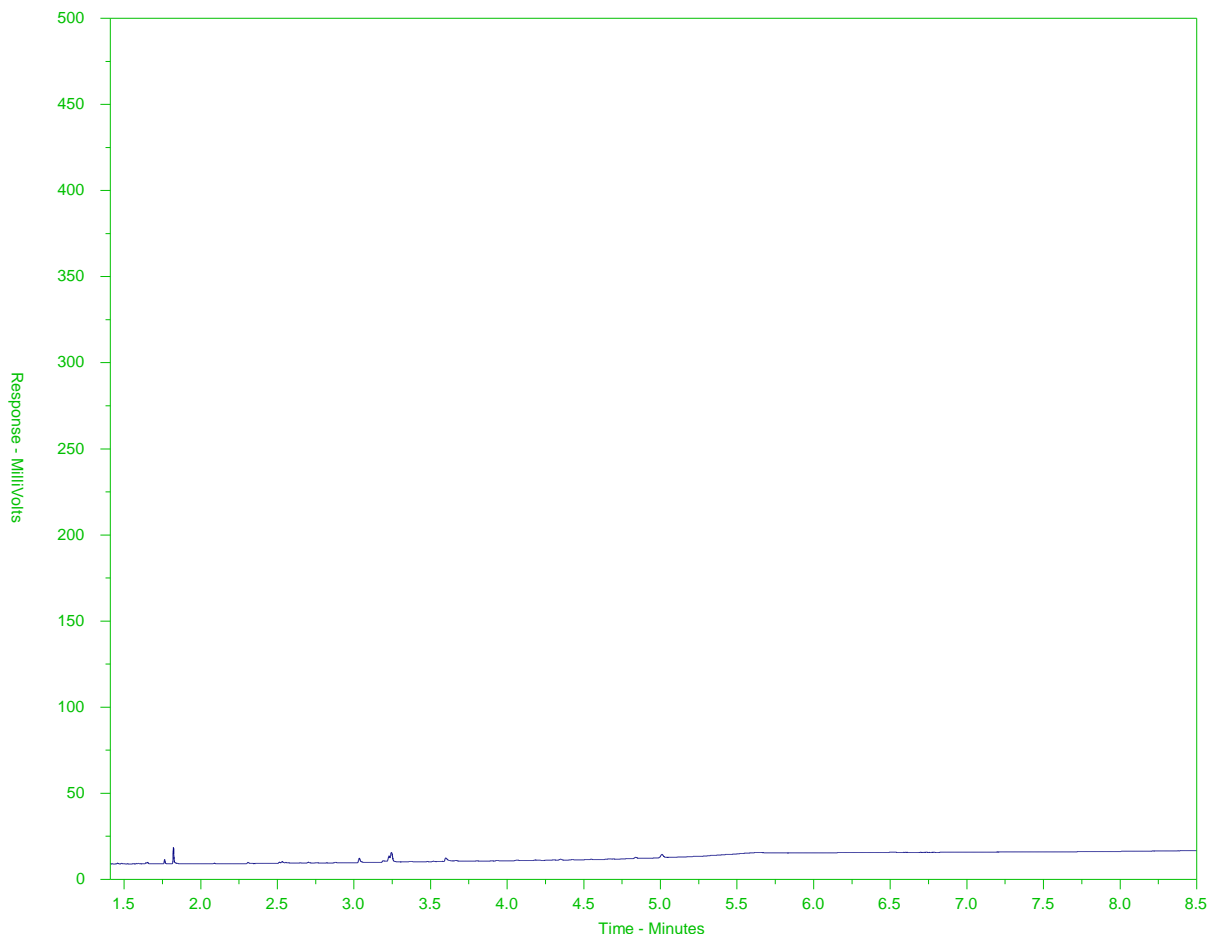
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-3
Client Sample ID: WT8



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

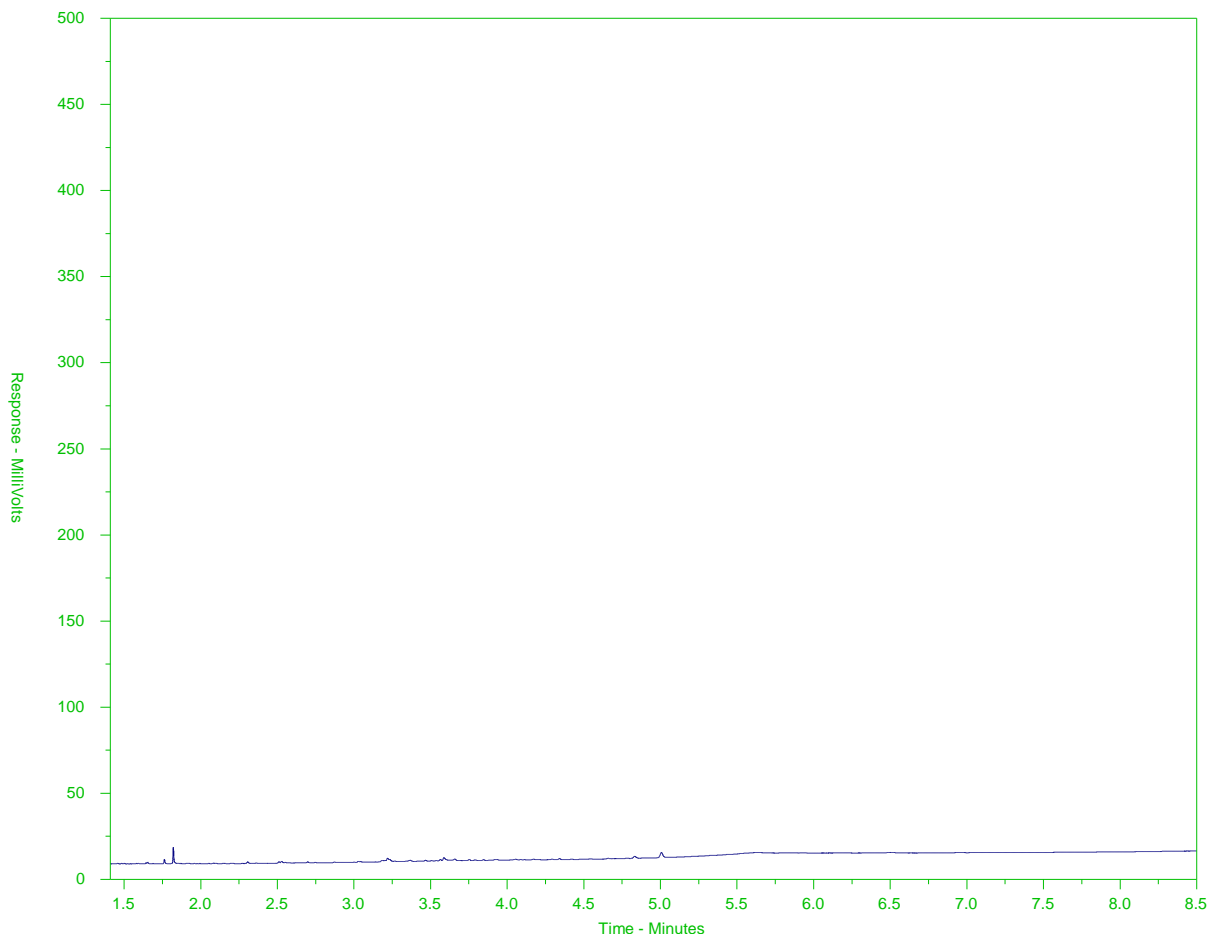
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-4
Client Sample ID: WT10



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

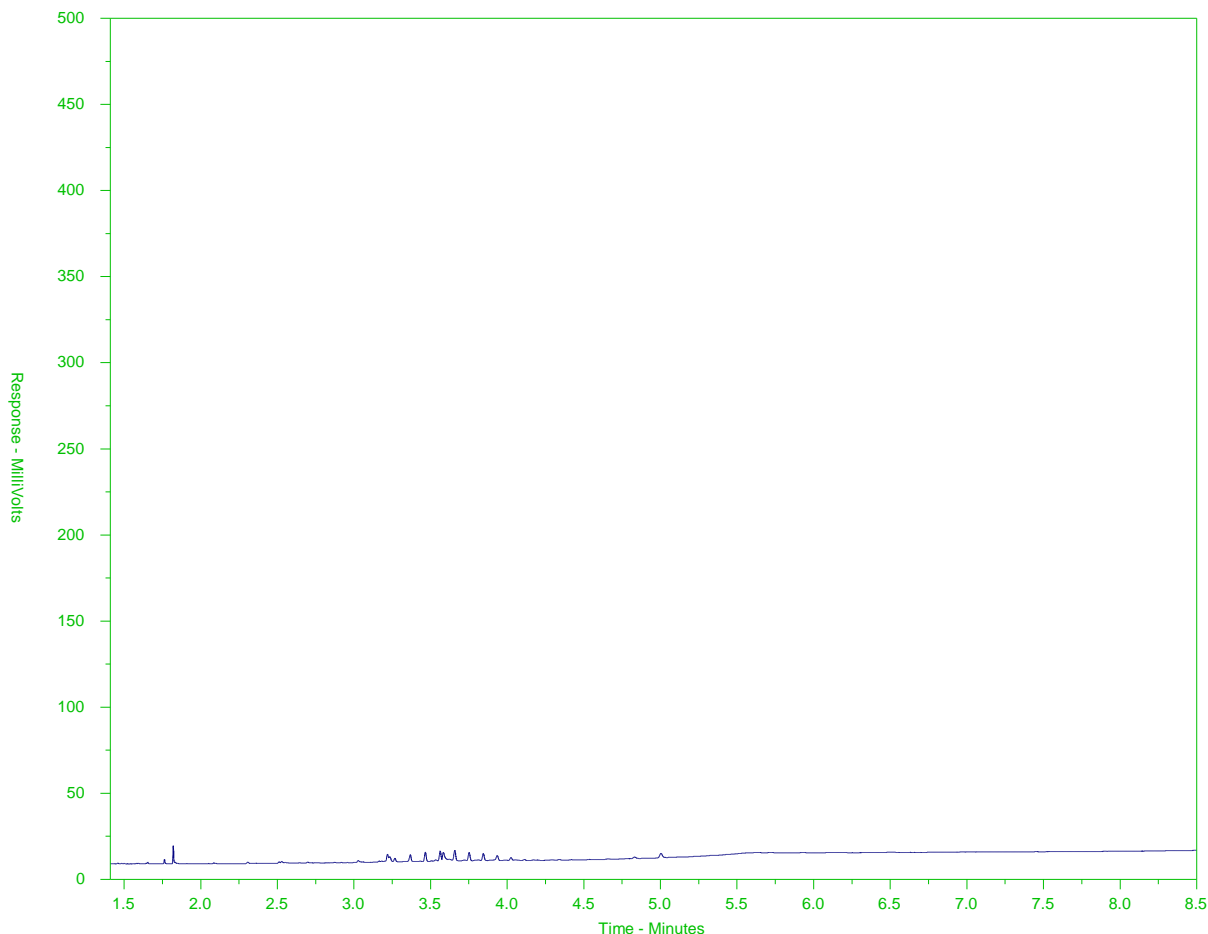
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-5
Client Sample ID: WT11



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

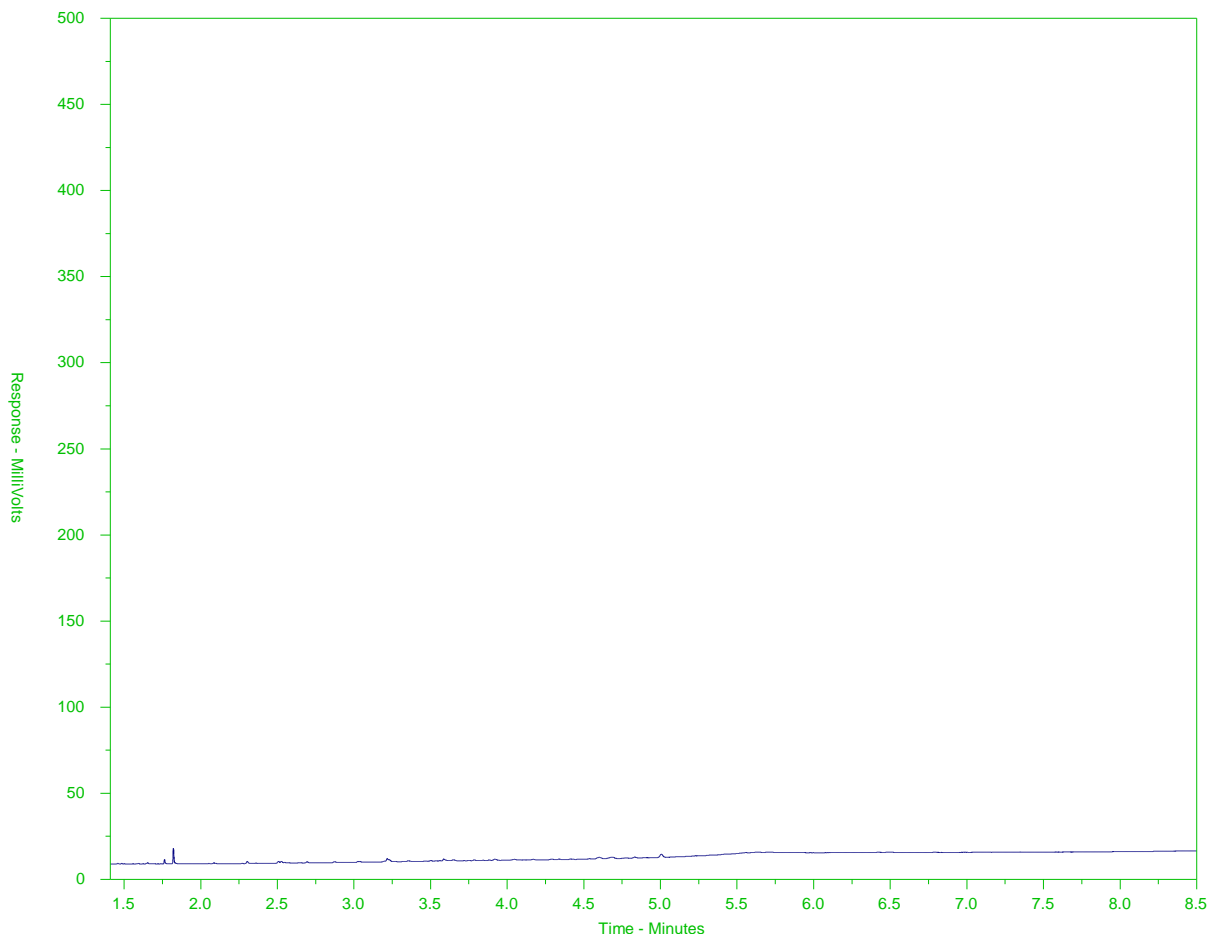
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-6
Client Sample ID: WT5-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

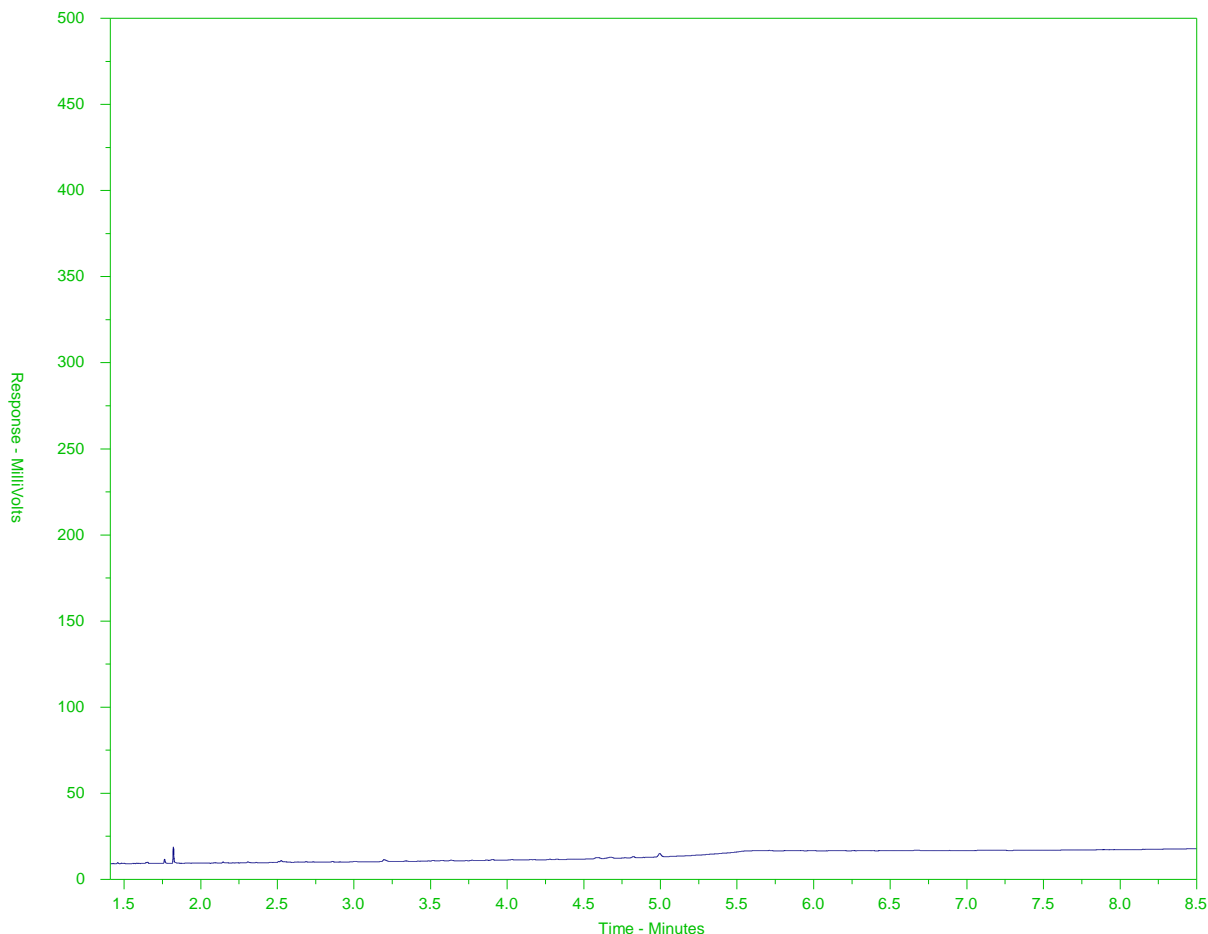
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-7
Client Sample ID: WT5-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

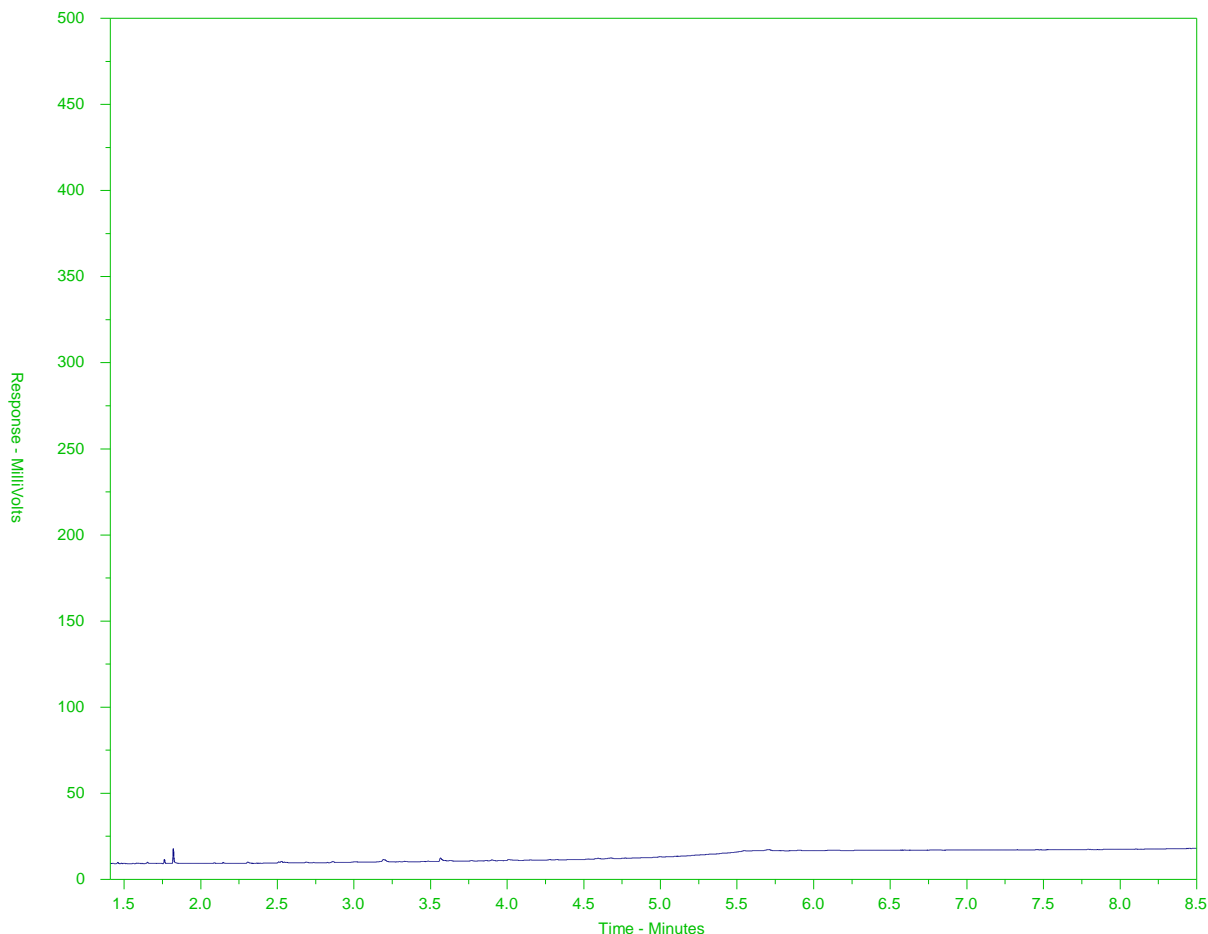
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-8
Client Sample ID: WT7-SURFACE



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

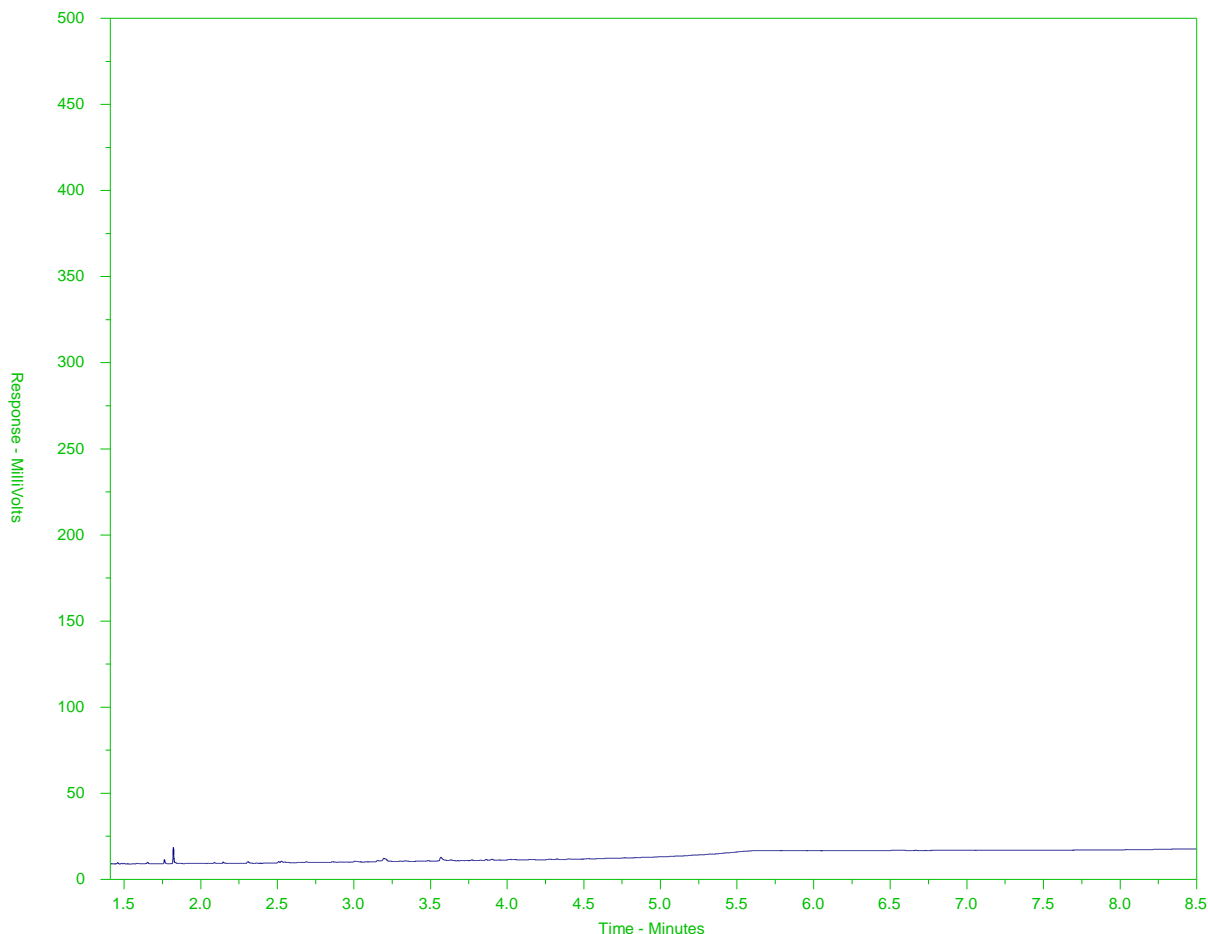
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-9
Client Sample ID: WT7-DEEP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

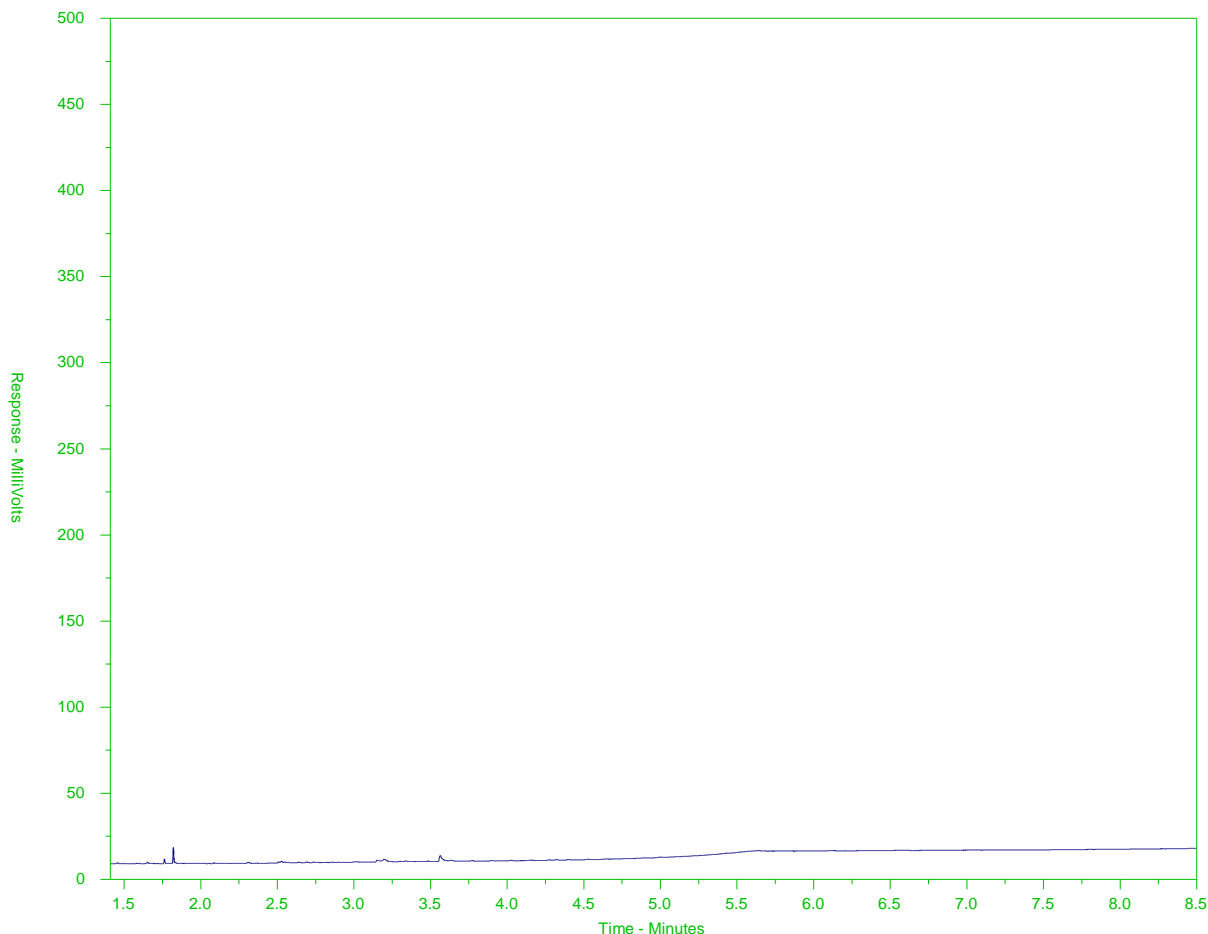
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-10
Client Sample ID: DUP



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

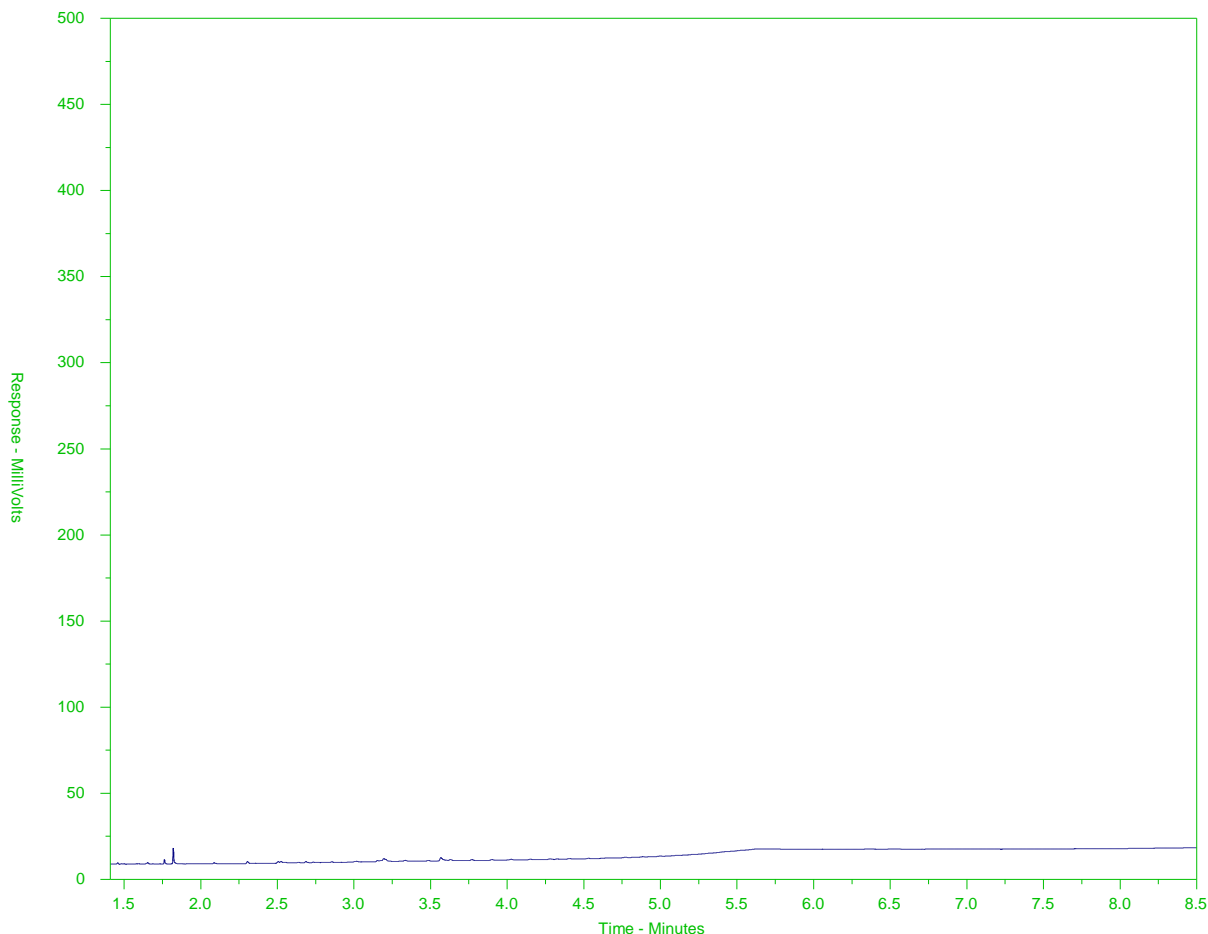
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2338676-C-11
Client Sample ID: FIELD BLANK



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



ALS Environmental

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2338676 COC/F

COC Number: 15 -

Page ____ of ____

Report To Contact and company name below will appear on the final report			Report Form			Please confirm all E&P TATs with your AM - surcharges will apply											
Company: STANTEC CONSULTING			Select Report Format: <input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EPO (DIGITAL)			Regular [R] <input checked="" type="checkbox"/> standard TAT if received by 3 pm - business days - no surcharges apply											
Contact: TYLER JOYCE			Quality Control (QC) Report with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			4 day [P4] <input type="checkbox"/>		3 day [P3] <input type="checkbox"/>		2 day [P2] <input type="checkbox"/>		1 Business day [E1] <input type="checkbox"/>		Same Day, Weekend or Statutory holiday [E0] <input type="checkbox"/>			
Phone: 778-229-2278			<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked			Priority [Business Day]		Emergency									
Company address below will appear on the final report			Select Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm											
Street: 500 - 4730 Kingsway			Email 1 or Fax: TYLER.JOYCE@STANTEC.COM			For tests that can not be performed according to the service level selected, you will be contacted.											
City/Province: Burnaby, BC			Email 2: STEVE.CHOU@STANTEC.COM			Analysis Request											
Postal Code: V5H 0C6			Email 3: CHASTIAN.SMITH@STANTEC.COM			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below											
Invoice To: Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO			Invoice Distribution														
Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO			Select Invoice Distribution: <input type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX														
Company:			Email 1 or Fax:														
Contact:			Email 2:														
Project Information			Oil and Gas Required Fields (client use)														
ALS Account # / Quote #: Q74015			AFE/Cost Center:			PO#:											
Job #: 123512431 - 601.200			Major/Minor Code:			Routing Code:											
PO / AFE: TASK CODE: 601.200			Requisitioner:														
LSD:			Location:														
ALS Lab Work Order # (lab use only): L2338676			ALS Contact: BRENT MACK			Sampler: STEVE CHOU, CHRISTIAN SMITH											
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Number of Containers											
WT2			29-AUG-19	11:30	WATER	10											
WT3			29-AUG-19	11:15	WATER	10											
WT8			29-AUG-19	12:45	WATER	10											
WT10			29-AUG-19	13:10	WATER	10											
WT11			29-AUG-19	12:00	WATER	10											
WT5-SURFACE			29-AUG-19	9:55	SEAWATER	10											
WT5-DEEP			29-AUG-19	9:45	SEA WATER	10											
WT7-SURFACE			29-AUG-19	10:20	SEA WATER	10											
WT7-DEEP			29-AUG-19	10:10	SEA WATER	10											
DUP			29-AUG-19		WATER	10											
FIELD BLANK			29-AUG-19		WATER	10											
Drinking Water (DW) Samples¹ (client use)			Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)			SAMPLE CONDITION AS RECEIVED (lab use only)											
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO						Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>											
Are samples for human drinking water use? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO						Ice Packs <input type="checkbox"/> Ice Cubes <input checked="" type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>											
						Cooling Initiated <input checked="" type="checkbox"/>											
						INITIAL COOLER TEMPERATURES °C											
						FINAL COOLER TEMPERATURES °C											
						9											
SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)											
Released by: STEVE CHOU			Received by: HAN														
Date: Aug 29, 2019			Date: 8/25														
Time: 14:20			Time: 2:05														

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FORM

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

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX P

Westridge Marine Terminal—Soil Quality Baseline Assessment



**Westridge Marine Terminal—
Soil Quality Baseline Assessment**

Trans Mountain Expansion Project

October 2, 2019

Prepared for:

Trans Mountain Pipeline ULC


Prepared by:

Stantec Consulting Ltd.

TMC Doc No.:
01-13283-TB-BB00-RG-APP-0010 R1


WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

This document entitled Westridge Marine Terminal—Soil Quality Baseline Assessment was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Trans Mountain Pipeline ULC (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment considering the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not consider any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Authored by  Digitally signed by Tyler
Joyce
Date: 2019.10.02
10:30:33 -07'00'

(signature)

Tyler Joyce, C.Tech.

Reviewed by  2019.10.02
10:24:23 -07'00'

(signature)

Matthew Redmond, P.Eng.



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Abbreviations

ALS	ALS Laboratory Group
BC	British Columbia
BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CALA	Canadian Analytical Laboratory Association
CCME	Canadian Council of Ministers of the Environment
CRM	certified reference material
CSA	Canadian Standards Association
CSR	Contaminated Site Regulation
CWS	Canada Wide Standards
EMA	<i>Environmental Management Act</i>
ESA	Environmental Site Assessment
HEPH	heavy extractable petroleum hydrocarbons
HSVL	headspace vapour level
HWR	Hazardous Waste Regulation
IL	industrial land use



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

KLTP	Kiewit Ledcor Trans Mountain Partnership
LEPH	light extractable petroleum hydrocarbons
LTDL	less than detection limit
mbgs	metres below ground surface
PAH	polycyclic aromatic hydrocarbons
PHC	petroleum hydrocarbon
ppmv	parts per million by volume
QA/QC	Quality Assurance/Quality Control
RPD	relative percentage difference
SQG	soil quality guidelines
TCLP	toxicity characteristic leaching procedure
TMEP	Trans Mountain Expansion Project
VH	volatile hydrocarbons
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WQG	BC Ambient Water Quality Guideline



Introduction

1.0 INTRODUCTION

Trans Mountain Pipeline ULC (Trans Mountain) intends to upgrade and expand the Westridge Marine Terminal (the Terminal) to increase its crude oil product delivery and export capacity. The Terminal's current discharge Permit (#3678) under the British Columbia (BC) *Environmental Management Act* (EMA) authorizes discharge of accumulated stormwater from the dyked area surrounding Tanks 201 and 202 (which includes stormwater from Tank 93) into Burrard Inlet through two outfalls (west and east). This Permit requires amendments to support construction-related discharge during the expansion construction works. Trans Mountain retained Stantec Consulting Ltd. (Stantec) to characterize baseline soil quality at the Terminal, to support the Phase 3 Permit amendment.

This soil quality baseline assessment presents observations and a summary of the results of the relevant soil quality data collected in 2017 and the soil analytical testing completed on soil samples from fifteen boreholes advanced in 2019 from the following three proposed construction areas:

1. Foreshore Excavation Area
2. Manifold and Piperack Area
3. Tunnel and Substation Area

The leachable characteristics of the soil data were assessed to determine the potential for impacts to surrounding surface water bodies. It is important to note that the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) acknowledges that this investigation was intended to characterize the baseline quality of soils in these construction areas (i.e., terrestrial soil) and that information on marine sediments is not required for this assessment.



Scope of Work

2.0 SCOPE OF WORK

The scope of work for this soil baseline assessment consisted of the following:

- Review of existing historical data collected at the Terminal that may be suitable for inclusion in the soil baseline assessment
- Identification of 15 new additional borehole locations to assess soil quality for the purposes of this baseline assessment
- Completion of a health and safety plan for field work at the Terminal
- Working with the contractor (Kiewit Ledcor Trans Mountain Partnership [KLTP]) to complete the required ground disturbance and daily work permits
- Completing a BC One Call information request and retaining the services of a private utility locator to locate all utilities on the Terminal prior to any sub-surface assessments
- Daylighting 15 borehole locations by hydro-vacuum extraction to a maximum depth of 3.2 metres below ground surface (mbgs)
- Collecting representative soil samples at regular depth intervals for visual classification and headspace vapour concentration measurements, and recording subsurface soil conditions at each borehole location, including soil colour, type, and relative moisture level
- Submitting twenty-three soil samples (including two duplicates) for laboratory analysis according to the analytical schedule provided in Section 4.3 below
- Completing this Soil Baseline Assessment report to summarize the findings of the assessment

3.0 REGULATORY

The discharge Permit for the Terminal is issued by the province of BC and therefore this assessment has been conducted to meet the requirements of provincial legislation and the supporting regulations and guidelines. In addition to the provincial legislation, the Canadian Council of Ministers of the Environment (CCME) federal guidelines were also used for comparison purposes only.

Site-specific regulatory aspects of note are summarized in the subsequent sections.

3.1 BC CONTAMINATED SITES REGULATIONS (CSR)

In British Columbia, the management and investigation of contaminated sites is regulated under the EMA. The Contaminated Site Regulation (CSR) is the enabling regulation under the EMA that includes procedures for the investigation and reporting of contaminated sites. The CSR also includes numerical standards for soil quality for specific land uses.

The Terminal is currently zoned as Industrial and is currently used as a marine terminal. Therefore, the generic numerical and matrix numerical standards for IL were used as comparison for the Terminal.



Regulatory

For the purposes of this study, the generic and matrix numerical standards protective of environmental health were applied to the Terminal; the standards that are intended to protect human health are omitted for this project as consideration of human health was not required to be evaluated for the Stage 3 Permit amendment.

The matrix numerical standards are applied according to land use and site-specific factors. According to subsection 12 (8) of the CSR, mandatory factors include intake of contaminated soil, and toxicity to soil invertebrates and plants. As noted above, the matrix standards protective of human health were omitted from this project and therefore the matrix standard for the intake of contaminated soil were not considered. Additional site-specific factors that apply at the Terminal include groundwater flow to surface water used by aquatic life. Both freshwater and marine standards are applied at the Site because of the presence of several watercourses running through and adjacent to the Terminal and the proximity of Burrard Inlet (see Figure 1).

As such, the CSR IL standards deemed applicable at the Terminal for the purposes of this project were:

- **Schedule 3.1 Part 1 Matrix**—Numerical Soil Standards—applying Site-specific Factors for toxicity to soil invertebrates and plants and groundwater flow to surface water used by aquatic life (marine and freshwater); and,
- **Schedule 3.1 Part 3**—Generic Numerical Soil Standards to Protect Ecological Health

3.2 BC HAZARDOUS WASTE REGULATIONS (HWR)

The Hazardous Waste Regulation (HWR), which was amended most recently on November 1, 2017, defines practices and methodologies for handling, transporting and storing/disposing of materials designated as hazardous waste. The objective of the HWR amendment, and simultaneous amendment of the CSR, was to “decouple” certain provisions of both.

The definition of hazardous waste was amended to exclude “onsite media”, which now enables the management under the CSR of all contaminated media, regardless of their levels of contamination, on the contaminated site that they originated on. Materials that do not meet the definition of onsite media (e.g., containerized hazardous waste, stockpiled or otherwise deposited hazardous waste etc.) continue to be regulated as they previously were under the HWR, regardless of whether or not they are located on a contaminated site.

Suspect media that are to be removed from a site must still be characterized as set out in the HWR, for purposes of transportation and ultimate off-site treatment and disposal. For example, soil would be classified as hazardous waste if, when subjected to the Toxicity Characteristic Leaching Procedure (TCLP) test prescribed in the HWR, it is capable of leaching one or more substances in concentrations exceeding the limits specified in HWR Schedule 4, Table 1. When excavated, it must be handled, transported and disposed of as hazardous waste.



Regulatory

Stantec compared the soil analytical results to the BC HWR to provide a conservative indication of what contaminants, if any, could be potentially leachable and contribute to contaminant concentration levels in the surface water across the Terminal. The leachate concentrations were also compared to the BC Water Quality Guidelines and the CCME water quality guidelines for the protection of both freshwater and marine aquatic life. A detailed description for each of these are provided below.

3.3 BC WATER QUALITY GUIDELINES

As noted above, the results of the TCLP analysis were compared to the BC Ambient Water Quality Guidelines (WQG). The WQGs were developed to assess and manage the health, safety, and sustainability of BC's aquatic resources. Water quality guidelines have been developed for the protection of aquatic, wildlife, agriculture, drinking water and recreation.

Based on the proximity to the Burrard Inlet and the presence of freshwater watercourses, the BC WQGs for the protection of freshwater and marine aquatic life were determined to be applicable and are used to evaluate the potential for potential impacts in surface water discharge across the Terminal.

3.4 CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME)

CCME's Canadian Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health (1999) for Industrial Land Use (IL) are considered applicable to the soil data reviewed. CCME's SQG were developed to protect ecological receptors in the environment as well as human health associated with four specific land uses (agricultural, residential/parkland, commercial and industrial).

The environmental soil quality guidelines are derived using toxicological data to determine the threshold level of effects for key ecological receptors. The derivation of human health soil quality guidelines is based on a different procedure using steps similar to those employed in a site-specific risk assessment. For both environmental and human health soil quality guidelines, check mechanisms are used to consider important direct and indirect soil exposure pathways. For the purposes of this report, the human health soil quality guidelines were not applied, as consideration of human health was not required for the Permit amendment.

The CCME-recommended environmental soil quality guidelines are based on the lowest value generated by the environmental approaches for each of the four land uses. The IL guidelines for the protection of environmental health were considered applicable to the Terminal.

In addition to the soil quality guidelines, the results of the toxicity characteristic leaching procedure (TCLP) testing were compared to the CCME water quality guidelines. The CCME water quality guidelines are divided into two categories based on the type of aquatic life receptor (freshwater or marine). Based on the proximity to the Burrard Inlet and the presence of freshwater watercourses that travel across the Terminal, the CCME water quality guidelines for the protection of both freshwater and marine aquatic life were determined to be applicable to the Terminal. The CCME water quality guidelines are to be applied to surface waters to evaluate the potential for potential impacts in surface water discharge across the Terminal.



3.5 CANADA WIDE STANDARDS FOR PETROLEUM HYDROCARBONS (CWS)

CCME also developed Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) F1-F4 at federal sites. The PHC CWS were developed for the four generic land uses and are dependent on soil grain size and depth. Soils are considered to be either fine grained (less than 75 µm) or coarse grained (greater than 75 µm). The grain size analysis was completed during the investigations and the results indicated that the soil in the study areas is coarse grained.

The land use for the Terminal was determined to be industrial; therefore, the PHC CWS for IL were applied. To be consistent, the assessment did not consider standards protective of human health applicable and therefore the CWS standards protective of potable groundwater were not applied for this Terminal.

4.0 METHODOLOGY

The following section summarizes the methodologies that were utilized to complete the scope of work.

4.1 PREVIOUS REPORT DATA

In 2017, Stantec completed a Limited Phase II Environmental Site Assessment (ESA) for Trans Mountain for the purposes of the lease application for expansion with the Vancouver Fraser Port Authority. The ESA included the advancement of six boreholes utilizing a hydro-vacuum to collect soil samples from the Foreshore Excavation Area at the Terminal. Of the six locations, the soil analytical data obtained from four were used to support this report. The other two locations were outside of the planned Foreshore Excavation Area. The analytical results from the four (HV17-01 to HV17-04) submitted soil samples are included in this report to provide additional analytical information for the characterization of soil in the Foreshore Excavation Area. There were no samples obtained from the manifold and tunnel areas during the 2017 assessment.

4.2 HYDROVAC AND SOIL SAMPLING METHODOLOGY

The sampling during the soil quality baseline assessment was completed using generally accepted environmental practices in accordance with the BC Ministry of Environment and Climate Change Strategy (BC ENV) Field Sampling Manual, BC ENV *Technical Guidance 1—Site Characterization and Confirmation Testing* (January 2009), CSR protocols, policies, procedures and guidelines, CSA Standard (CSA-Z769-00, R2013) for completing Phase II ESAs and Stantec's standard field procedures.

Tenold Hydovac was retained by KLTP and provided the daylighting services during the soil quality baseline assessment. The assessment was completed using hydro-vacuum excavation to a maximum depth of 3.5 mbgs.

Stantec collected soil samples at regular depths from each borehole. Soil samples were obtained directly from the walls of the boreholes. Each soil sample was split into two portions, with one portion placed into



Methodology

clean, laboratory supplied glass containers for analysis of potential contaminants of concern, and the remaining portion placed into a re-sealable plastic bag for visual classification and field vapour screening. Stantec recorded sample observations including depth interval, colour, soil type, grain size, and moisture content. Based on these observations, sample depths, and field vapour screening results, Stantec selected and submitted soil samples for laboratory chemical analysis to ALS Laboratory Group (ALS) in Burnaby, British Columbia. The soil samples obtained as part of the 2017 investigation were analyzed by Maxxam Analytics also located in Burnaby, BC.

4.3 FIELD SCREENING

Soil samples were analyzed in the field for hydrocarbon headspace vapour level (HSVL) concentrations using a calibrated RKI Eagle II portable gas detector. The gas detector measures hydrocarbon vapour concentrations in parts per million by volume (ppmv).

4.4 LABORATORY ANALYSIS

Analytical services for the 2019 assessment were provided by (ALS) in Burnaby, BC. ALS is an accredited laboratory with the Canadian Analytical Laboratory Association (CALA). All soil samples collected during the 2019 assessment were submitted to ALS for analysis of one or more of the following:

- Flashpoint
- pH
- Grain Size
- Metals
- TCLP Metals
- TCLP PAHs
- TCLP volatile organic compounds (VOCs)
- volatile hydrocarbons (VH)
- volatile petroleum hydrocarbons (VPH)
- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)
- light/heavy extractable petroleum hydrocarbons (LEPH/HEPH)
- polycyclic aromatic hydrocarbons (PAH); and
- CCME PHC fractions F1–F4

Samples collected during the 2017 assessment were analyzed by Maxxam in Burnaby, BC. Similar to ALS, Maxxam is also accredited with the CALA. The analytical methods employed by both laboratories to complete the requested analysis were identical.

4.5 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Stantec carried out quality assurance and control measures during the investigation and conducted the work in accordance with BC ENV Field Sampling Manual, BC ENV *Technical Guidance 1: Site Characterization and Confirmation Testing* (January 2009), Canadian Standards Association (CSA) Standard (CSA-Z769-00, R2013) for completing Phase II ESAs and Stantec's standard field procedures.



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

Methodology

A new pair of nitrile gloves was used for each soil sample to reduce the risk of cross-contamination between samples. All soil samples were placed in an ice-chilled cooler, sealed, and were delivered to ALS and Maxxam within appropriate holding times and within the acceptable temperature tolerance. All samples were delivered with a chain-of-custody form.

ALS and Maxxam are Canadian Association for Laboratory Accreditation (CALA)-accredited laboratories that use BC ENV recognized methods to conduct laboratory analyses. As conveyed by the laboratories, method blanks, control standards samples, certified reference material (CRM) standards, method spikes, replicates, duplicates, and instrument blanks are routinely analyzed as part of their Quality Assurance/Quality Control (QA/QC) programs.

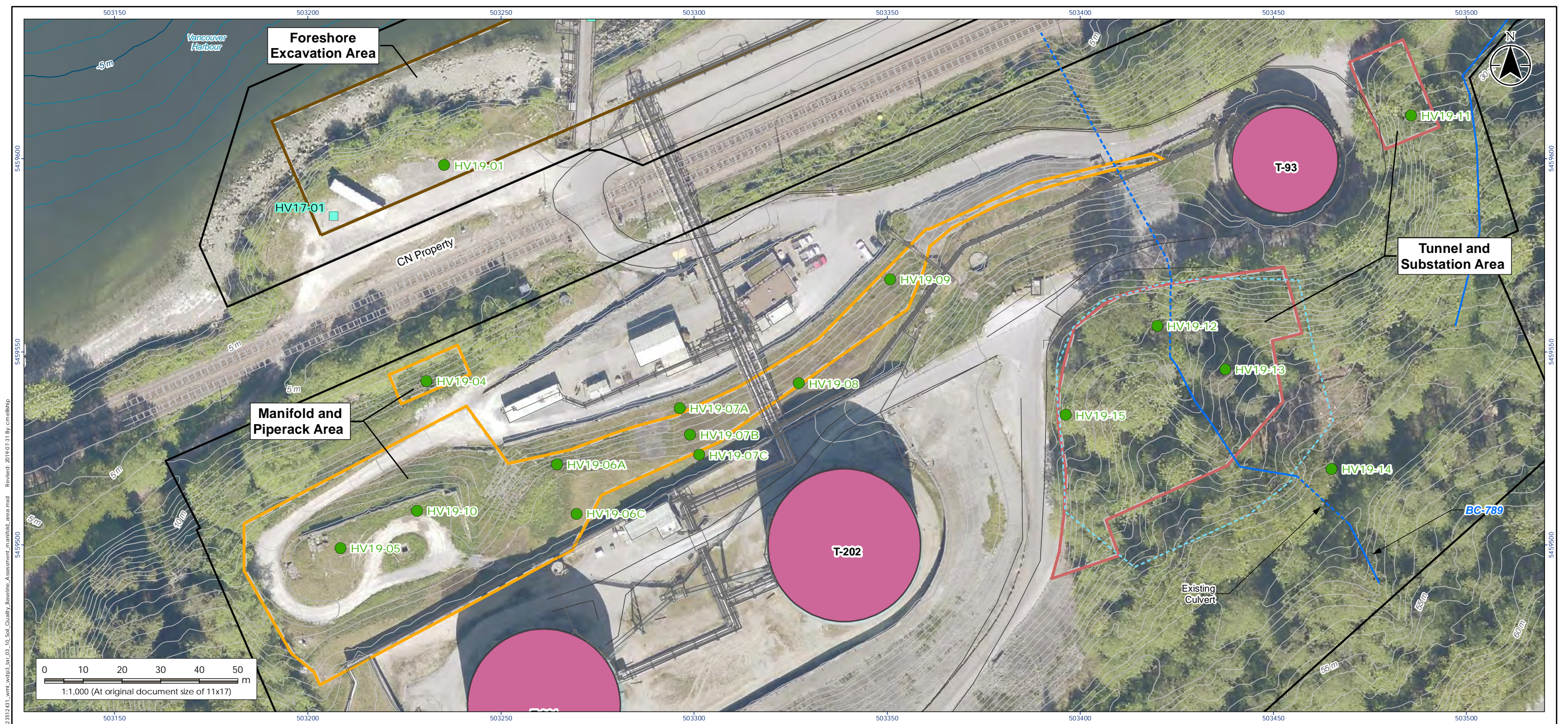
4.6 SAMPLE SITES

Nineteen locations were investigated as part of the soil baseline quality assessment. The sample site names and rationale for selection are provide in Table 1. The sample site locations are presented in Figure 1 and Figure 2.

Table 1 Sample Location Rationale

Area	Borehole ID	Rationale
Foreshore Excavation Area	HV17-01* HV17-02* HV17-03* HV17-04* HV19-01 HV19-02 HV19-03	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Foreshore Excavation Area.
Manifold and Piperack Area	HV19-04 HV19-05 HV19-06a HV19-06c HV19-07a HV19-07b HV19-07c HV19-08 HV19-09 HV19-10	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Manifold and Piperack Area. Boreholes HV19-06a, -06b and -06c, -07a and -07c were positioned in two cross-sectional lines across the slope to collect samples from varying depths.
Tunnel and Substation Area	HV19-11 HV19-12 HV19-13 HV19-14 HV19-15	These borehole locations were selected to provide a representative selection of baseline soil conditions in the Tunnel and Substation area.
NOTES: * = These boreholes were advanced during the Stantec 2017 Limited Phase II Environmental Site Assessment		





Notes

1. Coordinate System: NAD 1983 BC Environment Albers
2. Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); BCOGC Open Data Portal; Trans Mountain Expansion Project, Trans Mountain Pipeline ULC.; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW);
3. Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice: the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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- Project Property Boundary
- Watercourse
- Topographic Contour (m)
- Bathymetric Contour (m)
- Existing Building/Facility
- Existing Road/Rail
- Permit #3678 Discharge Area
- Existing Watercourse
- Existing Culvert

- Hydrovac Location (Stantec, 2019)
- Previously Advanced Hydrovac Location (Stantec, 2017)
- Excavation Area**
 - Manifold Area and Pipe Rack Area (Phase 3.1)
 - Tunnel Portal and Substation Area (Phase 3.2)
 - Foreshore (Phase 3.4.1)

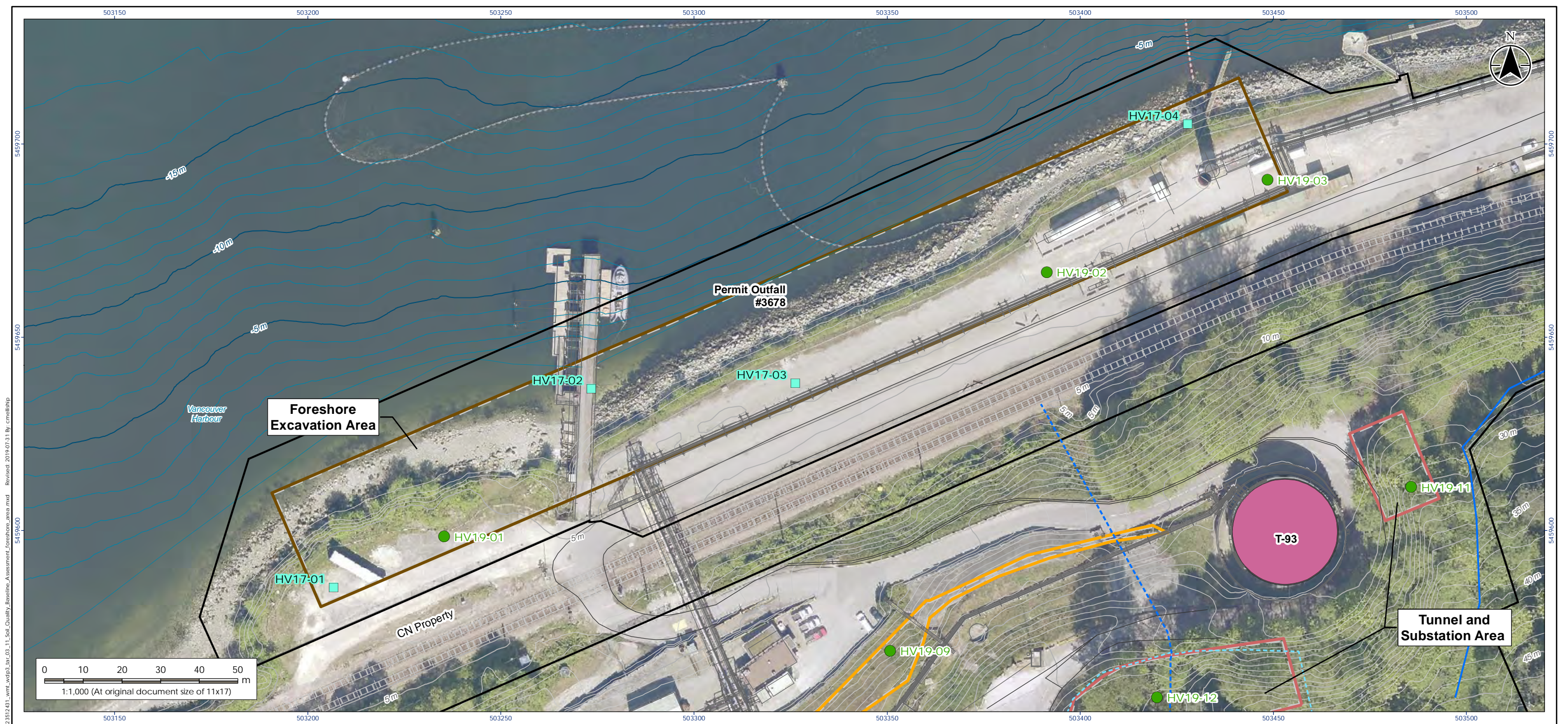


Project Location NTS: 092G07 BCGS: 92G.026 UTM: 10U 503386 5459495	Project Number 123512431 Prepared by TDINNEEN 20190708 PM Review LHARRISON PENDING
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Client/Project Trans Mountain Pipeline ULC Trans Mountain Expansion Project	Project Contact Bronwyn Pountney 403-514-6726 Suite 2700, 300 5th Avenue SW, Calgary, AB, T2P 5J2
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**Westridge Marine Terminal – Soil Quality
Baseline Assessment**



- Project Property Boundary
- Watercourse
- Topographic Contour (m)
- Bathymetric Contour (m)
- Existing Building/Facility
- Existing Road/Rail
- Permit #3678 Discharge Area
- Existing Watercourse
- Existing Culvert
- Hydrovac Location/Soil Sampling Site
- Previously Advanced Hydrovac Location/Soil Sampling Site
- Excavation Area**
 - Manifold Area and Pipe Rack Area (Phase 3.1)
 - Tunnel Portal and Substation Area (Phase 3.2)
 - Foreshore (Phase 3.4.1)

Notes

- Coordinate System: NAD 1983 BC Environment Albers
- Data Sources: DataBC, Government of British Columbia (GovBC); Natural Resources Canada, Government of Canada (GC); Trans Mountain Pipeline ULC; GeoMarine Environmental Consultants Ltd.; Opus Stewart Weir (OPW); CH2M Hill Inc.; Bird Studies Canada and NABCI, 2014.
- Data Limitations: The proposed pipeline right-of-way workspace and corridor have not been field-surveyed. The information shown on this figure have been obtained from various sources and are subject to change without notice; the current status may not be reflected. Crown land parcel data is unadjusted as provided by OPW. Chainage markers are two dimensional.
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Project Location		Project Number 123512431	
NTS: 092G07		Prepared by TDINNEEN 20190708	
BCGS: 92G.026		PM Review LHARRISON PENDING	
UTM: 10U 503386 5459495			
Client/Project		Project Contact	
Trans Mountain Pipeline ULC		Bronwyn Pountney	
Trans Mountain Expansion Project		403-514-6726	
		Suite 2700, 300 5th Avenue SW,	
		Calgary, AB, T2P 5J2	
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Title

Westridge Marine Terminal – Soil Quality Baseline Assessment

5.0 OBSERVATIONS AND RESULTS

The following sections provide a summary of the observations made and the analytical results of the soil quality baseline assessment.

5.1 FIELD OBSERVATIONS

Fifteen new boreholes were advanced using hydro-vacuum excavation to a depth between 0.6 mbgs to 3.2 mbgs.

HSVLT concentrations were measured in all soil samples during the field investigation. The HSVLTs ranged from less than detection limit (LTDL) of the instrument to 150 ppmv.

The soil stratigraphy was generally observed to be a sandy silt fill (which varied significantly in depth) overlying a poorly graded sandy silt/silty sand with gravel.

Groundwater was encountered at approximately 2.5 mbgs in boreholes in the Foreshore Excavation Area and was generally not encountered in other locations with the exception of HV19-06C in the Manifold and Piperack Area where groundwater was encountered at 1.0 mbgs and at HV19-11 and HV19-12 in the Tunnel and Substation Area where groundwater was encountered at 2.0 mbgs and 2.5 mbgs respectively.

The HSVLTs and observed soil stratigraphy are presented on the borehole logs in Appendix A.

5.2 ANALYTICAL RESULTS

During the soil quality baseline assessment, 23 soil samples, including 2 blind field duplicates, were submitted for analysis of the parameters listed in Section 4.3. The following is a summary of the analytical results:

- Reported concentration of arsenic (12.8 mg/kg) in the sample collected at HV17-4-06 within the Foreshore Excavation Area submitted during the 2017 limited Phase II ESA exceeded the CCME guideline (12 mg/kg) and the CSR standard (10 mg/kg).
- Remaining samples submitted in 2017 that were used for this study reported concentrations less than the applicable CCME guidelines and/or the CSR standards
- Several soil samples collected in 2019 reported pH values that were outside of the acceptable range (6.0–8.0) for CCME
- Reported concentrations of all remaining analyzed parameters in the soil samples submitted in 2019 are less than the laboratory detection limit and/or the applicable CCME guidelines and CSR standards.
- Reported concentration of TCLP analysis in the soil samples submitted in 2019 were less than the applicable BC HWR



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

Observations and Results

As noted in Sections 3.0 and 4.0, the results of the TCLP analysis were also compared to the CCME WQG and the BC WQG for the protection of freshwater and marine aquatic life.

The TCLP analysis was completed to conservatively estimate the leachability of the analyzed parameters which may contribute to increased concentrations in surface water across the Terminal.

The following is a summary of the detection limits that were raised and the standards and/or guidelines they were above, refer to the discussion section below for further information related to the raised detection limits:

- Detection limits for leachable arsenic, cobalt, nickel, selenium and zinc were raised above the CCME and BC guidelines for the protection of freshwater and marine aquatic life, and all samples reported concentrations less than those detection limits.
- Detection limit for leachable cadmium was raised above the CCME and BC guidelines for long-term freshwater and the CCME guideline for marine aquatic life
- Detection limit for leachable copper was raised above the CCME freshwater and the BC marine WQGs for aquatic life

The following is a summary of TCLP results that exceeded either the CSR and/or the CCME guidelines:

- TCLP concentration of cadmium in samples HV19-01 SA3 and SA5, HV19-04 SA5, HV19-05 SA5, HV19-07C SA4 and HV19-11 SA4 were reported to be greater than the CCME guidelines for the protection of marine and freshwater aquatic life.
- TCLP concentration of copper in samples HV19-01 SA3 and SA5, HV19-02 SA2, HV19-05 SA5, HV19-06C SA5, HV19-07B SA1, HV19-07C SA4, HV19-11 SA4 and HV19-14 SA2 were reported to be greater than the CCME guideline for the protection of freshwater aquatic life and the BC guideline for the protection of marine aquatic life.
- TCLP concentration of iron in samples HV19-01 SA3, HV19-03 SA2, HV19-05 SA5, HV19-06C SA5, HV19-07C SA4 were reported to be greater than the CCME guideline for the protection of freshwater aquatic life.
- TCLP concentration of iron in samples HV19-01 SA5, HV19-02 SA2, HV19-11 SA4 and HV19-14 SA2 were reported to be greater than the BC WQG for the protection of freshwater aquatic life.
- TCLP concentration of lead in sample HV19-07B SA1 was reported to be greater than the CCME guideline for the protection of freshwater aquatic life and the BC guideline for the protection of marine aquatic life.
- All remaining TCLP metal concentrations were less than the applicable CCME and/or BC WQGs for the protection of marine and/or freshwater aquatic life.
- Concentration of TCLP PAHs were reported to be less the applicable CCME and BC WQGs for the protection of marine and/or freshwater aquatic life
- Concentration of TCLP BTEX parameters were reported to be less than the applicable CCME and BC WQGs for the protection of marine and/or freshwater aquatic life



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

Discussion

The following table summarizes the parameters that had reported concentrations exceeding the indicated criteria within each construction area:

Table 2 Summary of Analytical Results

Construction Area			
Standard/ Guideline	Foreshore Excavation Area	Manifold and Piperack Area	Tunnel and Substation Area
CCME SQG	pH, arsenic	pH	none
CSR Soil Standards	arsenic	none	none
CCME WQG (Leachate)	cadmium, copper, iron	Cadmium, copper, iron, lead	Cadmium, copper, iron
BC WQG (Leachate)	copper, iron	Copper, lead	Copper, iron

The analytical results are summarized on Table 1 in Appendix B. The ALS laboratory certificates are provided in Appendix C. The Maxxam laboratory certificates were not provided in this report as they were appended to the previously submitted report from 2017.

6.0 DISCUSSION

The purpose of this assessment was to characterize the baseline soil quality prior to construction activities at the Westridge Marine Terminal and to use this baseline data to feed into the assessment of potential impacts to surface water, as a result of soil disturbance during proposed construction activities at the Terminal.

As noted in the methodology section above, soil samples were collected and submitted to the project laboratory for the analysis of metals, PHCs and PAHS. The analytical results from submitted soil samples in 2017 and 2019 were compared to the applicable CCME soil guidelines and/or CSR soil standards. The reported concentrations were within the applicable regulatory limits, with the exception of arsenic which exceeded the CCME guideline and CSR standard in the sample obtained from HV17-4 in the Foreshore Excavation Area in 2017.

In addition to the standard soil analysis, Stantec also requested that the laboratory complete TCLP analysis of select soil samples for metals, PAHs and BTEX. The intention of this analysis, as noted above, was to provide a conservative assessment of the leachability of potential contaminants, from soil to surface water, across the Terminal. This is a conservative approach as TCLP analysis is used to simulate leaching in a landfill (i.e., under acidic conditions).



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

Quality Assurance/Quality Control (QA/QC)

The results of the TCLP analysis were summarized and compared to the CCME and the BC WQGs to further evaluate whether leachable concentrations would exceed the WQGs for freshwater and marine aquatic life. When comparing to the CCME and BC WQG's, the detection limits of several metals parameters were raised above the guidelines. As a result, this assessment was unable to determine if the leachable concentrations for these parameters were above or below the applicable guidelines for these parameters where they were reported as non-detectable. However, the soil analytical results for those same parameters, with the exception of arsenic within the Foreshore Excavation Area, were reported to be within the applicable soil standards and guidelines. Therefore these parameters, with the exception of arsenic in the Foreshore Excavation Area, are not considered to be of concern.

The TCLP results indicate that the concentration of various metal parameters exceeded the applicable CCME and BC WQGs. The PAH and BTEX TCLP results were all reported to be less than the CCME and/or BC WQGs.

7.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

A detailed review of sampling data was completed by Stantec to confirm that the data presented was reliable and therefore usable to support the investigations and conclusions. A review of the field methodologies indicated that they were consistent with those considered acceptable based on Stantec standard operating procedures and current regulatory requirements.

All new soil samples collected during the program were submitted to ALS. As conveyed by the laboratory, method blanks, control standards samples, certified reference material (CRM) standards, method spikes, replicates, duplicates and instrument blanks are routinely analyzed as part of their QA/QC programs.

Sample integrity and reliability was checked by submitting field replicates. Whenever possible, BC ENV guidance regarding the minimum number of quality control samples was followed for blind field duplicate submissions.

The QA/QC program for analytical laboratory results included:

- Review of actual versus recommended sample holding times
- Review of sample temperature reported by the laboratory upon sample receipt
- Assessment of laboratory implemented QA/QC program (e.g., review of laboratory replicates, laboratory spike summaries, etc.)
- Assessment of sample collection methodologies and laboratory reliability using calculated relative percent differences (RPDs) between numbered and blind field duplicate/replicate samples.



7.1 SAMPLE HOLD TIME

To follow BC ENV protocols, samples should be submitted to the laboratory within 7 days from sampling and must be extracted within 48 hours of receipt by the laboratory. If the extraction process is not completed within 48 hours, the samples may be frozen to less than -7°C and extracted within 14 days of sampling. The sample extracts must be analyzed within 40 days of extraction.

The sample holding times were calculated by taking the difference between the sample collection date and/or extraction date and the sample analysis date. The samples collected were submitted to the laboratory within the recommended holding time of seven days and the laboratory completed the extraction within 48 hours of receipt for the respective analytical methods and analyzed as per BC ENV protocols.

Based on a review of all the laboratory certificates for hold times all samples were extracted and analyzed within the recommended hold time.

7.2 SAMPLE TEMPERATURE

Sample temperatures are recorded upon arrival at the laboratory by measuring three random sample container temperatures and calculating the average result to obtain a representative temperature. Sample temperatures are collected from samples which are submitted, however only samples that were submitted the day after collection will be noted if the temperature is outside of the acceptability range. The ideal sample temperature should be about 4°C at the time of sample submission. Samples that arrive at the laboratory with temperatures measured above 4°C may have reported concentrations for volatile constituents that are biased low as a result of the elevated sample temperatures.

Although it is ideal to have sample temperatures around 4°C, ALS and Maxxam have issued guidance discussing the difficulty in maintaining soil and groundwater samples around 4°C and have noted that a temperature range of 4°C to 10°C is generally considered acceptable.

For the scope of work conducted at the Terminal, three sets of data were submitted to the laboratory on the same day of collection for analysis and two were submitted the day after collection for analysis. Of the three that were submitted the same day, two were noted to be above the guidance of 10°C. However, as these were submitted the same day of analysis there was no issue with comprised data. The other samples submitted were below the 10°C guideline. As such the data set and sample concentrations were not likely to have been biased low with respect to temperature.



7.3 LABORATORY QA/QC

The appropriate analytical methods were used by the laboratory. Laboratory quality assurance samples such as matrix spikes and matrix spike duplicates were analyzed according to the laboratory method, and all laboratory quality control sample results were within method acceptance limits with the exception of data contained with Laboratory Report L2272171 which indicated that DUP-H (soil sample HV19-09 SA5) laboratory duplicate results were outside of the ALS data quality objective due to sample heterogeneity for molybdenum and strontium.

As there is no applied standard and/or guideline for strontium and the reported concentration of molybdenum (0.28 mg/kg) is two orders of magnitude below the most stringent CCME guideline of 40 mg/kg, this data quality issue does not appear to be a concern.

Stantec has reviewed the remaining laboratory quality assurance data, and the analytical results and have concluded that data quality is sufficiently reliable for the purposes of the investigation.

7.4 FIELD QA/QC

Sampling work was conducted in accordance with BC ENV *Technical Guidance Document 1: Site Characterization and Confirmation Testing* and Stantec's standard field procedures. A new pair of nitrile gloves was used for each sample to reduce the risk of cross contamination between samples. Field QA/QC measures included the collection of blind field duplicates for submission to the lab. A field duplicate sample is a homogenized sample that has been split into two separate containers and submitted to the lab as two separate samples. The duplicate sample is given a different sample name to prevent the laboratory from being aware of its similar origin. Field duplicates are collected in order to assess whether sampling collection, handling, or transportation procedures have introduced variance into analytical results, although variance may also be introduced by heterogeneity in the sample matrix. The relative percent difference (RPD) between original and the duplicate/replicate provides an estimate of the sum total of this variance.

The following were submitted as blind field duplicates:

- HV19-01 SA5/DUP1
- HV19-03 SA2/DUP2

The calculated field duplicate RPDs for both the parent and duplicate samples were within the acceptable RPD range for the calculated RPDs.

The QA/QC data are summarized in the analytical table in Appendix B.



Conclusion

7.5 SUMMARY QA/QC

The samples collected from the Terminal were submitted to a CALA-accredited laboratory that uses BC ENV and CCME recognized methods to conduct laboratory analyses. The quality of the data set was reviewed for holding time, temperature, laboratory quality assurance and control results, and field protocols for proper sample collection. The data set derived from the sampling program was considered representative of the Terminal conditions. Based on the results of the QA/QC Program, the data set was considered reliable for the purposes of this study.

8.0 CONCLUSION

Based on the results from soil quality baseline assessment completed at Westridge Marine Terminal, Stantec concludes that the concentration of arsenic present in soil sampled at the Foreshore Excavation Area is greater than the applicable standard and guideline. The concentration of arsenic in samples obtained from the remaining areas were reported to be less than the applicable standard and/or guideline.

The remaining metal parameter concentrations were reported to be below the applicable standards and/or guidelines for samples submitted from all three areas.

In addition to arsenic, the obtained pH values were outside of the CCME acceptable range of 6–8 in soil samples obtained from all three areas.

The concentration of petroleum hydrocarbons, PAHs and VOCs in soil samples submitted and analyzed were reported to be below the applicable standards and guidelines in all three areas.

The analytical results of the completed TCLP analysis indicate that cadmium, copper and iron were reported to be greater than the WQG's in the Foreshore Excavation Area and the Tunnel and Substation Area and cadmium, copper, iron and lead were reported to be greater than the WQG's in the Manifold and Piperack area.

Based on the information summarized in the report it is anticipated that Permit amendments may be required for Phase 3 construction activities as a result of the potential for metal contamination leaching into surface water at the Terminal. It is recommended that a surface water assessment be completed for the Terminal and the results be combined to accurately determine what amendments to the discharge Permit will be required, if any.



Limitations

9.0 LIMITATIONS

This report documents work that was performed in accordance with generally accepted professional standards at the time and location in which the services were provided. No other representations, warranties or guarantees are made concerning the accuracy or completeness of the data or conclusions contained within this report, including no assurance that this work has uncovered all potential liabilities associated with the identified property.

This report provides an evaluation of selected environmental conditions associated with the identified portion of the property that was assessed at the time the work was conducted and is based on information obtained by and/or provided to Stantec at that time. There are no assurances regarding the accuracy and completeness of this information. All information received from the client or third parties in the preparation of this report has been assumed by Stantec to be correct. Stantec assumes no responsibility for any deficiency or inaccuracy in information received from others.

The opinions in this report can only be relied upon as they relate to the condition of the portion of the identified property that was assessed at the time the work was conducted. Activities at the property subsequent to Stantec's assessment may have significantly altered the property's condition. Stantec cannot comment on other areas of the property that were not assessed.

Conclusions made within this report consist of Stantec's professional opinion as of the time of the writing of this report and are based solely on the scope of work described in the report, the limited data available and the results of the work. They are not a certification of the property's environmental condition. This report should not be construed as legal advice.

This report has been prepared for the exclusive use of the client identified herein and any use by any third party is prohibited. Stantec assumes no responsibility for losses, damages, liabilities or claims, howsoever arising, from third party use of this report.

The locations of any utilities, buildings and structures, and property boundaries illustrated in or described within this report, if any, including pole lines, conduits, water mains, sewers and other surface or sub-surface utilities and structures are not guaranteed. Before starting work, the exact location of all such utilities and structures should be confirmed and Stantec assumes no liability for damage to them.



WESTRIDGE MARINE TERMINAL—SOIL QUALITY BASELINE ASSESSMENT

Limitations

The conclusions are based on the Terminal conditions encountered by Stantec at the time the work was performed at the specific testing and/or sampling locations, and conditions may vary among sampling locations. Factors such as areas of potential concern identified in previous studies, site conditions (e.g., utilities) and cost may have constrained the sampling locations used in this assessment. In addition, analysis has been carried out for only a limited number of chemical parameters, and it should not be inferred that other chemical species are not present. Due to the nature of the investigation and the limited data available, Stantec does not warrant against undiscovered environmental liabilities nor that the sampling results are indicative of the condition of the entire terminal. As the purpose of this report is to identify terminal conditions which may pose an environmental risk; the identification of non-environmental risks to structures or people on the Terminal is beyond the scope of this assessment.

Should additional information become available which differs significantly from our understanding of conditions presented in this report, Stantec specifically disclaims any responsibility to update the conclusions in this report.

This report was prepared by Tyler Joyce, C.Tech. and reviewed by Mathew Redmond, P.Eng.



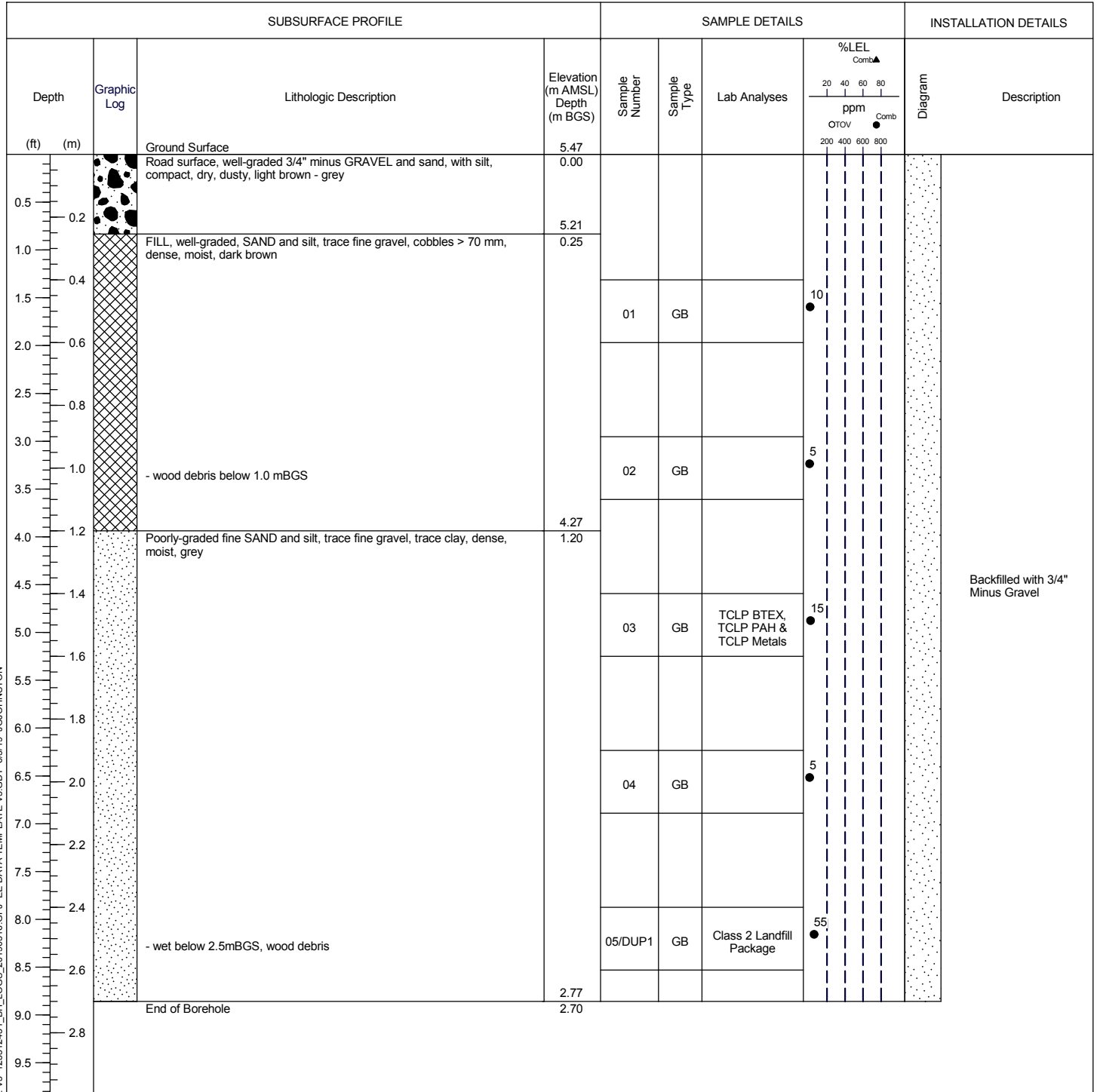
APPENDIX A

Borehole Logs

Hydrovac Excavation: HV19-01 - Foreshore Excavation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 07-May-2019
Ground surface elevation: 5.47 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503240.231
Northing: 5459592.03



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

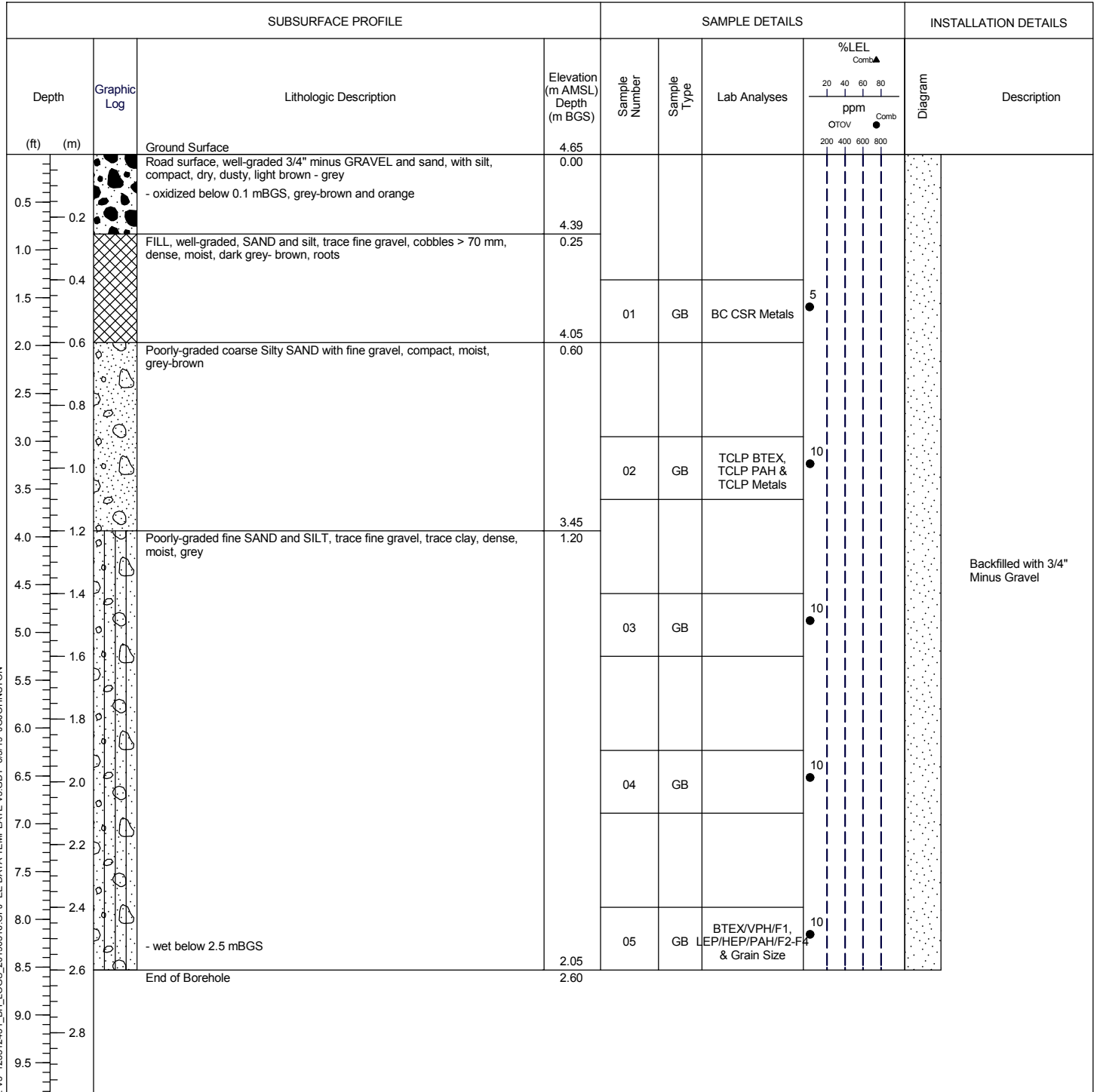
Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431_BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-02 - Foreshore Excavation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 07-May-2019
Ground surface elevation: 4.65 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503391.371
Northing: 5459666.882



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431_BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-03 - Foreshore Excavation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 07-May-2019
Ground surface elevation: 5.08 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503448.567
Northing: 5459690.739

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	5.08						
0.5		Road surface, well-graded 3/4" minus GRAVEL and sand, with silt, compact, dry, dusty, light brown - grey	0.00						
0.2		- oxidized below 0.1 mBGS, grey-brown and orange	4.83						
1.0		FILL, well-graded, SAND and silt, trace fine gravel, cobbles > 70 mm, dense, moist, dark grey	0.25						
0.4				01	GB		20		
1.5			4.48						
2.0		Poorly-graded, medium grained SAND, loose, moist, brown	0.60						
0.6				02/DUP2	GB	TCLP BTEX, TCLP PAH & TCLP Metals	20		
2.5									
3.0									
3.5									
4.0		Poorly-graded fine SAND and silt, trace fine gravel, trace clay, dense, moist, grey	3.88						
1.2			1.20						
4.5				03	GB		10		
5.0									
5.5									
6.0									
6.5				04	GB		20		
7.0									
7.5									
8.0									
8.5				05	GB		20		
2.6		- wet below 2.5 mBGS, dark grey, wood debris							
9.0									
2.8		End of Borehole	2.28						
2.80									

Backfilled with 10/20 Granular Filter Sand

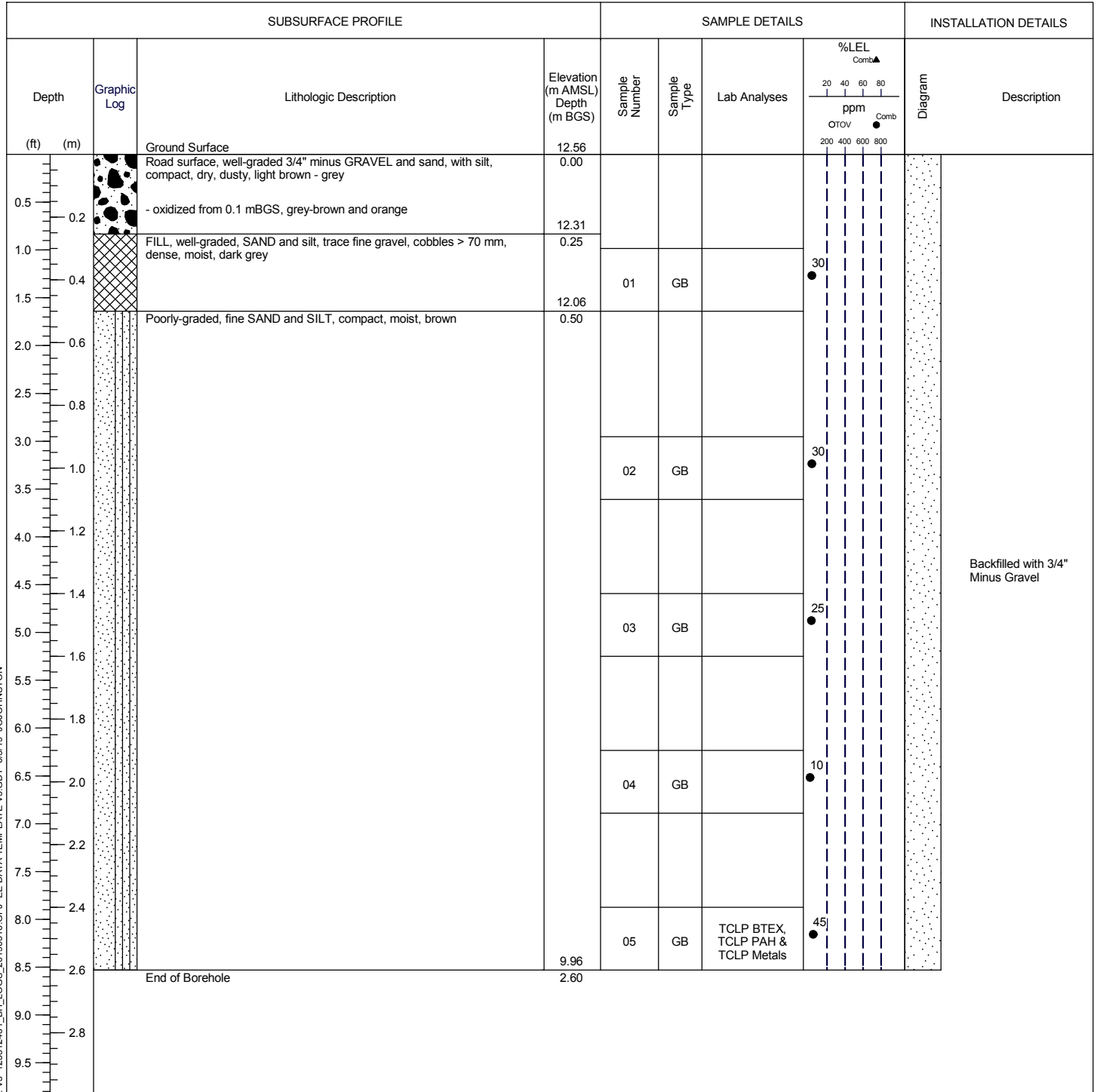
Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-04 - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 09-May-2019
Ground surface elevation: 12.56 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503233.226
Northing: 5459536.313



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

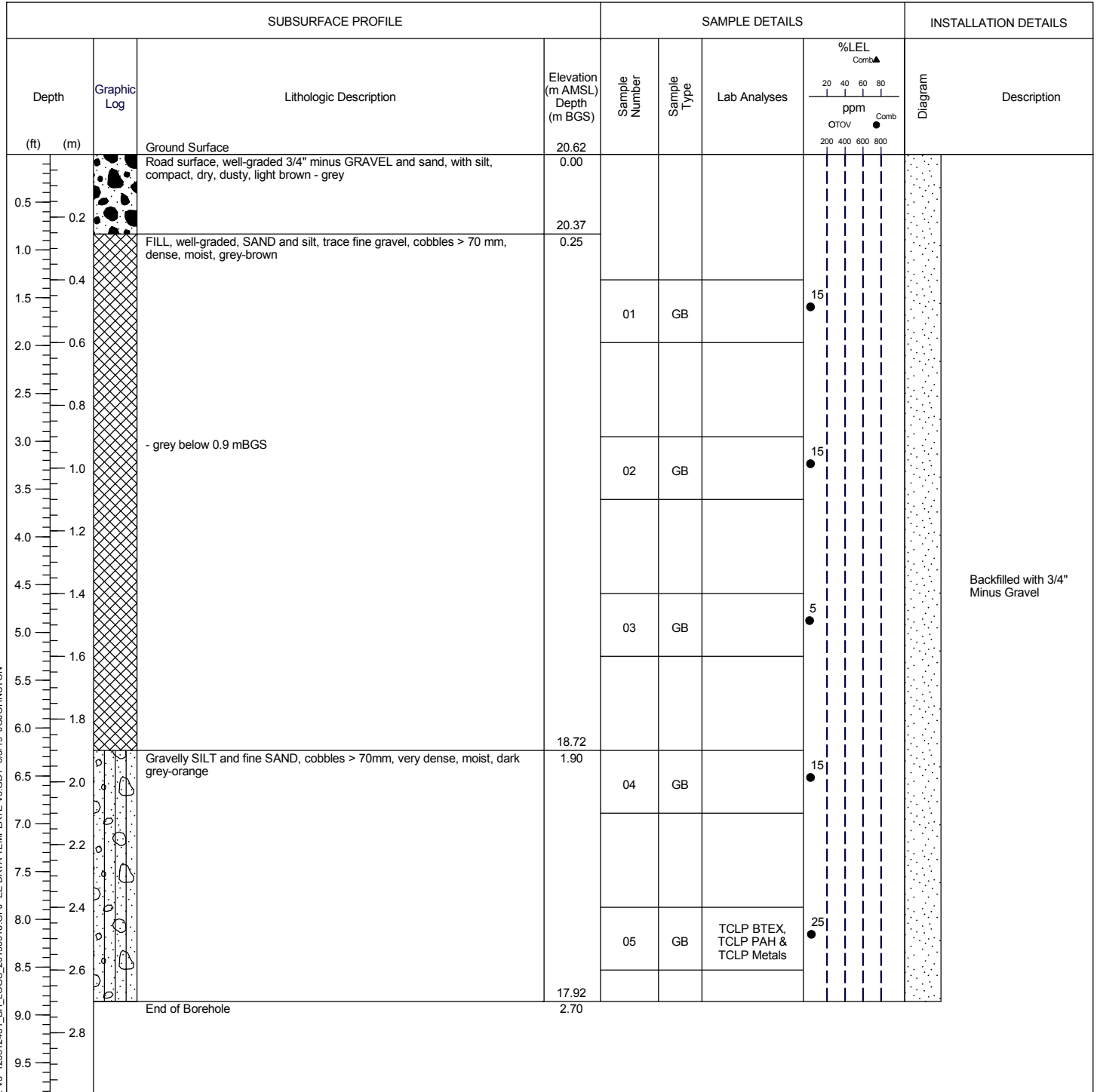
Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431.BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-05 - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 09-May-2019
Ground surface elevation: 20.62 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503208.462
Northing: 5459499.205



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-06A - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 10-May-2019
Ground surface elevation: 20.11 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503228.282
Northing: 5459508.814

SUBSURFACE PROFILE				SAMPLE DETAILS			INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	20.11					
		Grass and Moss Cover. Silty SAND and gravel, trace organics, roots, compact, moist, dark-brown	0.00					
0.5		Silty SAND and gravel, compact, moist, red-brown	0.10					
1.0								
1.5								
2.0			19.51	01	GB	0		
2.5			0.60					
3.0								
3.5								
4.0								
4.5								
5.0								
5.5								
6.0								
6.5								
7.0								
7.5								
8.0								
8.5								
9.0								
9.5								
		End of Borehole						
								Backfilled with 3/4" Minus Gravel

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



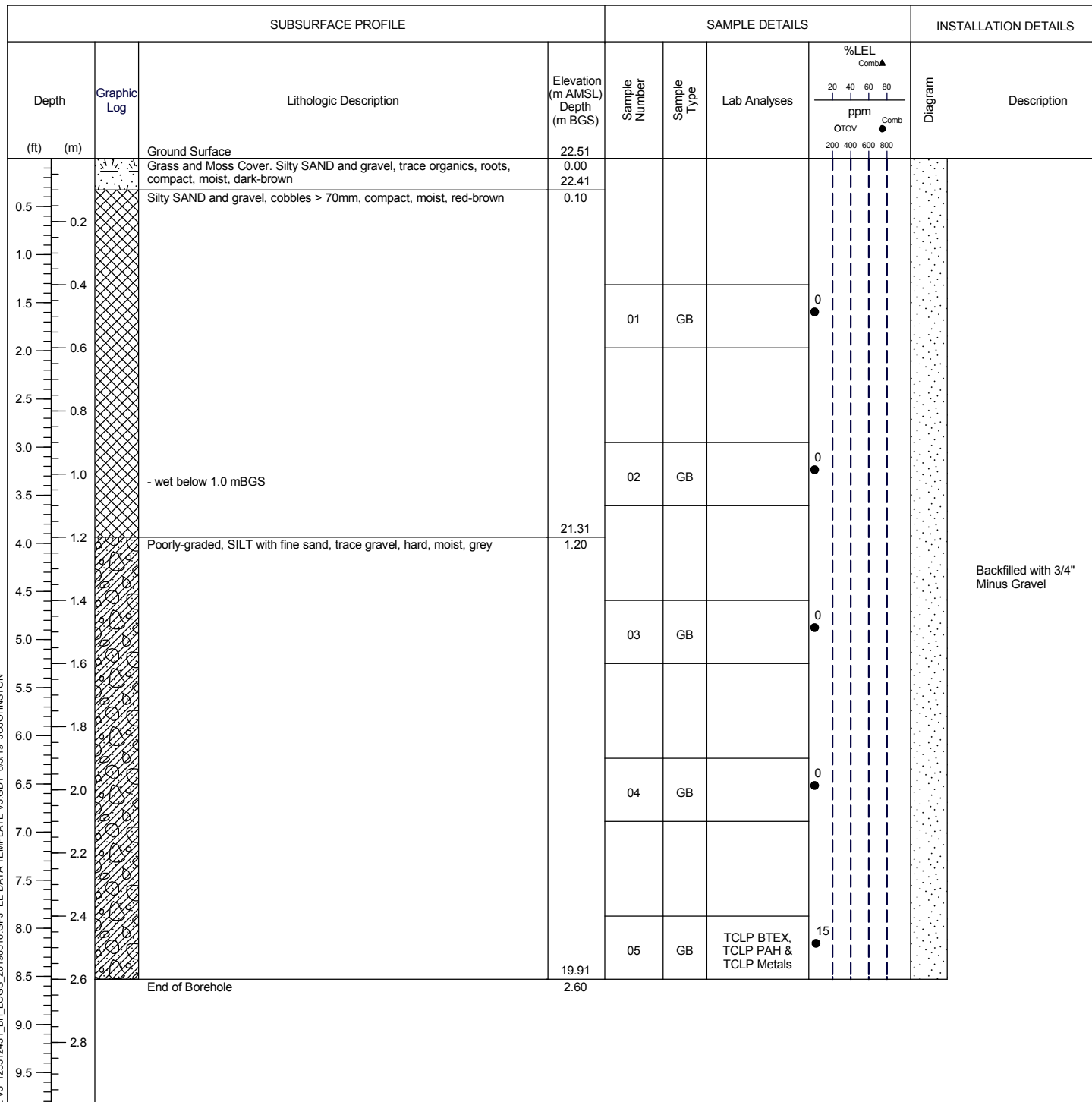
Drawn By/Checked By: JJ

Sheet 1 of 1

Hydrovac Excavation: HV19-06C - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 10-May-2019
Ground surface elevation: 22.51 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503269.58
Northing: 5459508.095



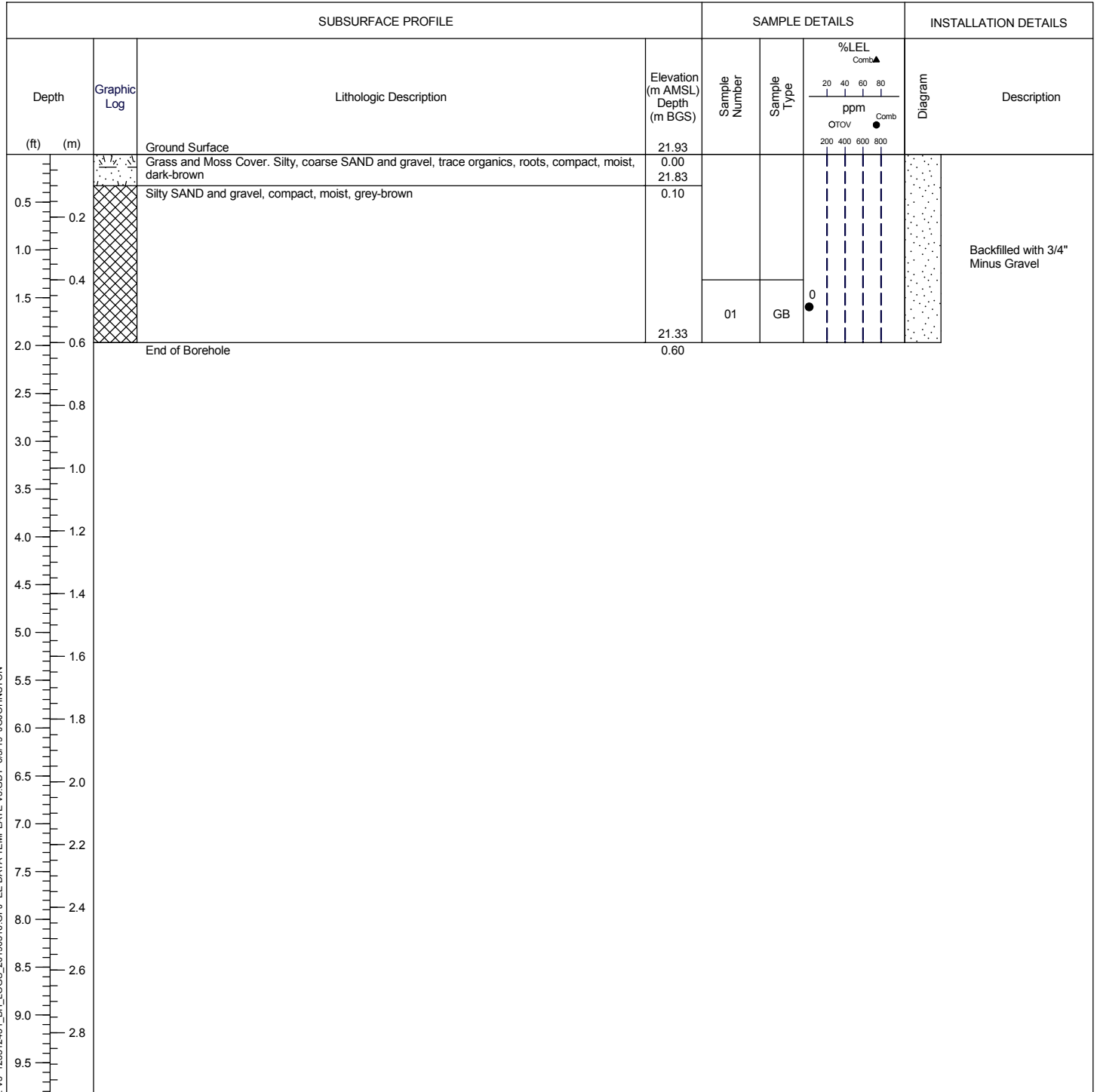
Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-07A - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 10-May-2019
Ground surface elevation: 21.93 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503301.306
Northing: 5459523.315



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



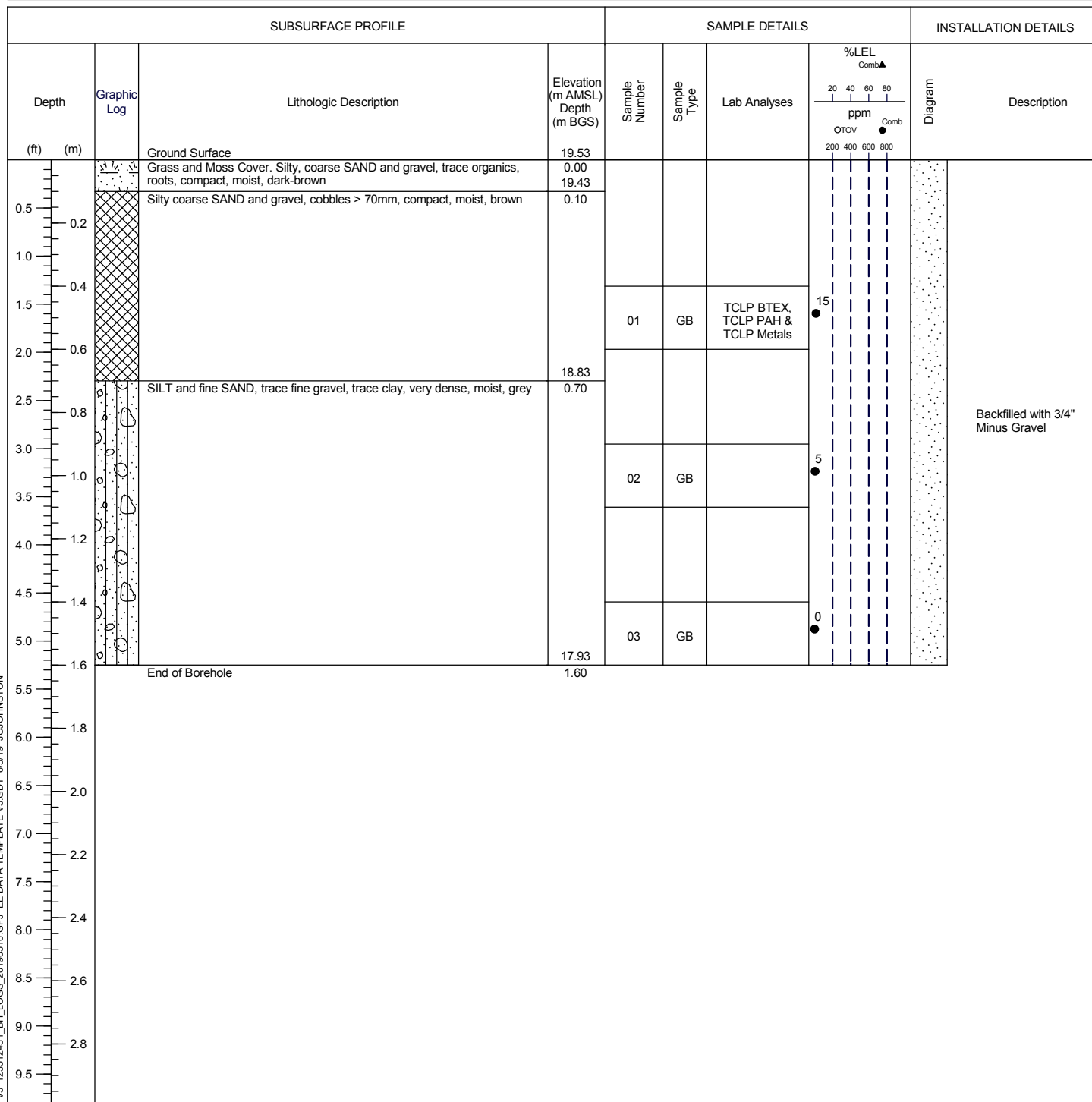
Drawn By/Checked By: JJ

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Hydrovac Excavation: HV19-07B - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 10-May-2019
Ground surface elevation: 19.53 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503298.99
Northing: 5459528.515



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-07C - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 10-May-2019
Ground surface elevation: 15.73 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503296.315
Northing: 5459535.42

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	15.73						
		Grass and Moss Cover. Silty SAND and gravel, trace organics, roots, compact, moist, dark-brown	0.00						
0.5		Silty SAND and gravel, cobbles > 70mm, compact, moist, red-brown	15.63						
0.2			0.10						
1.0		Poorly-graded coarse SAND and GRAVEL, trace silt, compact, moist, grey-brown	15.48						
0.4			0.25						
1.5				01	GB		0		
2.0									
0.6			15.03						
2.5		SILT and fine SAND, trace fine gravel, trace clay, dense, moist, grey	0.70						
0.8									
3.0				02	GB		10		
1.0									
3.5									
1.2									
4.0									
1.4									
4.5									
5.0				03	GB		15		
1.6									
5.5		Poorly-graded, SILT with fine sand, trace gravel, hard, moist, grey	14.03						
1.8			1.70						
6.0									
2.0				04	GB	Landfill Package, CSR Metals, PHCs & Grain Size	30		
6.5									
2.2									
7.0									
2.4									
7.5									
8.0									
2.6				05	GB		0		
8.5									
2.8			13.13						
2.6		End of Borehole	2.60						
9.0									
2.8									
9.5									

Backfilled with 3/4" Minus Gravel

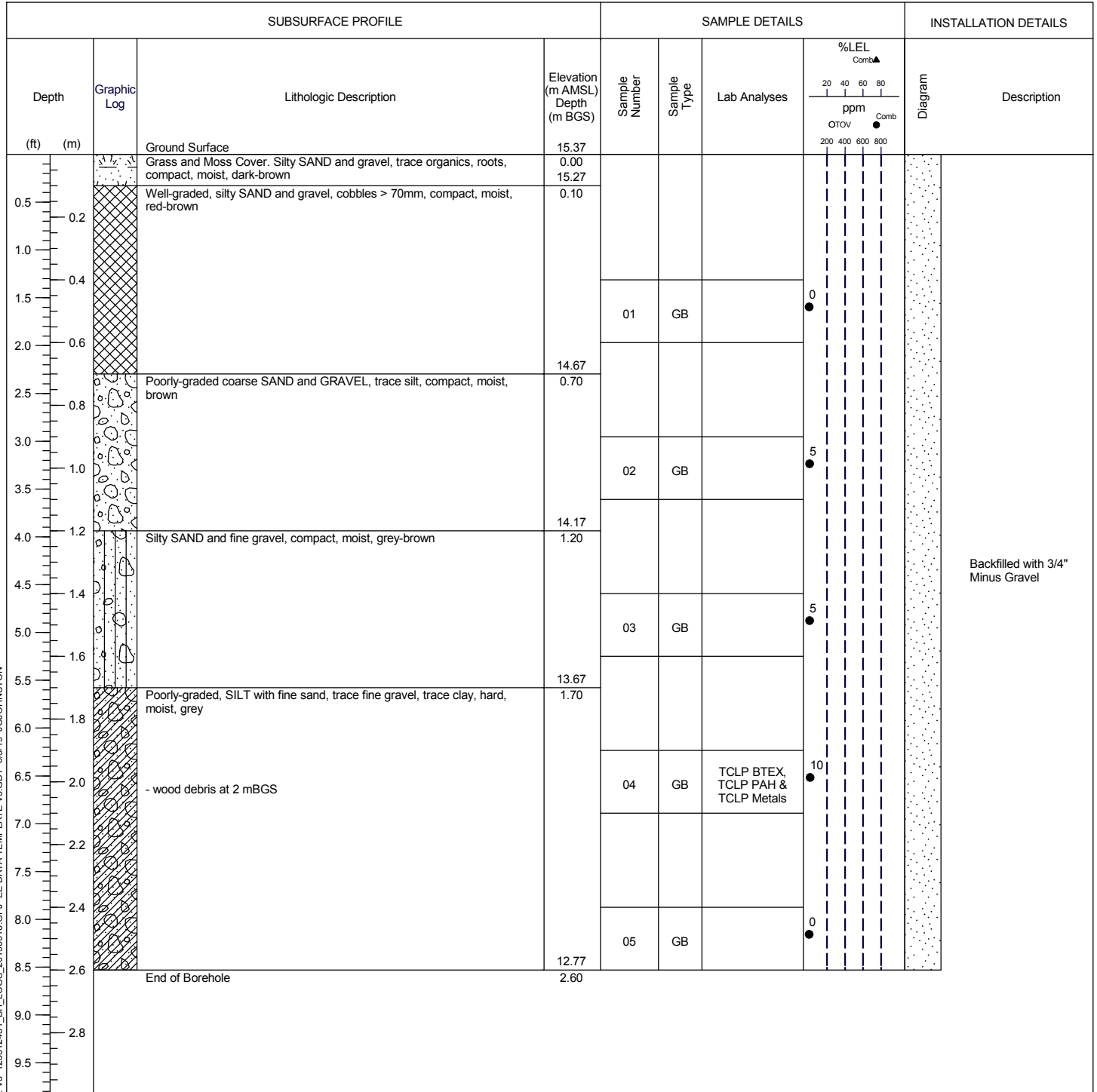
Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-08 - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 13-May-2019
Ground surface elevation: 15.37 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503262.687
Northing: 5459526.377



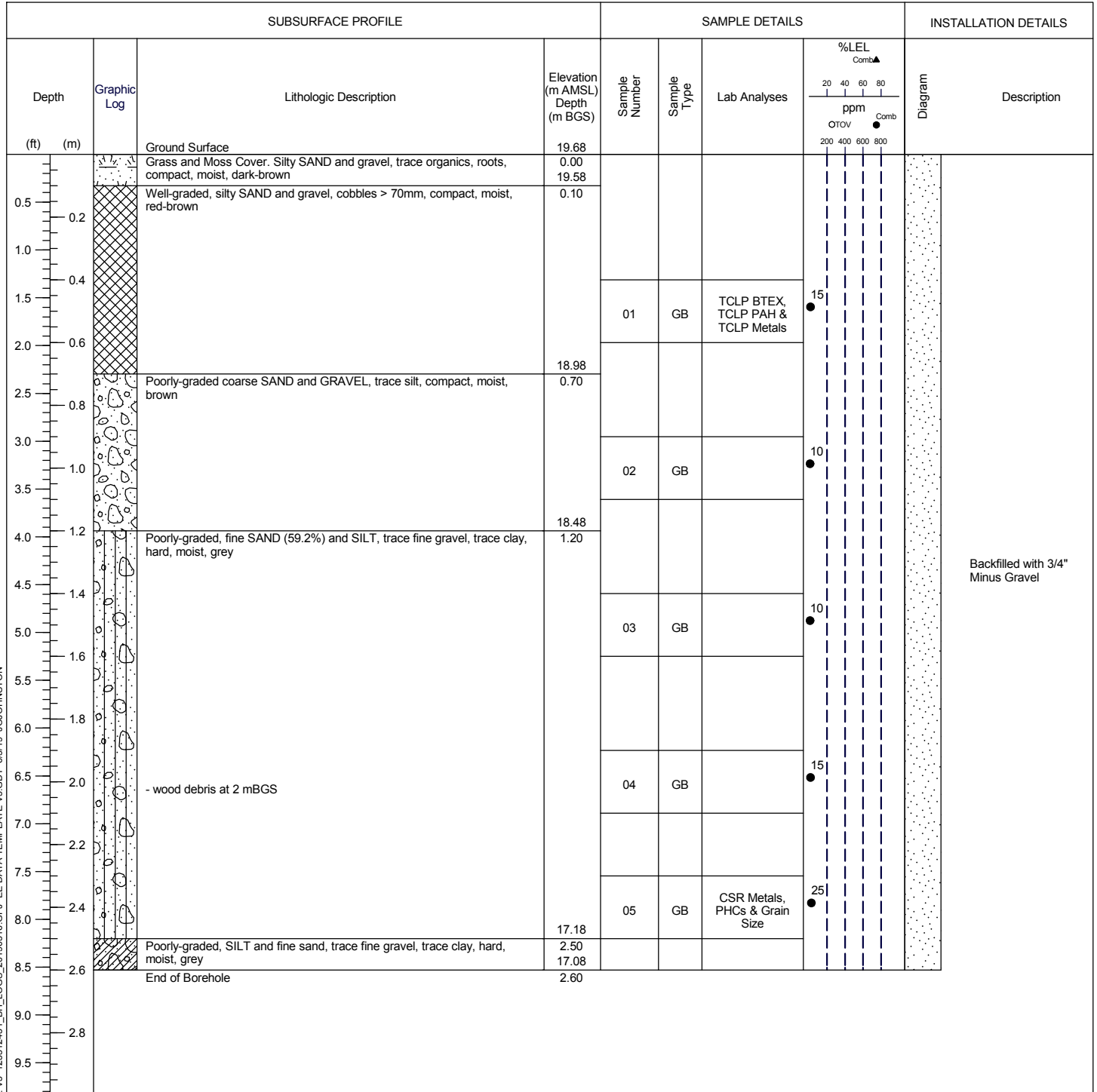
Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-09 - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 13-May-2019
Ground surface elevation: 19.68 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503327.136
Northing: 5459541.875



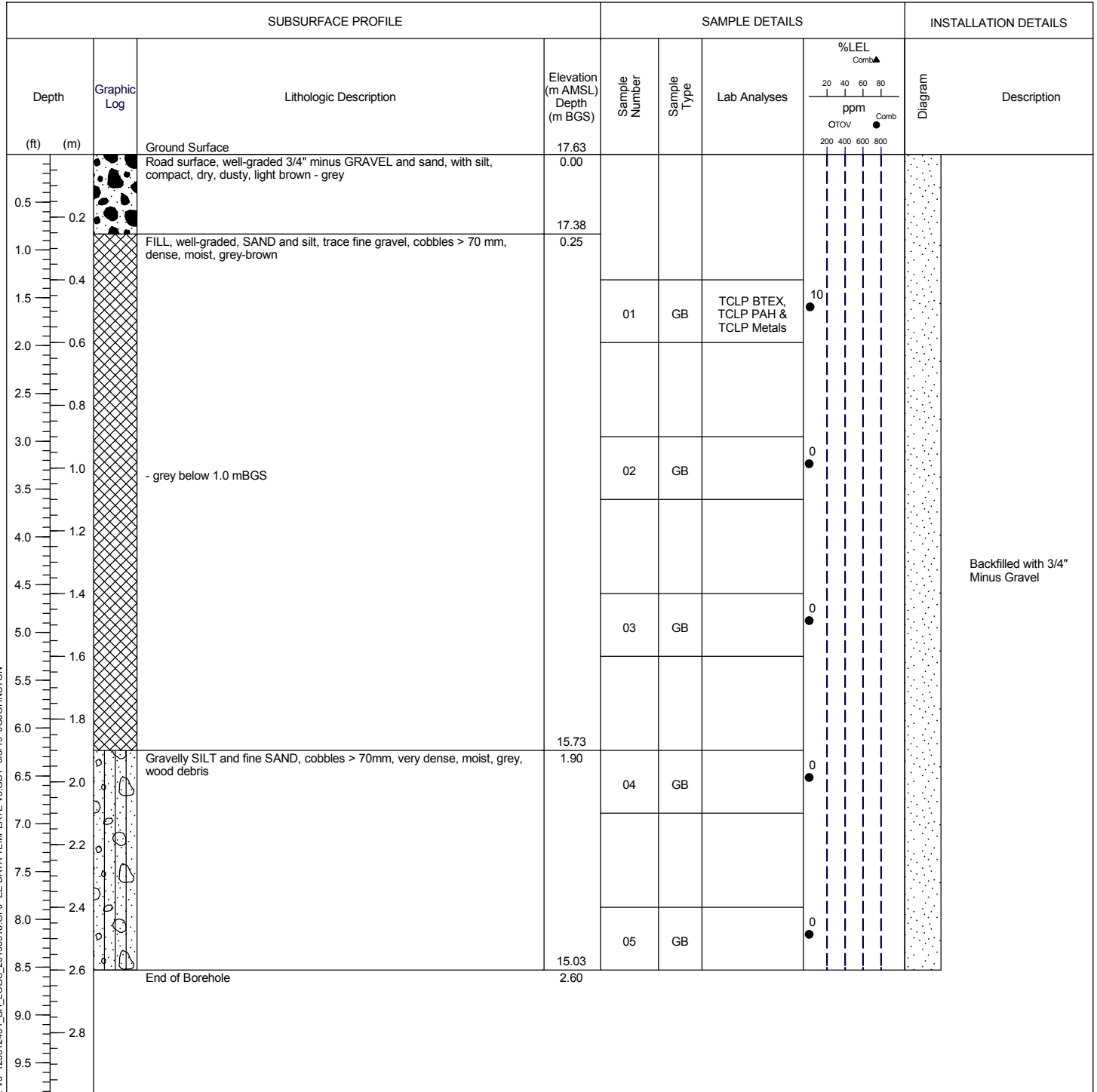
Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Hydrovac Excavation: HV19-10 - Manifold and Piperack Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 09-May-2019
Ground surface elevation: 17.63 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503350.838
Northing: 5459568.762



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431_BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-11 - Tunnel and Substation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 13-May-2019
Ground surface elevation: 29.67 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503491.119
Northing: 5459613.414

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	29.67						
0.5		Woody debris cover, disturbed. Poorly-graded, medium SAND and SILT, trace gravel, trace clay, trace organics, roots, compact, moist, black-brown with orange mottling.	0.00						
1.0		Poorly-graded SAND with silt, trace fine gravel, trace organics, compact, moist, grey-brown, roots	0.25						
1.5				01	GB		0		
2.0									
2.5									
3.0				02	GB		0		
3.5									
4.0									
4.5				03	GB		0		
5.0									
5.5		Poorly-graded medium SAND and SILT, loose, wet, dark grey	1.70						
6.0									
6.5		- wet below 2.0 mBGS		04	GB	TCLP BTEX, TCLP PAH & TCLP Metals	0		
7.0									
7.5		Poorly-graded medium SAND and SILT, trace gravel, loose, wet, dark grey	2.30						
8.0				05	GB		0		
8.5									
9.0		End of Borehole	2.70						
9.5									

Backfilled with 3/4"
Minus Gravel

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431.BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-12 - Tunnel and Substation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 08-May-2019
Ground surface elevation: 32.85 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503396.258
Northing: 5459533.627

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	32.85						
0.5		Woody debris cover with weeds, disturbed. Poorly-graded, medium SAND and SILT, with coarse gravel, trace organics, tree roots, compact, moist, black-brown.	0.00						
1.0		Poorly-graded, medium SAND and SILT, with coarse gravel, compact, moist, brown. - buried plastic debris (yellow flagging tape)	0.25						
1.5				01	GB		0		
2.0									
2.5									
3.0									
3.5		- red-brown colour-change below 1.0 mBGS		02	GB		0		
4.0									
4.5									
5.0		- rootlets, black inclusions below 1.5 mBGS		03	GB		0		
5.5									
6.0									
6.5				04	GB		0		
7.0									
7.5									
8.0		- oxidized below 2.4 mBGS, orange-brown - wet below 2.5 mBGS		05	GB	TCLP BTEX, TCLP PAH & TCLP Metals	0		
8.5									
9.0									
9.5		End of Borehole	30.05 2.80						Backfilled with 3/4" Minus Gravel

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

Sheet 1 of 1

Hydrovac Excavation: HV19-13 - Tunnel and Substation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 08-May-2019
Ground surface elevation: 32.89 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503419.961
Northing: 5459556.782

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	32.89						
0.5		Woody debris cover with weeds, disturbed. Poorly-graded, medium SAND and SILT, trace gravel, trace organics, tree roots, compact, moist, black-brown.	0.00						
1.0		Poorly-graded, medium SAND and SILT, trace gravel, compact, moist, brown, rootlets	0.25						
1.5				01	GB	Landfill Package, CSR Metals, PHCs & Grain Size	10		
2.0									
2.5		Poorly-graded, medium SAND and SILT, trace gravel, compact, moist, brown	0.70						
3.0				02	GB		0		
3.5									
4.0									
4.5									
5.0				03	GB		0		
5.5									
6.0		Poorly-graded, medium SAND and SILT, trace fine gravel, dense, moist, brown	1.70						
6.5				04	GB	TCLP BTEX, TCLP PAH & TCLP Metals	0		
7.0									
7.5									
8.0				05	GB		0		
8.5		- wet below 2.6 mBGS							
9.0		End of Borehole	2.70						
9.5									

Backfilled with 3/4" Minus Gravel

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

Sheet 1 of 1

Hydrovac Excavation: HV19-14 - Tunnel and Substation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 13-May-2019
Ground surface elevation: 37.12 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503437.6
Northing: 5459545.492

SUBSURFACE PROFILE				SAMPLE DETAILS				INSTALLATION DETAILS	
Depth (ft) (m)	Graphic Log	Lithologic Description	Elevation (m AMSL) Depth (m BGS)	Sample Number	Sample Type	Lab Analyses	%LEL Comb ppm OTOV Comb	Diagram	Description
		Ground Surface	37.12						
0.5		Woody debris cover with weeds, disturbed. Poorly-graded, medium SAND and SILT, trace gravel, trace organics, compact, moist, black-brown.	0.00						
1.0		Poorly-graded, medium SAND and SILT, trace gravel, compact, moist, brown, rootlets	0.25						
1.5				01	GB		15		
2.0									
2.5		Poorly-graded, medium SAND and SILT, trace gravel, compact, moist, brown	0.70						
3.0				02	GB	TCLP BTEX, TCLP PAH & TCLP Metals	25		
3.5									
4.0									
4.5				03	GB		15		
5.0									
5.5									
6.0		Poorly-graded, medium SAND and SILT, trace fine gravel, dense, moist, brown	1.70						
6.5				04	GB		10		
7.0									
7.5									
8.0									
8.5				05	GB		15		
9.0		End of Borehole	2.60						
9.5									

Backfilled with 3/4" Minus Gravel

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



Drawn By/Checked By: JJ

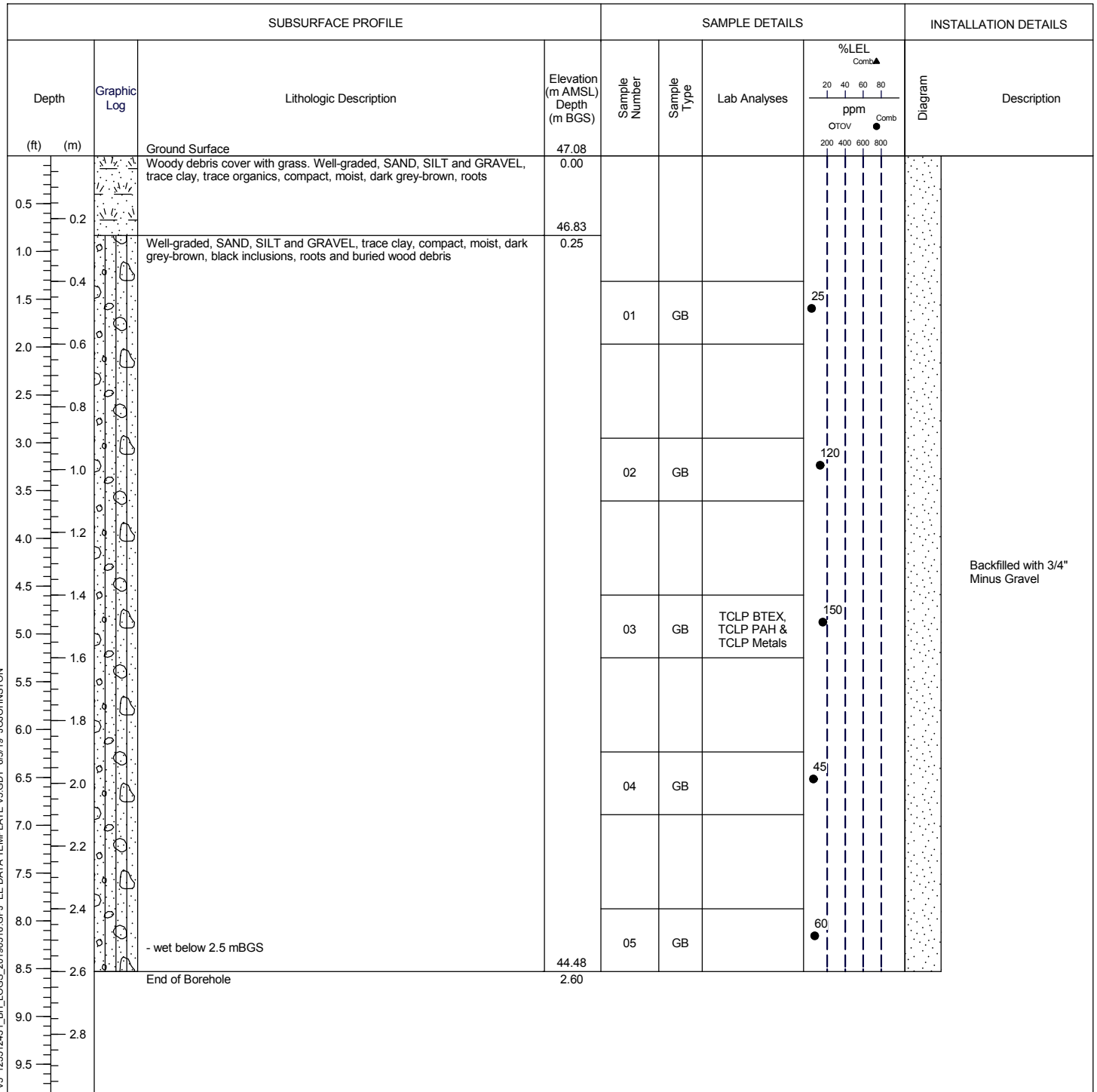
Sheet 1 of 1

STANTEC BOREHOLE AND WELL V5 123512431_BH_LOGS_20190516.GPJ EE DATA TEMPLATE V5.GDT 6/5/19 JOJOHNSTON

Hydrovac Excavation: HV19-15 - Tunnel and Substation Area

Project: Soil Quality Baseline Assessment
Client: Trans Mountain Expansion Project
Location: Westridge Marine Terminal, Burnaby, BC
Number: 123512431.601.400
Field investigator: JJ
Contractor: Tenold Hydrovac

Drilling method: Hydrovac
Date started/completed: 09-May-2019
Ground surface elevation: 47.08 m AMSL
Top of casing elevation: n/a m AMSL
Easting: 503465.158
Northing: 5459519.642



Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
GB - grab sample
ppm - parts per million by volume
n/a - not available



APPENDIX B

Analytical Tables

Table 1
Summary of Soil Analytical Results
TMEP - Westridge Marine Terminal

Sample Area		Sample Location		Sample Date		Sample ID		Sample Depth		Sampling Company		Laboratory		Laboratory Work Order		Laboratory Sample ID																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				</	
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Table
Summary of Soil Analytical Results
Fraser Wharves Remediation
Vancouver Fraser Port Authority

Notes:	
CSR-Schedule 3.1.3	CSR Schedule 3.1 - Part 3 - Generic Numerical Soil Standards (Contaminated Sites Regulation (B.C. Reg. 375/96, April 1, 1997: includes amendments up to B.C. Reg. 116/2018, June 14, 2018))
A	Generic Numerical Soil Standards to protect ecological health - Industrial Land Use (IL)
CSR-Schedule 3.1.1	CSR Schedule 3.1 - Part 1 - Matrix Numerical Soil Standards (Contaminated Sites Regulation (B.C. Reg. 375/96, April 1, 1997: includes amendments up to B.C. Reg. 116/2018, June 14, 2018))
B	Matrix Standard - Industrial Land Use (IL) - Groundwater flow to surface water used by aquatic life (freshwater)
C	Matrix Standard - Industrial Land Use (IL) - Groundwater flow to surface water used by aquatic life (marine)
D	Matrix Standard - Industrial Land Use (IL) - Toxicity to soil invertebrates and plants (applicable to all sites)
CCME	Canadian Council of Ministers of the Environment
F	Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, on-line summary table, for industrial land use and coarse grained soil
G	Canadian Environmental Quality Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, on-line summary table, for industrial land use and fine grained soil
H	Canada Wide Standards for PHC in Soil - Industrial land use - Coarse-grained Soil, Tier 1 (Revised Jan 2008, Table 3), lowest guideline, excluding protection of potable GW pathway
I	Canada Wide Standards for PHC in Soil - Industrial land use - Fine-grained, Surface Soil, Tier 1 (Revised Jan 2008, Table 2), lowest guideline, excluding protection of potable GW pathway
J	Canadian Soil Quality Guideline for the Protection of Environmental and Human Health, PAH, 2008. revised 2010, for an Industrial land use (Table 2 - Interim/Provisional Soil Quality Criteria, CCME 1991)
K	Canadian Soil Quality Guideline for the Protection of Environmental and Human Health, PAH, 2008. revised 2010, for an Industrial land use (Table 2 - Soil Quality Guideline for Environmental Health)
L	Canadian Soil Quality Guideline for the Protection of Environmental and Human Health, PAH, 2008. revised 2010, for an Industrial land use (Table 2 - Soil Quality Guideline for Protection of freshwater life)
M	Canadian Soil Quality Guideline for the Protection of Environmental and Human Health, PAH, 2008. revised 2010, for an Industrial land use (Table 2 - Soil Quality Guideline for Soil and food ingestion)
N	Canadian Soil Quality Guideline for the Protection of Environmental and Human Health, PAH, 2008. revised 2010, for an Industrial land use (Table 2 - Soil Quality Guideline for Soil Contact)
BC-HWR	British Columbia Hazardous Waste Removal Guidelines
O	BC Environmental Management Act, Hazardous Waste Regulation (includes amendments up to B.C. Reg. 63/2009, April 1, 2009)
P	CCME Water Quality Guidelines from the Protection of Freshwater Aquatic Life
Q	BC Water Quality Guidelines: Freshwater Aquatic Life (March 2018)
R	CCME Water Quality Guidelines from the Protection of Freshwater Aquatic Life
S	BC Water Quality Guidelines: Freshwater Aquatic Life (March 2018)
6.5^	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
>	Greater than
N2	Soil standards protective of groundwater used for drinking water are the same regardless of land use.
N4	Standard applies to total chromium (all species).
N9	Sodium ion standards apply to soluble sodium.
PH1	Beryllium standards vary with soil pH from 1-2,500 ug/g for groundwater used for drinking water for all land use types. For pH < 5.5 standard = 1 ug/g; For pH 5.5-< 6.0 standard = 1.5; For pH 6.0-< 6.5 standard = 4 ug/g; For pH 6.5->7.0 standard = 20 ug/g; For pH 7.0->7.5 standard = 150 ug/g; For pH 7.5->8.0 standard = 1,000 ug/g; For pH ≥ 8.0 standard = 2,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 6.
PH2	Beryllium standards vary with soil pH from 1-500 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 6.5 standard = 1 ug/g; For pH 6.5-<7.0 standard = 4 ug/g; For pH 7.0-<7.5 standard = 30 ug/g; For pH 7.5-<8.0 standard = 250 ug/g; For pH ≥ 8.0 standard = 500 ug/g. Consult CSR Schedule 3.1.1, Matrix 6.
PH3	Beryllium standards vary with soil pH from 85-350,000 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH < 5.0 standard = 85 ug/g; For pH 5.0 -<5.5 standard = 100 ug/g; For pH 5.5-<6.0 standard = 200 ug/g; For pH 6.0 -<6.5 standard = 550 ug/g; For pH 6.5-<7.0 standard = 2,500 ug/g; For pH 7.0-<7.5 standard = 20,000 ug/g; For pH 7.5-<8.0 standard = 150,000 ug/g; For pH ≥ 8.0 standard = 350,000 ug/g. Consult CSR Schedule 3.1.1, Matrix 6.
PH6	Cadmium standards vary with soil pH from 1-70 ug/g for groundwater used for drinking water for all land use types. For pH < 7.0 standard = 1 ug/g; For pH 7.0->7.5 standard = 4.5 ug/g; For pH 7.5->8.0 standard = 30 ug/g; For pH ≥ 8.0 standard = 70 ug/g. Consult CSR Schedule 3.1.1, Matrix 7.
PH7	Cadmium standards vary with soil pH from 1-50 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 7.0 standard = 1 ug/g; For pH 7.0->7.5 standard = 3 ug/g; For pH 7.5->8.0 standard = 20 ug/g; For pH ≥ 8.0 standard = 50 ug/g. Consult CSR Schedule 3.1.1, Matrix 7.
PH8	Cadmium standards vary with soil pH from 1-200 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH < 5.5 standard = 1 ug/g; For pH 5.5-<6.0 standard = 1.5 ug/g; For pH 6.0 -<6.5 standard = 2 ug/g; For pH 6.5-<7.0 standard = 3.5 ug/g; For pH 7.0-<7.5 standard = 15 ug/g; For pH 7.5-<8.0 standard = 95 ug/g; For pH ≥ 8.0 standard = 200 ug/g. Consult CSR Schedule 3.1.1, Matrix 7.
PH11	Lead standards vary with soil pH from 120-8,500 ug/g for groundwater used for drinking water for all land use types. For pH < 5.5 standard = 120 ug/g; For pH 5.5-<6.0 standard = 150 ug/g; For pH 6.0 -<6.5 standard = 800 ug/g; For pH 6.5-<7.0 standard = 3,500 ug/g; For pH 7.0-<7.5 standard = 7,500 ug/g; For pH ≥ 7.5 standard = 8,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 18.
PH12	Lead standards vary with soil pH from 200-90,000 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 5.0 standard = 200 ug/g; For pH 5.0 -<5.5 standard = 350 ug/g; For pH 5.5-<6.0 standard = 1,500 ug/g; For pH 6.0 -<6.5 standard = 8,500 ug/g; For pH 6.5-<7.0 standard = 35,000 ug/g; For pH 7.0->7.5 standard = 80,000 ug/g; For pH ≥ 7.5 standard = 90,000 ug/g. Consult CSR Schedule 3.1.1, Matrix 18.
PH13	Lead standards vary with soil pH from 120-15,000 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH < 5.5 standard = 120 ug/g; For pH 5.5-<6.0 standard = 300 ug/g; For pH 6.0 -<6.5 standard = 1,500 ug/g; For pH 6.5-<7.0 standard = 6,500 ug/g; For pH ≥ 7.0 standard = 15,000 ug/g. Consult CSR Schedule 3.1.1, Matrix 18.
PH16	Nickel standards vary with soil pH from 70-500 ug/g for groundwater used for drinking water for all land use types. For pH < 7.5 standard = 70 ug/g; For pH 7.5-<8.0 standard = 250 ug/g; For pH ≥ 8.0 standard = 500 ug/g. Consult CSR Schedule 3.1.1, Matrix 24.
PH17	Nickel standards vary with soil pH from 90-9,500 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 5.0 standard = 90 ug/g; For pH 5.0 -<5.5 standard = 100 ug/g; For pH 5.5-<6.0 standard = 150 ug/g; For pH 6.0 -<6.5 standard = 200 ug/g; For pH 6.5-<7.0 standard = 300 ug/g; For pH 7.0->7.5 standard = 900 ug/g; For pH 7.5-<8.0 standard = 5,000 ug/g; For pH ≥ 8.0 standard = 9,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 24.
PH18	Nickel standards vary with soil pH from 70-500 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH < 7.5 standard = 70 ug/g; For pH 7.5-<8.0 standard = 250 ug/g; For pH ≥ 8.0 standard = 500 ug/g. Consult CSR Schedule 3.1.1, Matrix 24.
PH25	Zinc standards vary with soil pH from 200-5,500 ug/g for groundwater used for drinking water for all land use types. For pH < 5.0 standard = 200 ug/g; For pH 5.0 -<5.5 standard = 250 ug/g; For pH 5.5-<6.0 standard = 300 ug/g; For pH 6.0 -<6.5 standard = 450 ug/g; For pH 6.5-<7.0 standard = 600 ug/g; For pH 7.0->7.5 standard = 1,000 ug/g; For pH 7.5-<8.0 standard = 3,000 ug/g; For pH ≥ 8.0 standard = 5,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 40.
PH26	Zinc standards vary with soil pH from 150-3,000 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 6.0 standard = 150 ug/g; For pH 6.0 -<6.5 standard = 250 ug/g; For pH 6.5-<7.0 standard = 350 ug/g; For pH 7.0->7.5 standard = 600 ug/g; For pH 7.5-<8.0 standard = 1,500 ug/g; For pH ≥ 8.0 standard = 3,000 ug/g. Consult CSR Schedule 3.1.1, Matrix 40.
PH27	Zinc standards vary with soil pH from 150-200 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH <8.0 standard = 150 ug/g; For pH ≥ 8.0 standard = 200 ug/g. Consult CSR Schedule 3.1.1, Matrix 40.
PH30	Copper standards vary with soil pH from 250-100,000 ug/g for groundwater used for drinking water for all land use types. For pH < 5.0 standard = 250 ug/g; For pH 5.0 -<5.5 standard = 500 ug/g; For pH 5.5-<6.0 standard = 2,000 ug/g; For pH 6.0 -<6.5 standard = 10,000 ug/g; For pH 6.5-<7.0 standard = 50,000 ug/g; For pH ≥ 7.0 standard = 100,000 ug/g. Consult CSR Schedule 3.1.1, Matrix 11.
PH32	Copper standards vary with soil pH from 75-7,500 ug/g for groundwater flow to surface water used by aquatic life (freshwater) for all land use types. For pH < 5.5 standard = 75 ug/g; For pH 5.5-<6.0 standard = 100 ug/g; For pH 6.0 -<6.5 standard = 700 ug/g; For pH 6.5-<7.0 standard = 3,000 ug/g; For pH 7.0-<7.5 standard = 6,500 ug/g; For pH ≥ 7.5 standard = 7,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 11.
PH33	Copper standards vary with soil pH from 75-1,500 ug/g for groundwater flow to surface water used by aquatic life (marine) for all land use types. For pH < 6.0 standard = 75 ug/g; For pH 6.0 -<6.5 standard = 150 ug/g; For pH 6.5-<7.0 standard = 650 ug/g; For pH ≥ 7.0 standard = 1,500 ug/g. Consult CSR Schedule 3.1.1, Matrix 11.
s7	Standard is applicable to PHC in the F1 range minus BTEX.
RPD	Relative percentage Difference
n/c	not calculated

APPENDIX C

Laboratory Certificates



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 08-MAY-19
Report Date: 11-JUN-19 13:35 (MT)
Version: FINAL REV. 2

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2269977
Project P.O. #: 123512431 Task 601.400
Job Reference: WMT
C of C Numbers: 17-828877
Legal Site Desc:

Comments: ADDITIONAL 06-JUN-19 15:09

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269977-1 Soil 08-MAY-19 10:30 HV19-12SA5	L2269977-2 Soil 08-MAY-19 13:15 HV19-13SA1	L2269977-3 Soil 08-MAY-19 13:30 HV19-13SA4		
Grouping	Analyte					
SOIL						
Physical Tests	Moisture (%)		12.2			
	pH (1:2 soil:water) (pH)		7.10			
Particle Size	General Texture Class		Coarse			
	MUST PSA % > 75um (%)		53.2			
Metals	Aluminum (Al) (mg/kg)		16100			
	Antimony (Sb) (mg/kg)		0.21			
	Arsenic (As) (mg/kg)		2.81			
	Barium (Ba) (mg/kg)		73.2			
	Beryllium (Be) (mg/kg)		0.22			
	Bismuth (Bi) (mg/kg)		<0.20			
	Boron (B) (mg/kg)		<5.0			
	Cadmium (Cd) (mg/kg)		0.053			
	Calcium (Ca) (mg/kg)		4340			
	Chromium (Cr) (mg/kg)		20.5			
	Cobalt (Co) (mg/kg)		7.83			
	Copper (Cu) (mg/kg)		16.2			
	Iron (Fe) (mg/kg)		20600			
	Lead (Pb) (mg/kg)		3.01			
	Lithium (Li) (mg/kg)		5.6			
	Magnesium (Mg) (mg/kg)		4950			
	Manganese (Mn) (mg/kg)		404			
	Mercury (Hg) (mg/kg)		<0.050			
	Molybdenum (Mo) (mg/kg)		0.28			
	Nickel (Ni) (mg/kg)		14.8			
	Phosphorus (P) (mg/kg)		301			
	Potassium (K) (mg/kg)		780			
	Selenium (Se) (mg/kg)		<0.20			
	Silver (Ag) (mg/kg)		<0.10			
	Sodium (Na) (mg/kg)		252			
	Strontium (Sr) (mg/kg)		42.5			
	Sulfur (S) (mg/kg)		<1000			
	Thallium (Tl) (mg/kg)		0.052			
	Tin (Sn) (mg/kg)		<2.0			
	Titanium (Ti) (mg/kg)		1050			
	Tungsten (W) (mg/kg)		<0.50			
	Uranium (U) (mg/kg)		0.364			
	Vanadium (V) (mg/kg)		57.7			

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269977-1 Soil 08-MAY-19 10:30 HV19-12SA5	L2269977-2 Soil 08-MAY-19 13:15 HV19-13SA1	L2269977-3 Soil 08-MAY-19 13:30 HV19-13SA4		
Grouping	Analyte					
SOIL						
Metals	Zinc (Zn) (mg/kg)		35.6			
	Zirconium (Zr) (mg/kg)		4.6			
TCLP Extractables	1st Preliminary pH (pH)	6.31		7.63		
	2nd Preliminary pH (pH)	1.43		1.34		
	Final pH (pH)	4.98		4.95		
	Extraction Solution Initial pH (pH)	4.90		4.90		
	Acenaphthene (mg/L)	<0.000050		<0.000050		
	Acenaphthylene (mg/L)	<0.000050		<0.000050		
	Acridine (mg/L)	<0.000050		<0.000050		
	Anthracene (mg/L)	<0.000050		<0.000050		
	Benz(a)anthracene (mg/L)	<0.000050		<0.000050		
	Benzo(a)pyrene (mg/L)	<0.000050		<0.000050		
	Benzo(b&j)fluoranthene (mg/L)	<0.000050		<0.000050		
	Benzo(g,h,i)perylene (mg/L)	<0.000050		<0.000050		
	Benzo(k)fluoranthene (mg/L)	<0.000050		<0.000050		
	Chrysene (mg/L)	<0.000050		<0.000050		
	Dibenz(a,h)anthracene (mg/L)	<0.000050		<0.000050		
	Fluoranthene (mg/L)	<0.000050		<0.000050		
	Fluorene (mg/L)	<0.000050		<0.000050		
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050		<0.000050		
	Naphthalene (mg/L)	<0.000050		<0.000050		
	Phenanthrene (mg/L)	<0.000050		<0.000050		
	Pyrene (mg/L)	<0.000050		<0.000050		
TCLP Metals	1st Preliminary pH (pH)	6.31	6.82	7.63		
	2nd Preliminary pH (pH)	1.43	1.32	1.34		
	Final pH (pH)	4.94	4.93	4.92		
	Extraction Solution Initial pH (pH)	4.90	4.90	4.90		
	Aluminum (Al)-Leachable (mg/L)	0.74	0.20	0.14		
	Antimony (Sb)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Arsenic (As)-Leachable (mg/L)	<0.010	<0.010	<0.010		
	Barium (Ba)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Beryllium (Be)-Leachable (mg/L)	<0.025	<0.025	<0.025		
	Boron (B)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Cadmium (Cd)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Calcium (Ca)-Leachable (mg/L)	18.1	22.8	14.2		
	Chromium (Cr)-Leachable (mg/L)	<0.010	<0.010	<0.010		
	Cobalt (Co)-Leachable (mg/L)	<0.025	<0.025	<0.025		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269977-1 Soil 08-MAY-19 10:30 HV19-12SA5	L2269977-2 Soil 08-MAY-19 13:15 HV19-13SA1	L2269977-3 Soil 08-MAY-19 13:30 HV19-13SA4		
Grouping	Analyte					
SOIL						
TCLP Metals	Copper (Cu)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Iron (Fe)-Leachable (mg/L)	<0.15	<0.15	<0.15		
	Lead (Pb)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Lithium (Li)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Magnesium (Mg)-Leachable (mg/L)	2.34	5.22	3.92		
	Manganese (Mn)-Leachable (mg/L)	0.200	0.043	0.085		
	Mercury (Hg)-Leachable (mg/L)	<0.0010	<0.0010	<0.0010		
	Molybdenum (Mo)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Nickel (Ni)-Leachable (mg/L)	<0.050	<0.050	<0.050		
	Selenium (Se)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Silver (Ag)-Leachable (mg/L)	<0.00025	<0.00025	<0.00025		
	Thallium (Tl)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Leachable (mg/L)	<0.050	<0.050	<0.050		
	Uranium (U)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Vanadium (V)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Zinc (Zn)-Leachable (mg/L)	<0.15	<0.15	<0.15		
Volatile Organic Compounds	Benzene (mg/kg)		<0.0050			
	Ethylbenzene (mg/kg)		<0.015			
	Methyl t-butyl ether (MTBE) (mg/kg)		<0.20			
	Styrene (mg/kg)		<0.050			
	Toluene (mg/kg)		<0.050			
	ortho-Xylene (mg/kg)		<0.050			
	meta- & para-Xylene (mg/kg)		<0.050			
	Xylenes (mg/kg)		<0.075			
	Surrogate: 4-Bromofluorobenzene (SS) (%)		77.9			
	Surrogate: 1,4-Difluorobenzene (SS) (%)		88.5			
Hydrocarbons	EPH10-19 (mg/kg)		<200			
	EPH19-32 (mg/kg)		<200			
	LEPH (mg/kg)		<200			
	HEPH (mg/kg)		<200			
	F1 (C6-C10) (mg/kg)		<10			
	F1-BTEX (mg/kg)		<10			
	F2 (C10-C16) (mg/kg)		<30			
	F2-Naphth (mg/kg)		<30			
	F3 (C16-C34) (mg/kg)		<50			
	F3-PAH (mg/kg)		<50			
	F4 (C34-C50) (mg/kg)		<50			

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269977-1 Soil 08-MAY-19 10:30 HV19-12SA5	L2269977-2 Soil 08-MAY-19 13:15 HV19-13SA1	L2269977-3 Soil 08-MAY-19 13:30 HV19-13SA4		
Grouping	Analyte					
SOIL						
Hydrocarbons	Volatile Hydrocarbons (VH6-10) (mg/kg)		<100			
	VPH (C6-C10) (mg/kg)		<100			
	Chrom. to baseline at nC50		YES			
	Surrogate: 2-Bromobenzotrifluoride (%)		90.9			
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)		94.7			
	Surrogate: 3,4-Dichlorotoluene (SS) (%)		78.5			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)		<0.0050			
	Acenaphthylene (mg/kg)		<0.0050			
	Anthracene (mg/kg)		<0.0040			
	Benz(a)anthracene (mg/kg)		<0.010			
	Benzo(a)pyrene (mg/kg)		<0.010			
	Benzo(b&j)fluoranthene (mg/kg)		<0.010			
	Benzo(b+j+k)fluoranthene (mg/kg)		<0.015			
	Benzo(g,h,i)perylene (mg/kg)		<0.010			
	Benzo(k)fluoranthene (mg/kg)		<0.010			
	Chrysene (mg/kg)		<0.010			
	Dibenz(a,h)anthracene (mg/kg)		<0.0050			
	Fluoranthene (mg/kg)		<0.010			
	Fluorene (mg/kg)		<0.010			
	Indeno(1,2,3-c,d)pyrene (mg/kg)		<0.010			
	1-Methylnaphthalene (mg/kg)		<0.050			
	2-Methylnaphthalene (mg/kg)		<0.010			
	Naphthalene (mg/kg)		<0.010			
	Phenanthrene (mg/kg)		<0.010			
	Pyrene (mg/kg)		<0.010			
	Quinoline (mg/kg)		<0.050			
	Surrogate: Acenaphthene d10 (%)		84.8			
	Surrogate: Chrysene d12 (%)		71.8			
	Surrogate: Naphthalene d8 (%)		91.9			
	Surrogate: Phenanthrene d10 (%)		91.6			
	B(a)P Total Potency Equivalent (mg/kg)		<0.020			
	IACR (CCME) (mg/kg)		<0.15			

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269977-1 Soil 08-MAY-19 10:30 HV19-12SA5	L2269977-2 Soil 08-MAY-19 13:15 HV19-13SA1	L2269977-3 Soil 08-MAY-19 13:30 HV19-13SA4		
Grouping	Analyte					
WASTE						
Physical Tests	Free Liquids (Paint Filter)		Absent			
Waste Characterizations	Flash Point (Deg. C)		>75			
	Benzene (mg/L)	<0.0050	<0.0050	<0.0050		
	Toluene (mg/L)	<0.0050	<0.0050	<0.0050		
	Ethylbenzene (mg/L)	<0.0050	<0.0050	<0.0050		
	meta- & para-Xylene (mg/L)	<0.0050	<0.0050	<0.0050		
	ortho-Xylene (mg/L)	<0.0050	<0.0050	<0.0050		
	Xylenes (mg/L)	<0.0075	<0.0075	<0.0075		

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
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Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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EPH-TUMB-FID-VA Soil EPH in Solids by Tumbler and GCFID BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-BTX-CALC-VA Soil F1-Total BTX CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10) and F1-BTEX, a subsample of the sediment/soil is extracted with methanol and analysed by purge & trap GC/FID. The F1-BTEX result is then calculated as follows:

F1-BTEX: F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).

F1-HSFID-VA Soil CCME F1 by headspace GCMS CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

F2F3-PAH-CALC-VA Soil F2&F3 minus PAHs [Calculation] CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F2 (C10-C16) and F3 (C16-C34), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds prior to analysis by on-column GC/FID. The F2-Naph and F3-PAH results are then calculated as follows:

1. F2-Naph: F2 (C10-C16) minus naphthalene.
2. F3-PAH: F3 (C16-C34) minus selected PAHs (phenanthrene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and pyrene).

F2F4-TUMB-H/A-FID-VA Soil CWS F2-F4 Hydrocarbons by Tumbler GCFID CCME PETROLEUM HYDROCARBONS

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.

Notes:

1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where F4 (C34-C50) and F4G-sg results are reported for a sample, the larger of the reported values is used for comparison against the relevant CCME standard for F4.
7. The gravimetric heavy hydrocarbon results (F4G-sg), cannot be added to the C6 to C50 hydrocarbon results.
8. This method is validated for use.
9. Data from analysis of quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram.

FLASH-PMCC-AUTO-VA Waste Flash Point by Pensky-Martens Closed Cup ASTM D93-15a

This method uses procedures adapted from ASTM D93-15a to determine the flash point of liquid and solid samples using an Automated Pensky-Martens Closed Cup Flash Point Tester. The flash point is the lowest temperature (corrected to a barometric pressure of 101.3 kPa) at which the application of an ignition source causes the vapours of the sample to ignite.

HG-200.2-CVAF-VA Soil Mercury in Soil by CVAAS EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

HG-TCLP-CVAFS-VA Soil Mercury by CVAAS (TCLP) EPA 1311/245.7

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 245.7).

LEPH/HEPH-CALC-VA Soil LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-

Reference Information

c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H₂S) may be excluded if lost during sampling, storage, or digestion.

MET-TCLP-CCMS-VA Soil Metals by ICPMS (TCLP) EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TCLP-P13-CCMS-VA Soil Metals by ICPMS (TCLP) BCMOE Protocol 13 & EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA) and Protocol 13 for Contaminated Sites - Screening Level Risk Assessment - 2008, published by the BCMOE. In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #2 (glacial acetic acid). The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MOISTURE-VA Soil Moisture content CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TCLP-ME-MS-VA Soil PAH's IN TCLP LEACHATE EPA 1311/3511/8270 (MOD)

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-TMB-H/A-MS-VA Soil PAH - Rotary Extraction (Hexane/Acetone) EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PAINT FILTER-VA Waste Paint Filter Test EPA 9095B

A specified amount of material is placed in a paint filter. If any portion of the test material passes through the filter in the five minute test period, the material is deemed to contain free liquids. The absence of any amount of free liquid classifies the sample as a solid.

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-MUST-SK Soil % Particles > 75um (Coarse/Fine) ASTM D422-63-SIEVE

An air-dried sample is reduced to < 2 mm size and mixed with a dispersing agent (Calgon solution). The sample is washed through a 200 mesh (75 µm) sieve. The retained mass of sample is used to determine % sand fraction.

Reference: ASTM D422-63

VH-HSFID-VA Soil VH in soil by Headspace GCFID BC Env. Lab Manual (VH in Solids)

Reference Information

This analysis involves the extraction of a subsample of the sediment/soil with methanol. Aliquots of the methanol extract are then added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is analyzed for Volatile Hydrocarbons (VH) by capillary column gas chromatography with flame-ionization detection (GC/FID). The methanol extraction and VH analysis are carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Volatile Hydrocarbons in Solids by GC/FID" (Version 2.1 July 1999).

VH-SURR-FID-VA Soil VH Surrogates for Soils BC Env. Lab Manual (VH in Solids)

VOC7-L-HSMS-VA Soil VOCs in soil by Headspace GCMS EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-TCLP-VA Waste BTEX in Waste by TCLP USEPA Method 1311

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). A representative sample of waste is extracted in a Zero Headspace Extractor at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #1. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved. The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Soil VOC7 and/or VOC Surrogates for Soils EPA 5035A/5021A/8260C

VPH-CALC-VA Soil VPH is VH minus select aromatics BC MOE VPH

VPHs measures Volatile Petroleum Hydrocarbons in soil. Results are calculated by subtraction of specific Monocyclic Aromatic Hydrocarbons from VH6-10, as per the BC Lab Manual VPH calculation procedure.

VPHs = VH6-10 minus Benzene, Toluene, Ethylbenzene, Xylenes, and Styrene

XYLENES-CALC-VA Soil Sum of Xylene Isomer Concentrations EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

XYLENES-TCLP-CALC-VA Waste Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-828877

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

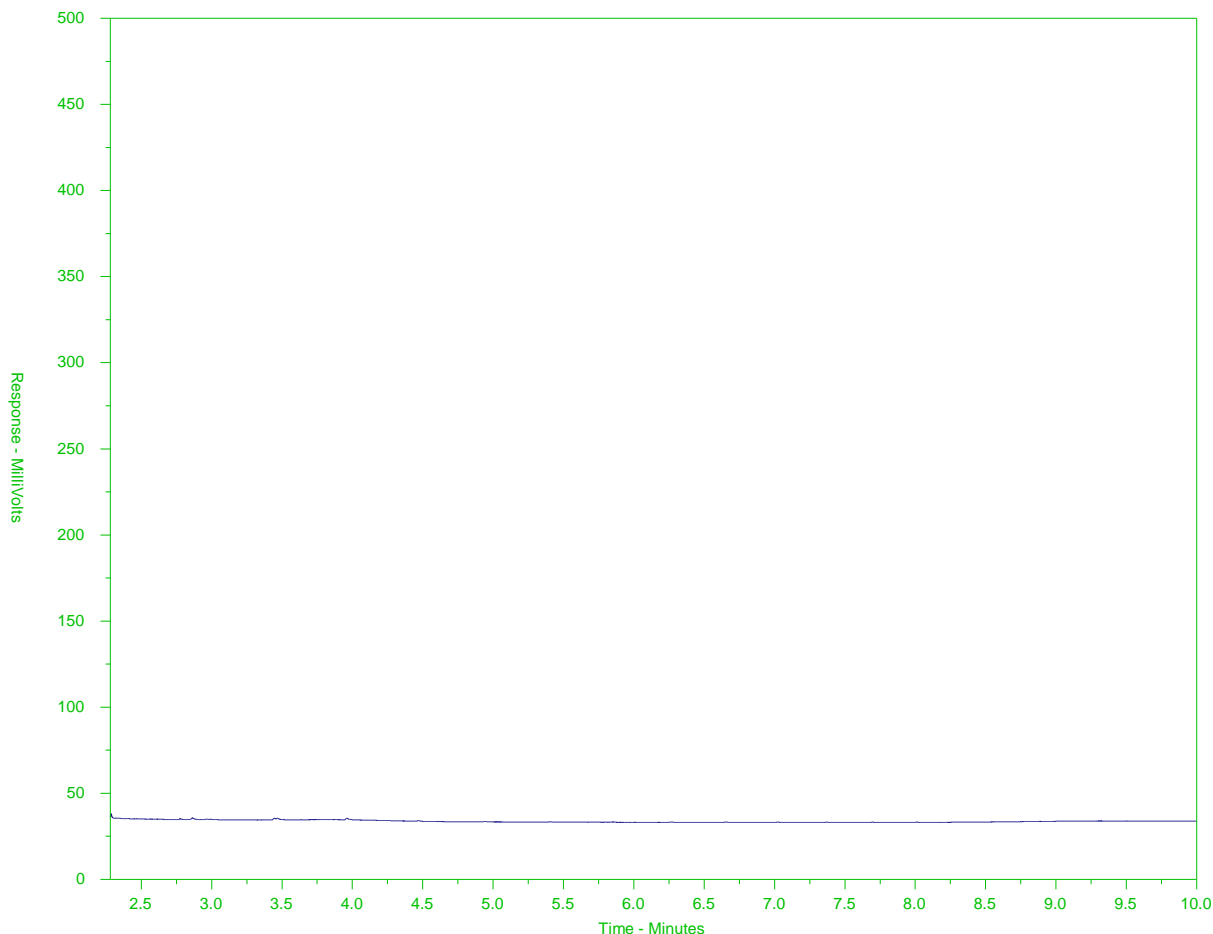
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2269977-2
Client Sample ID: HV19-13SA1



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

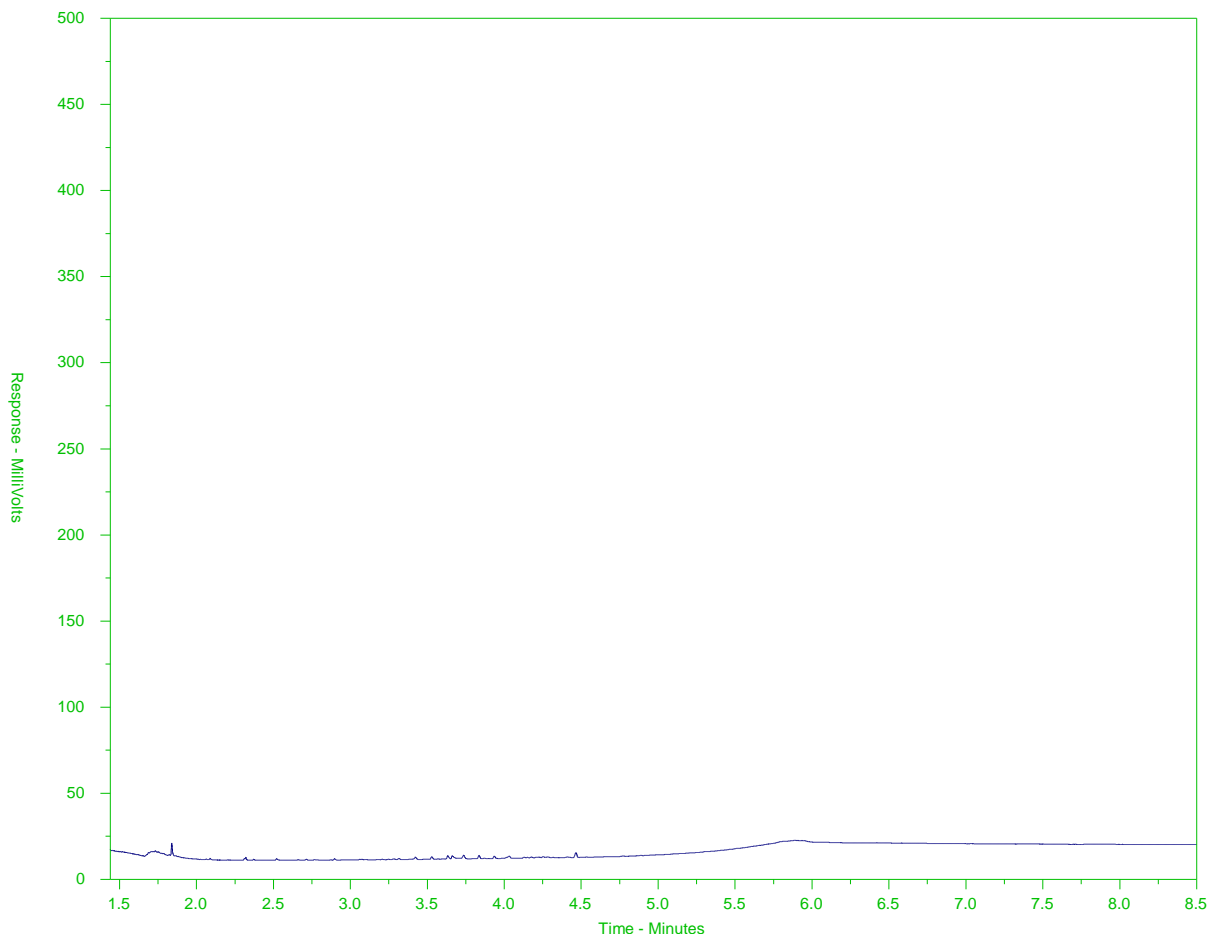
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2269977-C-2
Client Sample ID: HV19-13SA1



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

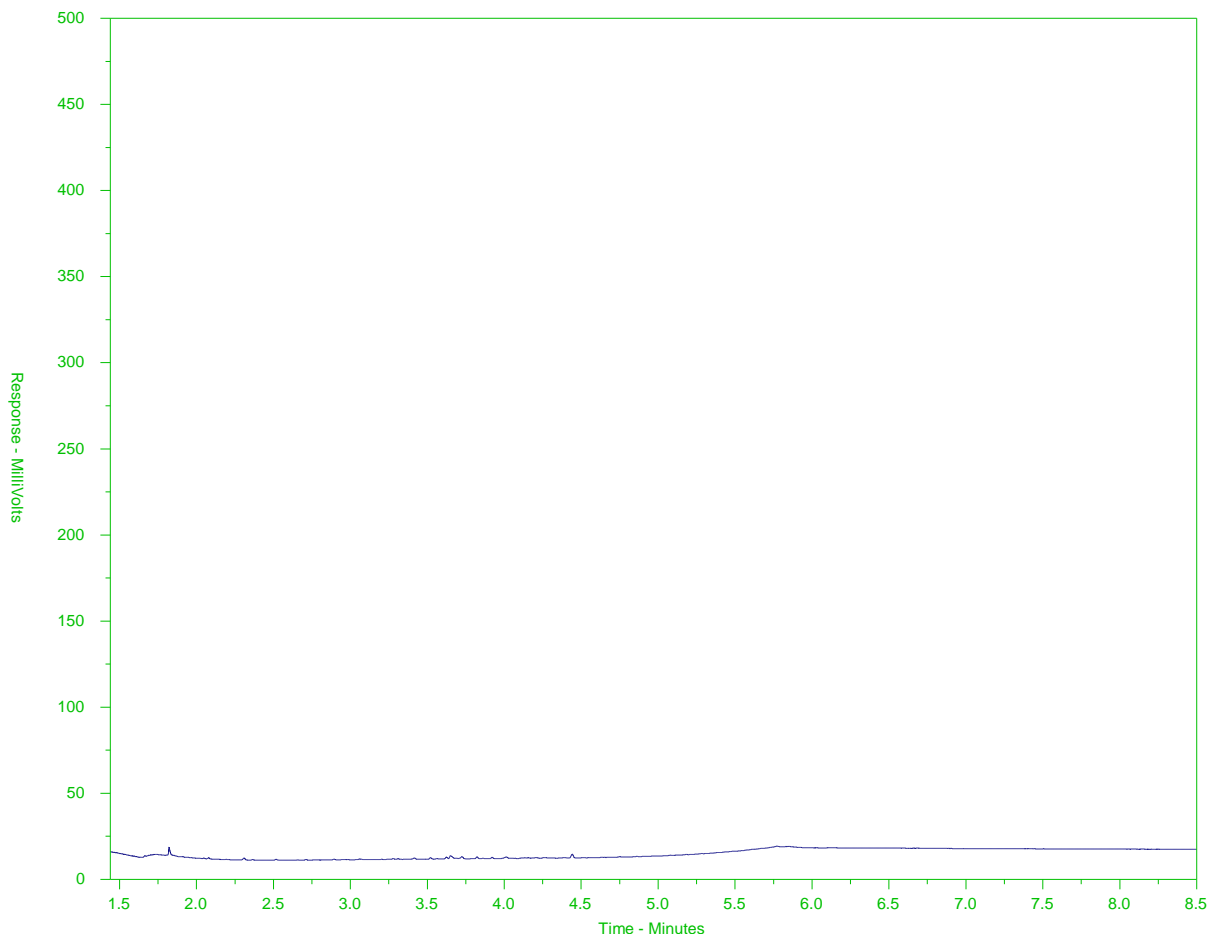
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: WG3046209-C-3#L2269977-C-2
 Client Sample ID: HV19-13SA1



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

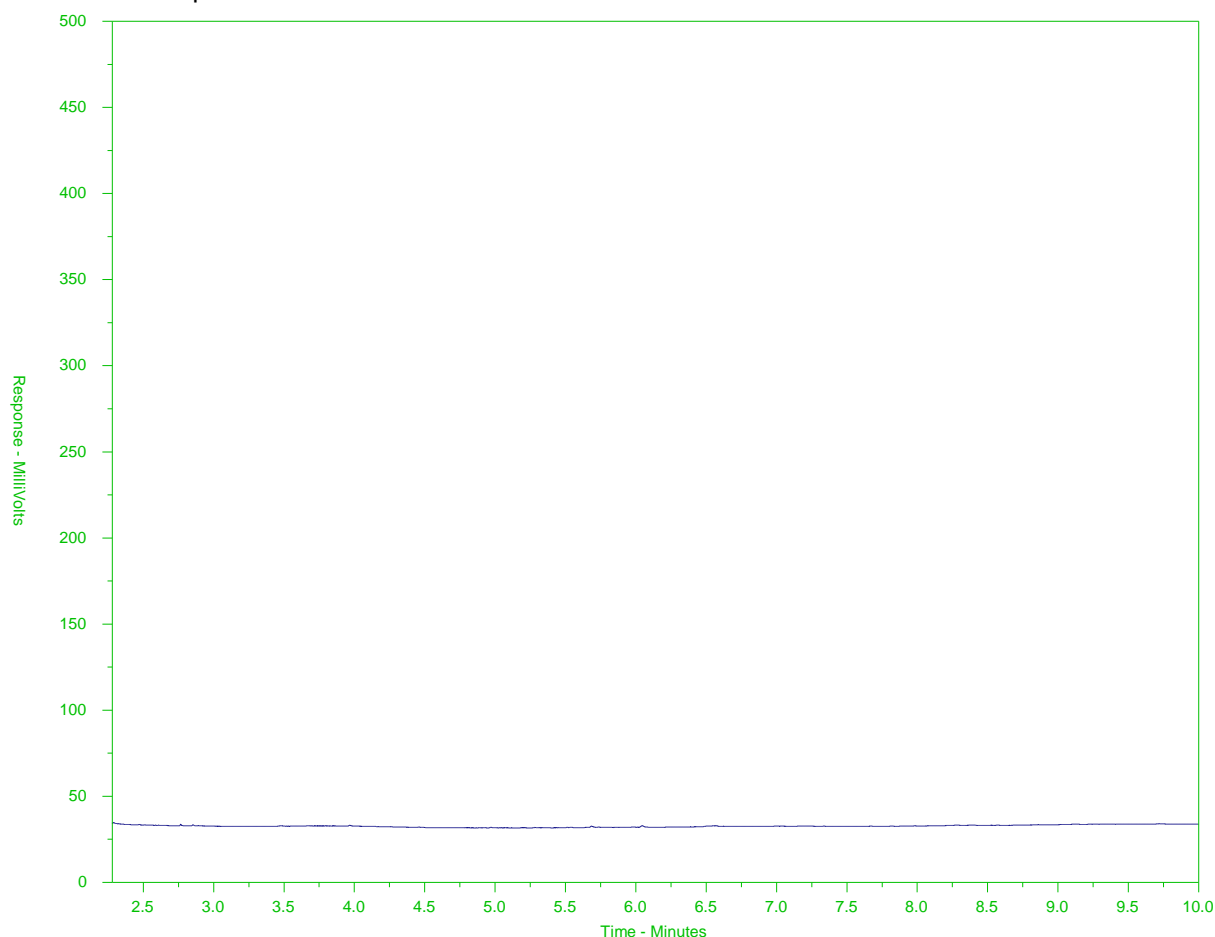
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: WG3046224-3#L2269977-2
Client Sample ID: HV19-13SA1



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



L2269977-COFC

COC Number: 17 - 828877

Page / of /

Report To		Report Format / Distribution		Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	STANTEC CONSULTING	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R]	<input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	ACCOUNTS PAYABLE	Quality Control (QC) Report with Report	<input type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4-20%]	<input type="checkbox"/> 1 Business day [E - 100%]
Phone:	604 436 3014	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%]	<input type="checkbox"/> Same Day, Weekend or Statutory holiday [E2 - 200% (Laboratory opening fees may apply)]
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2-50%]	
Street:	500, 4730 KINGSWAY AVE	Email 1 or Fax:	EDD@stantec.com	Date and Time Required for all E&P TATs: dd-mm-yy hh:mm	
City/Province:	BURNABY, BC V5H 0C6	Email 2:	tyler.joyce@stantec.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H 0C6	Email 3:	jodi.johnston@stantec.com	Analysis Request including FLASHPOINT	
Invoice To:	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Copy of Invoice with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	NUMBER OF CONTAINERS	
Company:	Stantec	Email 1 or Fax:	tyler.joyce@stantec.com	TCLP BTEX	
Contact:	TYLER JOYCE	Email 2:	jodi.johnston@stantec.com	TCLP PAH	
Project Information		Oil and Gas Required Fields (client use)		TCLP METALS	
ALS Account # / Quote #	Q70 Q74015	APE/Cost Center: PO#		BTEX, VPH, FI	
Job #:	WMT	Major/Minor Code: Routing Code:		LEP/HEP/PAH	
PO / AFE:	(123512431) 123512431	Requisitioner:		CCME F2-F4	
LSD:	TASK 601.400	Location:		CLASS 2 LANDFILL	
ALS Lab Work Order # (lab use only):		ALS Contact:	BRENT MACK	BC CSR METALS	
ALS Sample # (lab use only)		Sampler:	JODI JOHNSTON	GRAN SIZE (200 mesh)	
Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mm-yy)	Time (hh:mm)	SAMPLES ON HOLD	
HV19-12SA5		08-May-19	10:30	SUSPECTED HAZARD (see Special Instructions)	
HV19-13SA1		↓	1315		
HV19-13SA4		08-May-19	1330		
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System?				Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use?				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input checked="" type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by:	JODI JOHNSTON	Date:	2019/05/08	Received by:	tk
		Time:	1610	Date:	May 8
REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION		WHITE - LABORATORY COPY YELLOW - CLIENT COPY		Time: 4:05pm	



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 08-MAY-19
Report Date: 11-JUN-19 14:45 (MT)
Version: FINAL REV. 2

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2269978
Project P.O. #: 123512431 Task 601.400
Job Reference: WMT
C of C Numbers: 17-828876
Legal Site Desc:

Comments: ADDITIONAL 06-JUN-19 15:17

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-1 Soil 07-MAY-19 15:30 HV19-01SA3	L2269978-2 Soil 07-MAY-19 15:45 HV19-01SA5	L2269978-3 Soil 07-MAY-19 DUP1	L2269978-4 Soil 07-MAY-19 10:50 HV19-02SA1	L2269978-5 Soil 07-MAY-19 11:00 HV19-02SA2
Grouping	Analyte					
SOIL						
Physical Tests	Moisture (%)					
	pH (1:2 soil:water) (pH)		8.52		7.86	
Particle Size	General Texture Class					
	MUST PSA % > 75um (%)					
Metals	Aluminum (Al) (mg/kg)				11200	
	Antimony (Sb) (mg/kg)				0.18	
	Arsenic (As) (mg/kg)				3.01	
	Barium (Ba) (mg/kg)				55.2	
	Beryllium (Be) (mg/kg)				0.14	
	Bismuth (Bi) (mg/kg)				<0.20	
	Boron (B) (mg/kg)				<5.0	
	Cadmium (Cd) (mg/kg)				0.066	
	Calcium (Ca) (mg/kg)				4810	
	Chromium (Cr) (mg/kg)				15.3	
	Cobalt (Co) (mg/kg)				6.21	
	Copper (Cu) (mg/kg)				15.6	
	Iron (Fe) (mg/kg)				17200	
	Lead (Pb) (mg/kg)				3.41	
	Lithium (Li) (mg/kg)				6.3	
	Magnesium (Mg) (mg/kg)				4790	
	Manganese (Mn) (mg/kg)				286	
	Mercury (Hg) (mg/kg)				<0.050	
	Molybdenum (Mo) (mg/kg)				0.29	
	Nickel (Ni) (mg/kg)				11.8	
	Phosphorus (P) (mg/kg)				429	
	Potassium (K) (mg/kg)				920	
	Selenium (Se) (mg/kg)				<0.20	
	Silver (Ag) (mg/kg)				<0.10	
	Sodium (Na) (mg/kg)				427	
	Strontium (Sr) (mg/kg)				38.4	
	Sulfur (S) (mg/kg)				<1000	
	Thallium (Tl) (mg/kg)				<0.050	
	Tin (Sn) (mg/kg)				<2.0	
	Titanium (Ti) (mg/kg)				749	
	Tungsten (W) (mg/kg)				<0.50	
	Uranium (U) (mg/kg)				0.366	
	Vanadium (V) (mg/kg)				49.6	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L2269978-6 Soil 07-MAY-19 11:10 HV19-02SA5	L2269978-7 Soil 07-MAY-19 12:00 HV19-03SA2	L2269978-8 Soil 07-MAY-19 15:30 DUP2		
Grouping	Analyte						
SOIL							
Physical Tests	Moisture (%)	13.2					
	pH (1:2 soil:water) (pH)						
Particle Size	General Texture Class	Coarse					
	MUST PSA % > 75um (%)	58.9					
Metals	Aluminum (Al) (mg/kg)						
	Antimony (Sb) (mg/kg)						
	Arsenic (As) (mg/kg)						
	Barium (Ba) (mg/kg)						
	Beryllium (Be) (mg/kg)						
	Bismuth (Bi) (mg/kg)						
	Boron (B) (mg/kg)						
	Cadmium (Cd) (mg/kg)						
	Calcium (Ca) (mg/kg)						
	Chromium (Cr) (mg/kg)						
	Cobalt (Co) (mg/kg)						
	Copper (Cu) (mg/kg)						
	Iron (Fe) (mg/kg)						
	Lead (Pb) (mg/kg)						
	Lithium (Li) (mg/kg)						
	Magnesium (Mg) (mg/kg)						
	Manganese (Mn) (mg/kg)						
	Mercury (Hg) (mg/kg)						
	Molybdenum (Mo) (mg/kg)						
	Nickel (Ni) (mg/kg)						
	Phosphorus (P) (mg/kg)						
	Potassium (K) (mg/kg)						
	Selenium (Se) (mg/kg)						
	Silver (Ag) (mg/kg)						
	Sodium (Na) (mg/kg)						
	Strontium (Sr) (mg/kg)						
	Sulfur (S) (mg/kg)						
	Thallium (Tl) (mg/kg)						
	Tin (Sn) (mg/kg)						
	Titanium (Ti) (mg/kg)						
	Tungsten (W) (mg/kg)						
	Uranium (U) (mg/kg)						
	Vanadium (V) (mg/kg)						

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-1 Soil 07-MAY-19 15:30 HV19-01SA3	L2269978-2 Soil 07-MAY-19 15:45 HV19-01SA5	L2269978-3 Soil 07-MAY-19 DUP1	L2269978-4 Soil 07-MAY-19 10:50 HV19-02SA1	L2269978-5 Soil 07-MAY-19 11:00 HV19-02SA2
Grouping	Analyte					
SOIL						
Metals	Zinc (Zn) (mg/kg)				33.3	
	Zirconium (Zr) (mg/kg)				3.0	
TCLP Extractables	1st Preliminary pH (pH)	8.04				8.85
	2nd Preliminary pH (pH)	1.44				1.42
	Final pH (pH)	5.03				5.04
	Extraction Solution Initial pH (pH)	4.90				4.90
	Acenaphthene (mg/L)	<0.000050				0.000053
	Acenaphthylene (mg/L)	<0.000050				<0.000050
	Acridine (mg/L)	<0.000050				<0.000050
	Anthracene (mg/L)	<0.000050				<0.000050
	Benz(a)anthracene (mg/L)	<0.000050				<0.000050
	Benzo(a)pyrene (mg/L)	<0.000050				<0.000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000050				<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050				<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050				<0.000050
	Chrysene (mg/L)	<0.000050				<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050				<0.000050
	Fluoranthene (mg/L)	<0.000050				<0.000050
	Fluorene (mg/L)	<0.000050				<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050				<0.000050
	Naphthalene (mg/L)	<0.000050				<0.000050
	Phenanthrene (mg/L)	<0.000050				<0.000050
	Pyrene (mg/L)	<0.000050				<0.000050
TCLP Metals	1st Preliminary pH (pH)	8.04	9.19			8.85
	2nd Preliminary pH (pH)	1.44	1.62			1.42
	Final pH (pH)	5.02	5.18			5.04
	Extraction Solution Initial pH (pH)	4.90	4.92			4.90
	Aluminum (Al)-Leachable (mg/L)	0.34	0.21			0.25
	Antimony (Sb)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Arsenic (As)-Leachable (mg/L)	<0.010	<0.010			<0.010
	Barium (Ba)-Leachable (mg/L)	<0.50	<0.50			<0.50
	Beryllium (Be)-Leachable (mg/L)	<0.025	<0.025			<0.025
	Boron (B)-Leachable (mg/L)	<0.50	<0.50			<0.50
	Cadmium (Cd)-Leachable (mg/L)	0.00060	0.00131			<0.00050
	Calcium (Ca)-Leachable (mg/L)	66.9	186			77.4
	Chromium (Cr)-Leachable (mg/L)	<0.010	<0.010			<0.010
	Cobalt (Co)-Leachable (mg/L)	<0.025	<0.025			<0.025

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-6 Soil 07-MAY-19 11:10 HV19-02SA5	L2269978-7 Soil 07-MAY-19 12:00 HV19-03SA2	L2269978-8 Soil 07-MAY-19 15:30 DUP2		
Grouping	Analyte					
SOIL						
Metals	Zinc (Zn) (mg/kg)					
	Zirconium (Zr) (mg/kg)					
TCLP Extractables	1st Preliminary pH (pH)		7.24	7.31		
	2nd Preliminary pH (pH)		1.32	1.36		
	Final pH (pH)		4.97	4.96		
	Extraction Solution Initial pH (pH)		4.90	4.90		
	Acenaphthene (mg/L)		<0.000050	<0.000050		
	Acenaphthylene (mg/L)		<0.000050	<0.000050		
	Acridine (mg/L)		<0.000050	<0.000050		
	Anthracene (mg/L)		<0.000050	<0.000050		
	Benz(a)anthracene (mg/L)		<0.000050	<0.000050		
	Benzo(a)pyrene (mg/L)		<0.000050	<0.000050		
	Benzo(b&j)fluoranthene (mg/L)		<0.000050	<0.000050		
	Benzo(g,h,i)perylene (mg/L)		<0.000050	<0.000050		
	Benzo(k)fluoranthene (mg/L)		<0.000050	<0.000050		
	Chrysene (mg/L)		<0.000050	<0.000050		
	Dibenz(a,h)anthracene (mg/L)		<0.000050	<0.000050		
	Fluoranthene (mg/L)		<0.000050	<0.000050		
	Fluorene (mg/L)		<0.000050	<0.000050		
	Indeno(1,2,3-c,d)pyrene (mg/L)		<0.000050	<0.000050		
	Naphthalene (mg/L)		<0.000050	<0.000050		
	Phenanthrene (mg/L)		<0.000050	<0.000050		
	Pyrene (mg/L)		<0.000050	<0.000050		
TCLP Metals	1st Preliminary pH (pH)		7.24	7.31		
	2nd Preliminary pH (pH)		1.32	1.36		
	Final pH (pH)		4.95	4.97		
	Extraction Solution Initial pH (pH)		4.90	4.90		
	Aluminum (Al)-Leachable (mg/L)		0.60	0.61		
	Antimony (Sb)-Leachable (mg/L)		<0.0050	<0.0050		
	Arsenic (As)-Leachable (mg/L)		<0.010	<0.010		
	Barium (Ba)-Leachable (mg/L)		<0.50	<0.50		
	Beryllium (Be)-Leachable (mg/L)		<0.025	<0.025		
	Boron (B)-Leachable (mg/L)		<0.50	<0.50		
	Cadmium (Cd)-Leachable (mg/L)		<0.00050	<0.00050		
	Calcium (Ca)-Leachable (mg/L)		7.8	5.5		
	Chromium (Cr)-Leachable (mg/L)		<0.010	<0.010		
	Cobalt (Co)-Leachable (mg/L)		<0.025	<0.025		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-1 Soil 07-MAY-19 15:30 HV19-01SA3	L2269978-2 Soil 07-MAY-19 15:45 HV19-01SA5	L2269978-3 Soil 07-MAY-19 DUP1	L2269978-4 Soil 07-MAY-19 10:50 HV19-02SA1	L2269978-5 Soil 07-MAY-19 11:00 HV19-02SA2
Grouping	Analyte					
SOIL						
TCLP Metals	Copper (Cu)-Leachable (mg/L)	0.0220	0.0171			0.0114
	Iron (Fe)-Leachable (mg/L)	0.37	2.65			2.39
	Lead (Pb)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Lithium (Li)-Leachable (mg/L)	<0.50	<0.50			<0.50
	Magnesium (Mg)-Leachable (mg/L)	11.3	18.3			7.75
	Manganese (Mn)-Leachable (mg/L)	2.89	3.08			1.89
	Mercury (Hg)-Leachable (mg/L)	<0.0010	<0.0010			<0.0010
	Molybdenum (Mo)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Nickel (Ni)-Leachable (mg/L)	<0.050	<0.050			<0.050
	Selenium (Se)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Silver (Ag)-Leachable (mg/L)	<0.00025	<0.00025			<0.00025
	Thallium (Tl)-Leachable (mg/L)	<0.00050	0.00114			<0.00050
	Titanium (Ti)-Leachable (mg/L)	<0.050	<0.050			<0.050
	Uranium (U)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Vanadium (V)-Leachable (mg/L)	<0.0050	<0.0050			<0.0050
	Zinc (Zn)-Leachable (mg/L)	<0.15	<0.15			<0.15
Volatile Organic Compounds	VOC Sample Container			Field MeOH		
	Benzene (mg/kg)					
	Ethylbenzene (mg/kg)					
	Methyl t-butyl ether (MTBE) (mg/kg)					
	Styrene (mg/kg)					
	Toluene (mg/kg)					
	ortho-Xylene (mg/kg)					
	meta- & para-Xylene (mg/kg)					
	Xylenes (mg/kg)					
	Surrogate: 4-Bromofluorobenzene (SS) (%)					
	Surrogate: 1,4-Difluorobenzene (SS) (%)					
Hydrocarbons	EPH10-19 (mg/kg)					
	EPH19-32 (mg/kg)					
	LEPH (mg/kg)					
	HEPH (mg/kg)					
	F1 (C6-C10) (mg/kg)					
	F1-BTEX (mg/kg)					
	F2 (C10-C16) (mg/kg)					
	F2-Naphth (mg/kg)					
	F3 (C16-C34) (mg/kg)					
	F3-PAH (mg/kg)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-6 Soil 07-MAY-19 11:10 HV19-02SA5	L2269978-7 Soil 07-MAY-19 12:00 HV19-03SA2	L2269978-8 Soil 07-MAY-19 15:30 DUP2		
Grouping	Analyte					
SOIL						
TCLP Metals	Copper (Cu)-Leachable (mg/L)		<0.0050	<0.0050		
	Iron (Fe)-Leachable (mg/L)		0.74	0.54		
	Lead (Pb)-Leachable (mg/L)		<0.0050	<0.0050		
	Lithium (Li)-Leachable (mg/L)		<0.50	<0.50		
	Magnesium (Mg)-Leachable (mg/L)		1.12	0.85		
	Manganese (Mn)-Leachable (mg/L)		0.242	0.146		
	Mercury (Hg)-Leachable (mg/L)		<0.0010	<0.0010		
	Molybdenum (Mo)-Leachable (mg/L)		<0.0050	<0.0050		
	Nickel (Ni)-Leachable (mg/L)		<0.050	<0.050		
	Selenium (Se)-Leachable (mg/L)		<0.0050	<0.0050		
	Silver (Ag)-Leachable (mg/L)		<0.00025	<0.00025		
	Thallium (Tl)-Leachable (mg/L)		<0.00050	<0.00050		
	Titanium (Ti)-Leachable (mg/L)		<0.050	<0.050		
	Uranium (U)-Leachable (mg/L)		<0.0050	<0.0050		
	Vanadium (V)-Leachable (mg/L)		<0.0050	<0.0050		
	Zinc (Zn)-Leachable (mg/L)		<0.15	<0.15		
Volatile Organic Compounds	VOC Sample Container	Field MeOH				
	Benzene (mg/kg)	<0.0050				
	Ethylbenzene (mg/kg)	<0.015				
	Methyl t-butyl ether (MTBE) (mg/kg)	<0.20				
	Styrene (mg/kg)	<0.050				
	Toluene (mg/kg)	<0.050				
	ortho-Xylene (mg/kg)	<0.050				
	meta- & para-Xylene (mg/kg)	<0.050				
	Xylenes (mg/kg)	<0.075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	81.0				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	91.3				
Hydrocarbons	EPH10-19 (mg/kg)	<200				
	EPH19-32 (mg/kg)	<200				
	LEPH (mg/kg)	<200				
	HEPH (mg/kg)	<200				
	F1 (C6-C10) (mg/kg)	<10				
	F1-BTEX (mg/kg)	<10				
	F2 (C10-C16) (mg/kg)	<30				
	F2-Naphth (mg/kg)	<30				
	F3 (C16-C34) (mg/kg)	<50				
	F3-PAH (mg/kg)	<50				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-1 Soil 07-MAY-19 15:30 HV19-01SA3	L2269978-2 Soil 07-MAY-19 15:45 HV19-01SA5	L2269978-3 Soil 07-MAY-19 DUP1	L2269978-4 Soil 07-MAY-19 10:50 HV19-02SA1	L2269978-5 Soil 07-MAY-19 11:00 HV19-02SA2
Grouping	Analyte					
SOIL						
Hydrocarbons	F4 (C34-C50) (mg/kg)					
	Volatile Hydrocarbons (VH6-10) (mg/kg)					
	VPH (C6-C10) (mg/kg)					
	Chrom. to baseline at nC50					
	Surrogate: 2-Bromobenzotrifluoride (%)					
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)					
	Surrogate: 3,4-Dichlorotoluene (SS) (%)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)					
	Acenaphthylene (mg/kg)					
	Anthracene (mg/kg)					
	Benz(a)anthracene (mg/kg)					
	Benzo(a)pyrene (mg/kg)					
	Benzo(b&j)fluoranthene (mg/kg)					
	Benzo(b+j+k)fluoranthene (mg/kg)					
	Benzo(g,h,i)perylene (mg/kg)					
	Benzo(k)fluoranthene (mg/kg)					
	Chrysene (mg/kg)					
	Dibenz(a,h)anthracene (mg/kg)					
	Fluoranthene (mg/kg)					
	Fluorene (mg/kg)					
	Indeno(1,2,3-c,d)pyrene (mg/kg)					
	1-Methylnaphthalene (mg/kg)					
	2-Methylnaphthalene (mg/kg)					
	Naphthalene (mg/kg)					
	Phenanthrene (mg/kg)					
	Pyrene (mg/kg)					
	Quinoline (mg/kg)					
	Surrogate: Acenaphthene d10 (%)					
	Surrogate: Chrysene d12 (%)					
	Surrogate: Naphthalene d8 (%)					
	Surrogate: Phenanthrene d10 (%)					
	B(a)P Total Potency Equivalent (mg/kg)					
	IACR (CCME) (mg/kg)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-6 Soil 07-MAY-19 11:10 HV19-02SA5	L2269978-7 Soil 07-MAY-19 12:00 HV19-03SA2	L2269978-8 Soil 07-MAY-19 15:30 DUP2		
Grouping	Analyte					
SOIL						
Hydrocarbons	F4 (C34-C50) (mg/kg)	<50				
	Volatile Hydrocarbons (VH6-10) (mg/kg)	<100				
	VPH (C6-C10) (mg/kg)	<100				
	Chrom. to baseline at nC50	YES				
	Surrogate: 2-Bromobenzotrifluoride (%)	87.3				
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)	94.4				
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	98.3				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)	<0.0050				
	Acenaphthylene (mg/kg)	<0.0050				
	Anthracene (mg/kg)	<0.0040				
	Benz(a)anthracene (mg/kg)	<0.010				
	Benzo(a)pyrene (mg/kg)	<0.010				
	Benzo(b&j)fluoranthene (mg/kg)	<0.010				
	Benzo(b+j+k)fluoranthene (mg/kg)	<0.015				
	Benzo(g,h,i)perylene (mg/kg)	<0.010				
	Benzo(k)fluoranthene (mg/kg)	<0.010				
	Chrysene (mg/kg)	<0.010				
	Dibenz(a,h)anthracene (mg/kg)	<0.0050				
	Fluoranthene (mg/kg)	<0.010				
	Fluorene (mg/kg)	<0.010				
	Indeno(1,2,3-c,d)pyrene (mg/kg)	<0.010				
	1-Methylnaphthalene (mg/kg)	<0.050				
	2-Methylnaphthalene (mg/kg)	<0.010				
	Naphthalene (mg/kg)	<0.010				
	Phenanthrene (mg/kg)	<0.010				
	Pyrene (mg/kg)	<0.010				
	Quinoline (mg/kg)	<0.050				
	Surrogate: Acenaphthene d10 (%)	90.6				
	Surrogate: Chrysene d12 (%)	78.2				
	Surrogate: Naphthalene d8 (%)	86.3				
	Surrogate: Phenanthrene d10 (%)	103.6				
	B(a)P Total Potency Equivalent (mg/kg)	<0.020				
	IACR (CCME) (mg/kg)	<0.15				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-1 Soil 07-MAY-19 15:30 HV19-01SA3	L2269978-2 Soil 07-MAY-19 15:45 HV19-01SA5	L2269978-3 Soil 07-MAY-19 DUP1	L2269978-5 Soil 07-MAY-19 11:00 HV19-02SA2	L2269978-7 Soil 07-MAY-19 12:00 HV19-03SA2
Grouping	Analyte					
WASTE						
Physical Tests	Free Liquids (Paint Filter)		Absent			
Waste Characterizations	Flash Point (Deg. C)		>75	>75		
	Benzene (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Toluene (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Ethylbenzene (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	meta- & para-Xylene (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	ortho-Xylene (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Xylenes (mg/L)	<0.0075	<0.0075		<0.0075	<0.0075

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2269978-8 Soil 07-MAY-19 15:30 DUP2				
Grouping	Analyte					
WASTE						
Physical Tests	Free Liquids (Paint Filter)					
Waste Characterizations	Flash Point (Deg. C)					
	Benzene (mg/L)	<0.0050				
	Toluene (mg/L)	<0.0050				
	Ethylbenzene (mg/L)	<0.0050				
	meta- & para-Xylene (mg/L)	<0.0050				
	ortho-Xylene (mg/L)	<0.0050				
	Xylenes (mg/L)	<0.0075				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Silver (Ag)-Leachable	B	L2269978-2
Matrix Spike	Manganese (Mn)-Leachable	MS-B	L2269978-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
EPH-TUMB-FID-VA	Soil	EPH in Solids by Tumbler and GCFID	BC MOE EPH GCFID
Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).			
F1-BTX-CALC-VA	Soil	F1-Total BTX	CCME CWS PHC TIER 1 (2001)
This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10) and F1-BTEX, a subsample of the sediment/soil is extracted with methanol and analysed by purge & trap GC/FID. The F1-BTEX result is then calculated as follows:			
F1-BTEX: F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).			
F1-HSFID-VA	Soil	CCME F1 by headspace GCMS	CCME CWS PHC (Pub# 1310)
The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.			
F2F3-PAH-CALC-VA	Soil	F2&F3 minus PAHs [Calculation]	CCME CWS PHC TIER 1 (2001)
This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F2 (C10-C16) and F3 (C16-C34), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds prior to analysis by on-column GC/FID. The F2-Naph and F3-PAH results are then calculated as follows:			
1. F2-Naph: F2 (C10-C16) minus naphthalene. 2. F3-PAH: F3 (C16-C34) minus selected PAHs (phenanthrene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and pyrene).			
F2F4-TUMB-H/A-FID-VA	Soil	CWS F2-F4 Hydrocarbons by Tumbler GCFID	CCME PETROLEUM HYDROCARBONS
This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.			
Notes:			
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.			
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.			
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.			
4. F4G: Gravimetric Heavy Hydrocarbons			
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.			
6. Where F4 (C34-C50) and F4G-sg results are reported for a sample, the larger of the reported values is used for comparison against the relevant CCME standard for F4.			
7. The gravimetric heavy hydrocarbon results (F4G-sg), cannot be added to the C6 to C50 hydrocarbon results.			
8. This method is validated for use.			
9. Data from analysis of quality control samples is available upon request.			
10. Reported results are expressed as milligrams per dry kilogram.			
FLASH-PMCC-AUTO-VA	Waste	Flash Point by Pensky-Martens Closed Cup	ASTM D93-15a
This method uses procedures adapted from ASTM D93-15a to determine the flash point of liquid and solid samples using an Automated Pensky-Martens Closed Cup Flash Point Tester. The flash point is the lowest temperature (corrected to a barometric pressure of 101.3 kPa) at which the application of an ignition source causes the vapours of the sample to ignite.			
HG-200.2-CVAF-VA	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)
Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.			
HG-TCLP-CVAFS-VA	Soil	Mercury by CVAAS (TCLP)	EPA 1311/245.7
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is			

Reference Information

extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 245.7).

LEPH/HEPH-CALC-VA Soil LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H₂S) may be excluded if lost during sampling, storage, or digestion.

MET-TCLP-CCMS-VA Soil Metals by ICPMS (TCLP) EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TCLP-P13-CCMS-VA Soil Metals by ICPMS (TCLP) BCMOE Protocol 13 & EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA) and Protocol 13 for Contaminated Sites - Screening Level Risk Assessment - 2008, published by the BCMOE. In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #2 (glacial acetic acid). The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MOISTURE-VA Soil Moisture content CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TCLP-ME-MS-VA Soil PAH's IN TCLP LEACHATE EPA 1311/3511/8270 (MOD)

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-TMB-H/A-MS-VA Soil PAH - Rotary Extraction (Hexane/Acetone) EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PAINT FILTER-VA Waste Paint Filter Test EPA 9095B

A specified amount of material is placed in a paint filter. If any portion of the test material passes through the filter in the five minute test period, the material is deemed to contain free liquids. The absence of any amount of free liquid classifies the sample as a solid.

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved

Reference Information

(No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-MUST-SK Soil % Particles > 75um (Coarse/Fine) ASTM D422-63-SIEVE

An air-dried sample is reduced to < 2 mm size and mixed with a dispersing agent (Calgon solution). The sample is washed through a 200 mesh (75 µm) sieve. The retained mass of sample is used to determine % sand fraction.

Reference: ASTM D422-63

VH-HSFID-VA Soil VH in soil by Headspace GCFID BC Env. Lab Manual (VH in Solids)

This analysis involves the extraction of a subsample of the sediment/soil with methanol. Aliquots of the methanol extract are then added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is analyzed for Volatile Hydrocarbons (VH) by capillary column gas chromatography with flame-ionization detection (GC/FID). The methanol extraction and VH analysis are carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Volatile Hydrocarbons in Solids by GC/FID" (Version 2.1 July 1999).

VH-SURR-FID-VA Soil VH Surrogates for Soils BC Env. Lab Manual (VH in Solids)

VOC7-L-HSMS-VA Soil VOCs in soil by Headspace GCMS EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-TCLP-VA Waste BTEX in Waste by TCLP USEPA Method 1311

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). A representative sample of waste is extracted in a Zero Headspace Extractor at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #1. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved. The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Soil VOC7 and/or VOC Surrogates for Soils EPA 5035A/5021A/8260C

VPH-CALC-VA Soil VPH is VH minus select aromatics BC MOE VPH

VPHs measures Volatile Petroleum Hydrocarbons in soil. Results are calculated by subtraction of specific Monocyclic Aromatic Hydrocarbons from VH6-10, as per the BC Lab Manual VPH calculation procedure.

VPHs = VH6-10 minus Benzene, Toluene, Ethylbenzene, Xylenes, and Styrene

XYLENES-CALC-VA Soil Sum of Xylene Isomer Concentrations EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero.

The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

XYLENES-TCLP-CALC-VA Waste Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero.

The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-828876

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

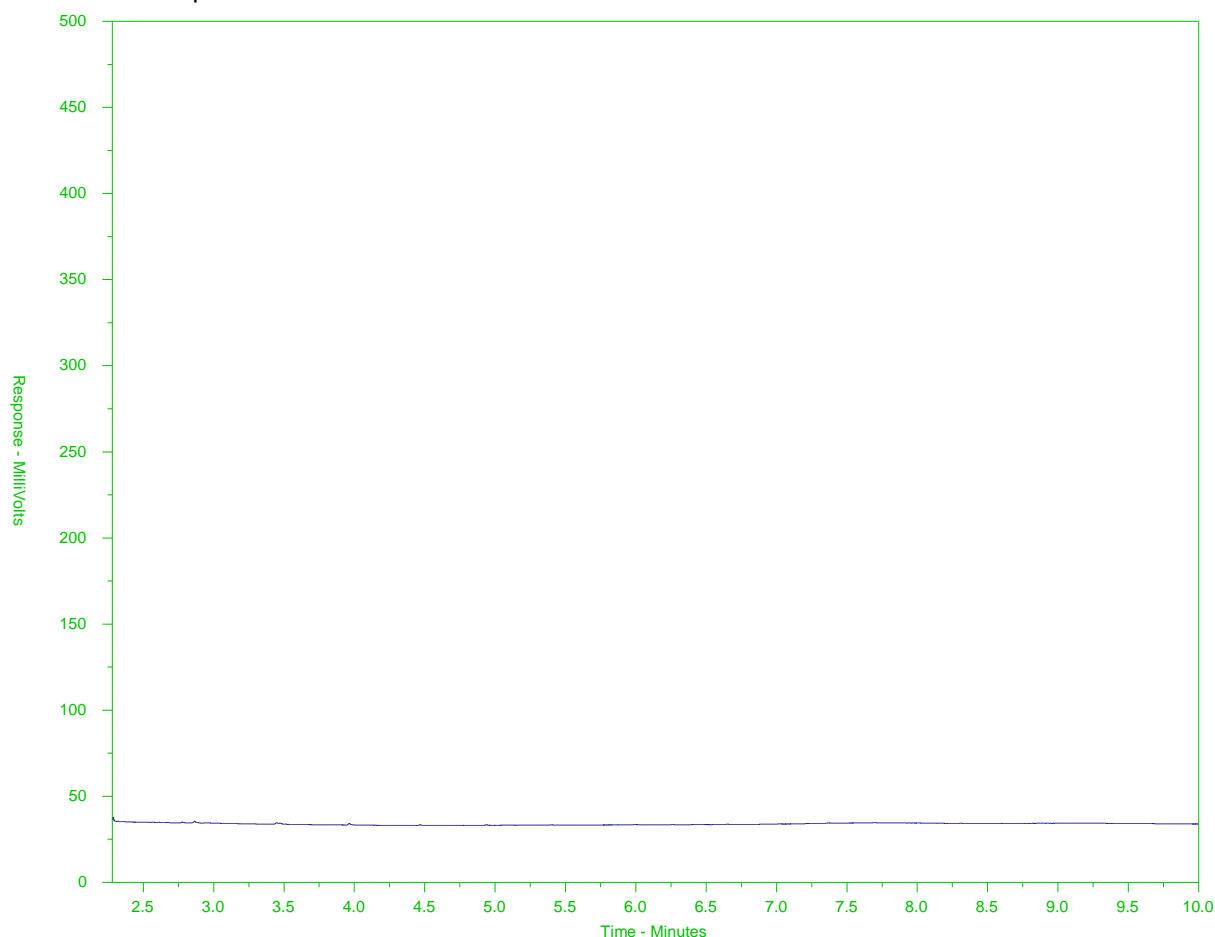
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2269978-6
Client Sample ID: HV19-02SA5



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

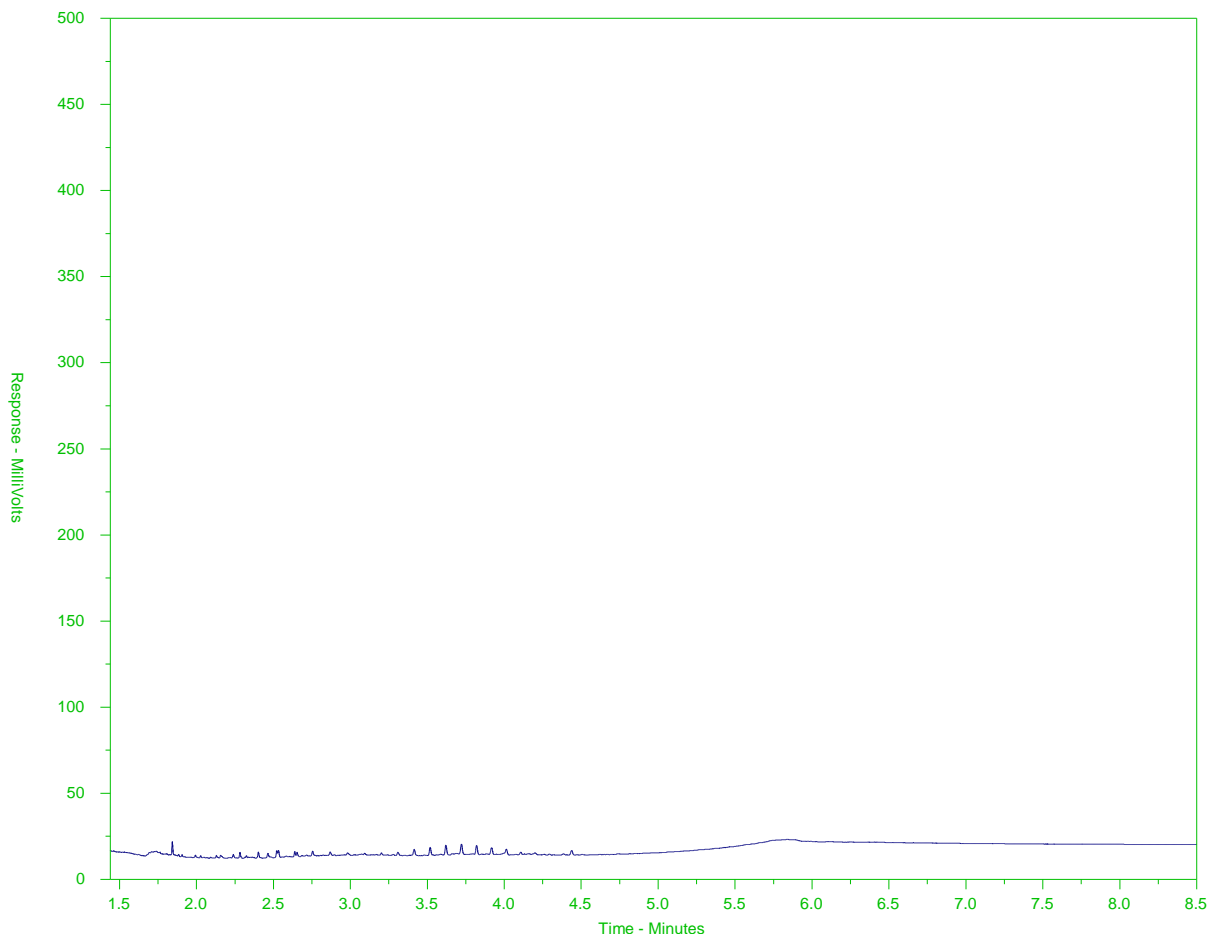
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2269978-C-6
Client Sample ID: HV19-02SA5



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L2269978-COFC

COC Number: 17 - 828876

Page 1 of 1

www.alsglobal.com

Report To		Report Format / Distribution		Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	STANTEC	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R]	<input checked="" type="checkbox"/> Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Accounts Payable	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4-20%]	<input type="checkbox"/> 1 Business day [E - 100%]
Phone:	604 436 3014	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%]	<input type="checkbox"/> Same Day, Weekend or Statutory holiday [E2 - 200% (Laboratory opening fees may apply)]
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2-50%]	<input type="checkbox"/>
Street:	500, 4730 KINGWAY AVE	Email 1 or Fax	EDD@stantec.com	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm	
City/Province:	BURNABY, BC	Email 2	tyler.joyce@stantec.com	For tests that cannot be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H0C6	Email 3	jodi.johnston@stantec.com	Analysis Request	
Invoice To	Same as Report To	Invoice Distribution		Indicate Filled (F), Preserved (P) or Filtered and Preserved (F/P) below	
Copy of Invoice with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	NUMBER OF CONTAINERS	
Company:	STANTEC	Email 1 or Fax	tyler.joyce@stantec.com	TCLP BTEX, TCLP PAH, TCLP Metals, BTEX, VPH, FI, LEP, HEP, PAH, CCME F2-F4, CLASS II Landfill, BC CSR Metals, Grain Size (#200), FLASHPOINT	
Contact:	TYLER JOYCE	Email 2	jodi.johnston@stantec.com	SAMPLES ON HOLD	
Project Information		Oil and Gas Required Fields (client use)		SUSPECTED HAZARD (see Special Instructions)	
ALS Account # / Quote #:	Q74015	AFE/Cost Center:	PO#		
Job #:	WMT	Major/Minor Code:	Routing Code:		
PO / AFE:	123512431 Task 601.400	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only):		ALS Contact:	BRENT MACK	Sampler:	
				JOOD JOHNSTON	
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	
	HV19-01SA3	07-MAY-19	15:30	Soil	3
	HV19-01SA5		15:45		6
	DUP 1				3
	HV19-02SA1		10:50		1
	HV19-02SA2		11:00		4
	HV19-02SA5		11:10		5
	HV19-03SA2		1200		4
	DUP 2	07-MAY-19		Soil	4
Drinking Water (DW) Samples (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System?				Frozen <input checked="" type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
<input type="checkbox"/> YES <input type="checkbox"/> NO				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use?				Cooling Initiated <input checked="" type="checkbox"/>	
<input type="checkbox"/> YES <input type="checkbox"/> NO				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by:	Jodi Johnston	Date:	009/05/08	Received by:	May 8
Time:	16:05	Date:		Time:	

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 10-MAY-19
Report Date: 11-JUN-19 13:43 (MT)
Version: FINAL REV. 2

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2271534
Project P.O. #: 123512431.601.400
Job Reference: WMT
C of C Numbers: 17-828878
Legal Site Desc:

Comments: ADDITIONAL 06-JUN-19 15:21

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271534-1 Soil 09-MAY-19 13:40 HV19-04SA5	L2271534-2 Soil 09-MAY-19 12:00 HV19-10SA1	L2271534-3 Soil 09-MAY-19 11:20 HV19-05SA5	L2271534-4 Soil 09-MAY-19 15:40 HV19-15SA3	
Grouping	Analyte					
SOIL						
TCLP Extractables	1st Preliminary pH (pH)	9.37	6.83	7.56	6.17	
	2nd Preliminary pH (pH)	5.52	1.42	1.41	1.43	
	Final pH (pH)	6.04	4.93	4.94	4.94	
	Extraction Solution Initial pH (pH)	2.85	4.90	4.90	4.90	
	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Benzo(a)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Benzo(b&j)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
TCLP Metals	1st Preliminary pH (pH)	9.37	6.83	7.56	6.17	
	2nd Preliminary pH (pH)	5.52	1.42	1.41	1.43	
	Final pH (pH)	7.88	4.91	4.96	5.02	
	Extraction Solution Initial pH (pH)	2.85	4.90	4.90	4.90	
	Aluminum (Al)-Leachable (mg/L)	<0.10	0.42	0.35	0.41	
	Antimony (Sb)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Arsenic (As)-Leachable (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Barium (Ba)-Leachable (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Beryllium (Be)-Leachable (mg/L)	<0.025	<0.025	<0.025	<0.025	
	Boron (B)-Leachable (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Cadmium (Cd)-Leachable (mg/L)	0.00050	<0.00050	0.00274	<0.00050	
	Calcium (Ca)-Leachable (mg/L)	1670	21.5	22.8	24.1	
	Chromium (Cr)-Leachable (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cobalt (Co)-Leachable (mg/L)	<0.025	<0.025	<0.025	<0.025	
	Copper (Cu)-Leachable (mg/L)	<0.0050	<0.0050	0.0751	<0.0050	
	Iron (Fe)-Leachable (mg/L)	<0.15	<0.15	0.83	<0.15	

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271534-1 Soil 09-MAY-19 13:40 HV19-04SA5	L2271534-2 Soil 09-MAY-19 12:00 HV19-10SA1	L2271534-3 Soil 09-MAY-19 11:20 HV19-05SA5	L2271534-4 Soil 09-MAY-19 15:40 HV19-15SA3	
Grouping	Analyte					
SOIL						
TCLP Metals	Lead (Pb)-Leachable (mg/L)	<0.0050	<0.0050	0.0098	<0.0050	
	Lithium (Li)-Leachable (mg/L)	<0.50	<0.50	<0.50	<0.50	
	Magnesium (Mg)-Leachable (mg/L)	8.68	3.92	4.28	3.43	
	Manganese (Mn)-Leachable (mg/L)	0.506	0.033	0.913	2.98	
	Mercury (Hg)-Leachable (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Molybdenum (Mo)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Nickel (Ni)-Leachable (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Selenium (Se)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Silver (Ag)-Leachable (mg/L)	<0.00025	<0.00025	<0.00025	<0.00025	
	Thallium (Tl)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Titanium (Ti)-Leachable (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Uranium (U)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Vanadium (V)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Zinc (Zn)-Leachable (mg/L)	<0.15	<0.15	<0.15	<0.15	

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271534-1 Soil 09-MAY-19 13:40 HV19-04SA5	L2271534-2 Soil 09-MAY-19 12:00 HV19-10SA1	L2271534-3 Soil 09-MAY-19 11:20 HV19-05SA5	L2271534-4 Soil 09-MAY-19 15:40 HV19-15SA3	
Grouping	Analyte					
WASTE						
Waste Characterizations	Benzene (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Toluene (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Ethylbenzene (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	meta- & para-Xylene (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	ortho-Xylene (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Xylenes (mg/L)	<0.0075	<0.0075	<0.0075	<0.0075	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-TCLP-CVAFS-VA	Soil	Mercury by CVAAS (TCLP)	EPA 1311/245.7
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 245.7).			
MET-TCLP-CCMS-VA	Soil	Metals by ICPMS (TCLP)	EPA 1311/6020A
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).			
MET-TCLP-P13-CCMS-VA	Soil	Metals by ICPMS (TCLP)	BCMOE Protocol 13 & EPA 1311/6020A
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA) and Protocol 13 for Contaminated Sites - Screening Level Risk Assessment - 2008, published by the BCMOE. In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #2 (glacial acetic acid). The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - mass spectrometry (EPA Method 6020A).			
PAH-TCLP-ME-MS-VA	Soil	PAH's IN TCLP LEACHATE	EPA 1311/3511/8270 (MOD)
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.			
VOC7-TCLP-VA	Waste	BTEX in Waste by TCLP	USEPA Method 1311
This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). A representative sample of waste is extracted in a Zero Headspace Extractor at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #1. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved. The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.			
XYLENES-TCLP-CALC-VA	Waste	Sum of Xylene Isomer Concentrations	CALCULATION
Calculation of Total Xylenes			
Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-828878

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



L2271534-COFC

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FROM

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 10-MAY-19
Report Date: 11-JUN-19 14:15 (MT)
Version: FINAL REV. 3

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2271535
Project P.O. #: 123512431.601.400
Job Reference: WMT
C of C Numbers: 17-828879
Legal Site Desc:

Comments: ADDITIONAL 06-JUN-19 15:24

28-MAY-2019 This report replaces the previous version and contains updates to Client Sample IDs, as requested.

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271535-1 Soil 10-MAY-19 14:00 HV19-06C SA5	L2271535-2 Soil 10-MAY-19 14:30 HV19-07B SA1	L2271535-3 Soil 10-MAY-19 13:00 HV19-07C SA4		
Grouping	Analyte					
SOIL						
Physical Tests	Moisture (%)			17.4		
	pH (1:2 soil:water) (pH)			8.06		
Particle Size	General Texture Class			Fine		
	MUST PSA % > 75um (%)			21.5		
Metals	Aluminum (Al) (mg/kg)			14000		
	Antimony (Sb) (mg/kg)			0.22		
	Arsenic (As) (mg/kg)			3.43		
	Barium (Ba) (mg/kg)			80.4		
	Beryllium (Be) (mg/kg)			0.22		
	Bismuth (Bi) (mg/kg)			<0.20		
	Boron (B) (mg/kg)			<5.0		
	Cadmium (Cd) (mg/kg)			0.085		
	Calcium (Ca) (mg/kg)			6840		
	Chromium (Cr) (mg/kg)			20.8		
	Cobalt (Co) (mg/kg)			8.11		
	Copper (Cu) (mg/kg)			20.9		
	Iron (Fe) (mg/kg)			22000		
	Lead (Pb) (mg/kg)			4.22		
	Lithium (Li) (mg/kg)			8.7		
	Magnesium (Mg) (mg/kg)			6120		
	Manganese (Mn) (mg/kg)			367		
	Mercury (Hg) (mg/kg)			<0.050		
	Molybdenum (Mo) (mg/kg)			0.36		
	Nickel (Ni) (mg/kg)			17.5		
	Phosphorus (P) (mg/kg)			596		
	Potassium (K) (mg/kg)			1290		
	Selenium (Se) (mg/kg)			<0.20		
	Silver (Ag) (mg/kg)			<0.10		
	Sodium (Na) (mg/kg)			681		
	Strontium (Sr) (mg/kg)			59.3		
	Sulfur (S) (mg/kg)			<1000		
	Thallium (Tl) (mg/kg)			0.076		
	Tin (Sn) (mg/kg)			<2.0		
	Titanium (Ti) (mg/kg)			1120		
	Tungsten (W) (mg/kg)			<0.50		
	Uranium (U) (mg/kg)			0.509		
	Vanadium (V) (mg/kg)			60.4		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271535-1 Soil 10-MAY-19 14:00 HV19-06C SA5	L2271535-2 Soil 10-MAY-19 14:30 HV19-07B SA1	L2271535-3 Soil 10-MAY-19 13:00 HV19-07C SA4		
Grouping	Analyte					
SOIL						
Metals	Zinc (Zn) (mg/kg)			45.9		
	Zirconium (Zr) (mg/kg)			5.8		
TCLP Extractables	1st Preliminary pH (pH)	6.35	8.46			
	2nd Preliminary pH (pH)	1.43	1.40			
	Final pH (pH)	4.98	4.94			
	Extraction Solution Initial pH (pH)	4.90	4.90			
	Acenaphthene (mg/L)	<0.000050	<0.000050			
	Acenaphthylene (mg/L)	<0.000050	<0.000050			
	Acridine (mg/L)	<0.000050	<0.000050			
	Anthracene (mg/L)	<0.000050	<0.000050			
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050			
	Benzo(a)pyrene (mg/L)	<0.000050	<0.000050			
	Benzo(b&j)fluoranthene (mg/L)	<0.000050	<0.000050			
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050			
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050			
	Chrysene (mg/L)	<0.000050	<0.000050			
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050			
	Fluoranthene (mg/L)	<0.000050	<0.000050			
	Fluorene (mg/L)	<0.000050	<0.000050			
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050			
	Naphthalene (mg/L)	<0.000050	<0.000050			
	Phenanthrene (mg/L)	<0.000050	<0.000050			
	Pyrene (mg/L)	<0.000050	<0.000050			
TCLP Metals	1st Preliminary pH (pH)	6.35	8.46	8.22		
	2nd Preliminary pH (pH)	1.43	1.40	1.41		
	Final pH (pH)	4.96	4.93	4.96		
	Extraction Solution Initial pH (pH)	4.90	4.90	4.93		
	Aluminum (Al)-Leachable (mg/L)	0.38	1.43	0.23		
	Antimony (Sb)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Arsenic (As)-Leachable (mg/L)	<0.010	<0.010	<0.010		
	Barium (Ba)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Beryllium (Be)-Leachable (mg/L)	<0.025	<0.025	<0.025		
	Boron (B)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Cadmium (Cd)-Leachable (mg/L)	<0.00050	<0.00050	0.00100		
	Calcium (Ca)-Leachable (mg/L)	46.4	2.2	33.9		
	Chromium (Cr)-Leachable (mg/L)	<0.010	<0.010	<0.010		
	Cobalt (Co)-Leachable (mg/L)	<0.025	<0.025	<0.025		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271535-1 Soil 10-MAY-19 14:00 HV19-06C SA5	L2271535-2 Soil 10-MAY-19 14:30 HV19-07B SA1	L2271535-3 Soil 10-MAY-19 13:00 HV19-07C SA4		
Grouping	Analyte					
SOIL						
TCLP Metals	Copper (Cu)-Leachable (mg/L)	0.0278	0.0120	0.0357		
	Iron (Fe)-Leachable (mg/L)	0.35	0.25	0.57		
	Lead (Pb)-Leachable (mg/L)	<0.0050	0.0182	<0.0050		
	Lithium (Li)-Leachable (mg/L)	<0.50	<0.50	<0.50		
	Magnesium (Mg)-Leachable (mg/L)	3.55	0.62	6.70		
	Manganese (Mn)-Leachable (mg/L)	0.969	0.137	1.16		
	Mercury (Hg)-Leachable (mg/L)	<0.0010	<0.0010	<0.0010		
	Molybdenum (Mo)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Nickel (Ni)-Leachable (mg/L)	<0.050	<0.050	<0.050		
	Selenium (Se)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Silver (Ag)-Leachable (mg/L)	<0.00025	<0.00025	<0.00025		
	Thallium (Tl)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Leachable (mg/L)	<0.050	<0.050	<0.050		
	Uranium (U)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Vanadium (V)-Leachable (mg/L)	<0.0050	<0.0050	<0.0050		
	Zinc (Zn)-Leachable (mg/L)	<0.15	<0.15	<0.15		
Volatile Organic Compounds	Benzene (mg/kg)			<0.0050		
	Ethylbenzene (mg/kg)			<0.015		
	Methyl t-butyl ether (MTBE) (mg/kg)			<0.20		
	Styrene (mg/kg)			<0.050		
	Toluene (mg/kg)			<0.050		
	ortho-Xylene (mg/kg)			<0.050		
	meta- & para-Xylene (mg/kg)			<0.050		
	Xylenes (mg/kg)			<0.075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)			87.4		
	Surrogate: 1,4-Difluorobenzene (SS) (%)			98.7		
Hydrocarbons	EPH10-19 (mg/kg)			<200		
	EPH19-32 (mg/kg)			<200		
	LEPH (mg/kg)			<200		
	HEPH (mg/kg)			<200		
	F1 (C6-C10) (mg/kg)			<10		
	F1-BTEX (mg/kg)			<10		
	F2 (C10-C16) (mg/kg)			<30		
	F2-Naphth (mg/kg)			<30		
	F3 (C16-C34) (mg/kg)			<50		
	F3-PAH (mg/kg)			<50		
	F4 (C34-C50) (mg/kg)			<50		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271535-1 Soil 10-MAY-19 14:00 HV19-06C SA5	L2271535-2 Soil 10-MAY-19 14:30 HV19-07B SA1	L2271535-3 Soil 10-MAY-19 13:00 HV19-07C SA4		
Grouping	Analyte					
SOIL						
Hydrocarbons	Volatile Hydrocarbons (VH6-10) (mg/kg)			<100		
	VPH (C6-C10) (mg/kg)			<100		
	Chrom. to baseline at nC50			YES		
	Surrogate: 2-Bromobenzotrifluoride (%)			90.8		
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)			95.4		
	Surrogate: 3,4-Dichlorotoluene (SS) (%)			94.5		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)			<0.0050		
	Acenaphthylene (mg/kg)			<0.0050		
	Anthracene (mg/kg)			<0.0040		
	Benz(a)anthracene (mg/kg)			<0.010		
	Benzo(a)pyrene (mg/kg)			<0.010		
	Benzo(b&j)fluoranthene (mg/kg)			<0.010		
	Benzo(b+j+k)fluoranthene (mg/kg)			<0.015		
	Benzo(g,h,i)perylene (mg/kg)			<0.010		
	Benzo(k)fluoranthene (mg/kg)			<0.010		
	Chrysene (mg/kg)			<0.010		
	Dibenz(a,h)anthracene (mg/kg)			<0.0050		
	Fluoranthene (mg/kg)			<0.010		
	Fluorene (mg/kg)			<0.010		
	Indeno(1,2,3-c,d)pyrene (mg/kg)			<0.010		
	1-Methylnaphthalene (mg/kg)			<0.050		
	2-Methylnaphthalene (mg/kg)			<0.010		
	Naphthalene (mg/kg)			<0.010		
	Phenanthrene (mg/kg)			<0.010		
	Pyrene (mg/kg)			<0.010		
	Quinoline (mg/kg)			<0.050		
	Surrogate: Acenaphthene d10 (%)			87.9		
	Surrogate: Chrysene d12 (%)			99.0		
	Surrogate: Naphthalene d8 (%)			68.4		
	Surrogate: Phenanthrene d10 (%)			81.1		
	B(a)P Total Potency Equivalent (mg/kg)			<0.020		
	IACR (CCME) (mg/kg)			<0.15		

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2271535-1 Soil 10-MAY-19 14:00 HV19-06C SA5	L2271535-2 Soil 10-MAY-19 14:30 HV19-07B SA1	L2271535-3 Soil 10-MAY-19 13:00 HV19-07C SA4		
Grouping	Analyte					
WASTE						
Physical Tests	Free Liquids (Paint Filter)			Absent		
Waste Characterizations	Flash Point (Deg. C)			>75		
	Benzene (mg/L)	<0.0050	<0.0050	<0.0050		
	Toluene (mg/L)	<0.0050	<0.0050	<0.0050		
	Ethylbenzene (mg/L)	<0.0050	<0.0050	<0.0050		
	meta- & para-Xylene (mg/L)	<0.0050	<0.0050	<0.0050		
	ortho-Xylene (mg/L)	<0.0050	<0.0050	<0.0050		
	Xylenes (mg/L)	<0.0075	<0.0075	<0.0075		

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
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Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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EPH-TUMB-FID-VA Soil EPH in Solids by Tumbler and GCFID BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-BTX-CALC-VA Soil F1-Total BTX CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10) and F1-BTEX, a subsample of the sediment/soil is extracted with methanol and analysed by purge & trap GC/FID. The F1-BTEX result is then calculated as follows:

F1-BTEX: F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).

F1-HSFID-VA Soil CCME F1 by headspace GCMS CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

F2F3-PAH-CALC-VA Soil F2&F3 minus PAHs [Calculation] CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F2 (C10-C16) and F3 (C16-C34), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds prior to analysis by on-column GC/FID. The F2-Naph and F3-PAH results are then calculated as follows:

1. F2-Naph: F2 (C10-C16) minus naphthalene.
2. F3-PAH: F3 (C16-C34) minus selected PAHs (phenanthrene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and pyrene).

F2F4-TUMB-H/A-FID-VA Soil CWS F2-F4 Hydrocarbons by Tumbler GCFID CCME PETROLEUM HYDROCARBONS

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.

Notes:

1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where F4 (C34-C50) and F4G-sg results are reported for a sample, the larger of the reported values is used for comparison against the relevant CCME standard for F4.
7. The gravimetric heavy hydrocarbon results (F4G-sg), cannot be added to the C6 to C50 hydrocarbon results.
8. This method is validated for use.
9. Data from analysis of quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram.

FLASH-PMCC-AUTO-VA Waste Flash Point by Pensky-Martens Closed Cup ASTM D93-15a

This method uses procedures adapted from ASTM D93-15a to determine the flash point of liquid and solid samples using an Automated Pensky-Martens Closed Cup Flash Point Tester. The flash point is the lowest temperature (corrected to a barometric pressure of 101.3 kPa) at which the application of an ignition source causes the vapours of the sample to ignite.

HG-200.2-CVAF-VA Soil Mercury in Soil by CVAAS EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

HG-TCLP-CVAFS-VA Soil Mercury by CVAAS (TCLP) EPA 1311/245.7

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 245.7).

LEPH/HEPH-CALC-VA Soil LEPHs and HEPHs BC MOE LEPH/HEPH

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-

Reference Information

c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H₂S) may be excluded if lost during sampling, storage, or digestion.

MET-TCLP-CCMS-VA Soil Metals by ICPMS (TCLP) EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TCLP-P13-CCMS-VA Soil Metals by ICPMS (TCLP) BCMOE Protocol 13 & EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA) and Protocol 13 for Contaminated Sites - Screening Level Risk Assessment - 2008, published by the BCMOE. In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #2 (glacial acetic acid). The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MOISTURE-VA Soil Moisture content CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TCLP-ME-MS-VA Soil PAH's IN TCLP LEACHATE EPA 1311/3511/8270 (MOD)

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-TMB-H/A-MS-VA Soil PAH - Rotary Extraction (Hexane/Acetone) EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PAINT FILTER-VA Waste Paint Filter Test EPA 9095B

A specified amount of material is placed in a paint filter. If any portion of the test material passes through the filter in the five minute test period, the material is deemed to contain free liquids. The absence of any amount of free liquid classifies the sample as a solid.

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-MUST-SK Soil % Particles > 75um (Coarse/Fine) ASTM D422-63-SIEVE

An air-dried sample is reduced to < 2 mm size and mixed with a dispersing agent (Calgon solution). The sample is washed through a 200 mesh (75 µm) sieve. The retained mass of sample is used to determine % sand fraction.

Reference: ASTM D422-63

VH-HSFID-VA Soil VH in soil by Headspace GCFID BC Env. Lab Manual (VH in Solids)

Reference Information

This analysis involves the extraction of a subsample of the sediment/soil with methanol. Aliquots of the methanol extract are then added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is analyzed for Volatile Hydrocarbons (VH) by capillary column gas chromatography with flame-ionization detection (GC/FID). The methanol extraction and VH analysis are carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Volatile Hydrocarbons in Solids by GC/FID" (Version 2.1 July 1999).

VH-SURR-FID-VA Soil VH Surrogates for Soils BC Env. Lab Manual (VH in Solids)

VOC7-L-HSMS-VA Soil VOCs in soil by Headspace GCMS EPA 5035A/5021A/8260C

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-TCLP-VA Waste BTEX in Waste by TCLP USEPA Method 1311

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). A representative sample of waste is extracted in a Zero Headspace Extractor at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #1. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved. The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Soil VOC7 and/or VOC Surrogates for Soils EPA 5035A/5021A/8260C

VPH-CALC-VA Soil VPH is VH minus select aromatics BC MOE VPH

VPHs measures Volatile Petroleum Hydrocarbons in soil. Results are calculated by subtraction of specific Monocyclic Aromatic Hydrocarbons from VH6-10, as per the BC Lab Manual VPH calculation procedure.

VPHs = VH6-10 minus Benzene, Toluene, Ethylbenzene, Xylenes, and Styrene

XYLENES-CALC-VA Soil Sum of Xylene Isomer Concentrations EPA 8260B & 524.2

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

XYLENES-TCLP-CALC-VA Waste Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-828879

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

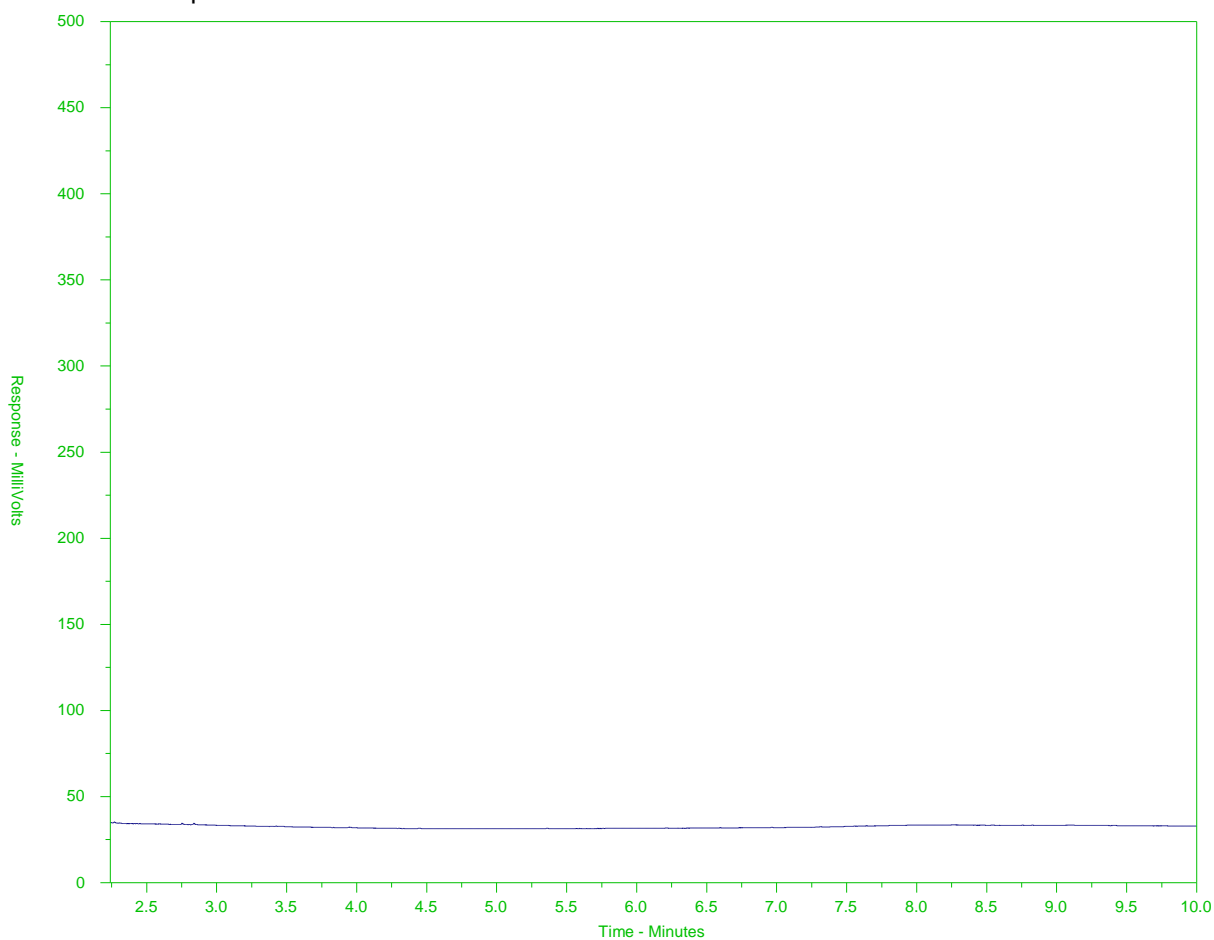
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2271535-3
Client Sample ID: HV19-07C5A4



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

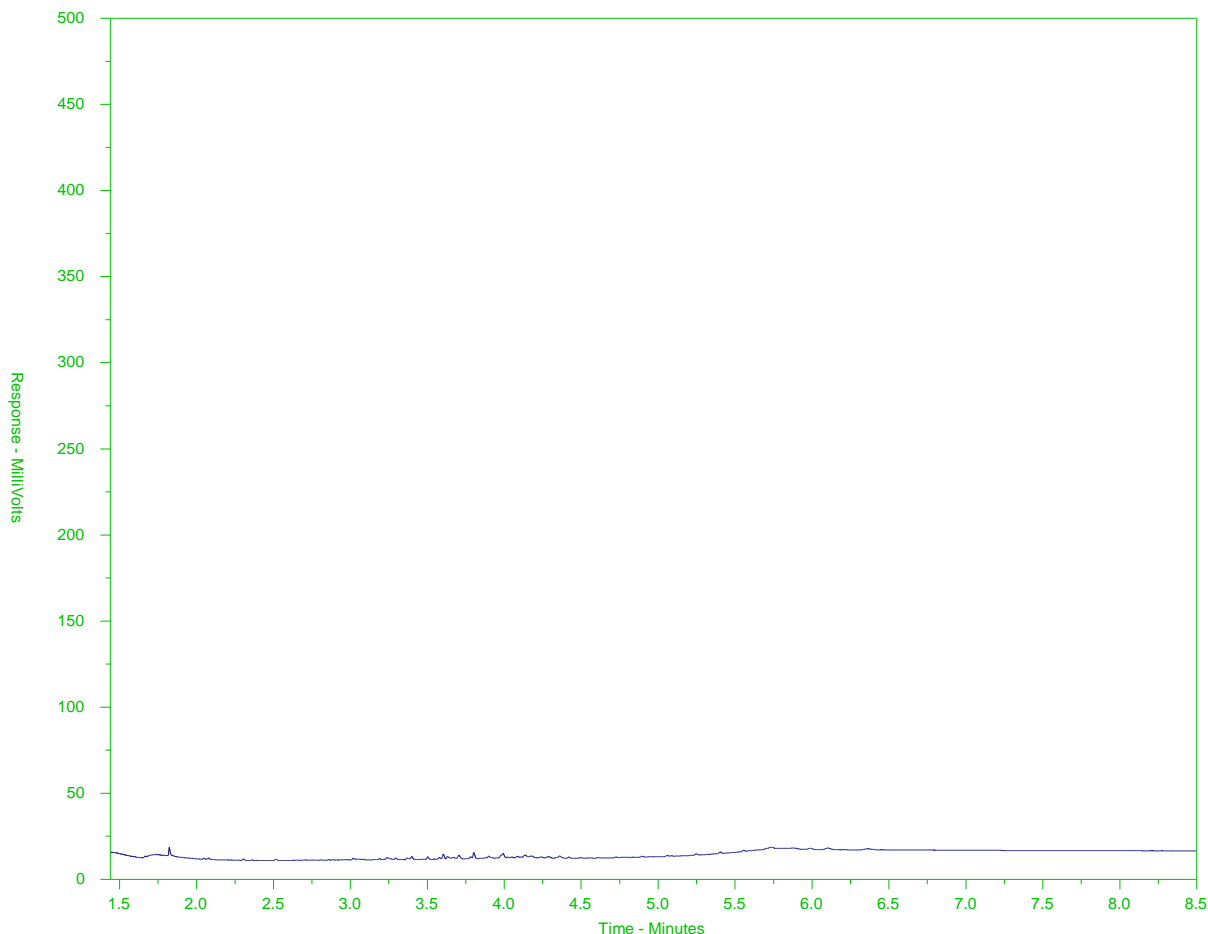
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2271535-C-3
Client Sample ID: HV19-07C5A4



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

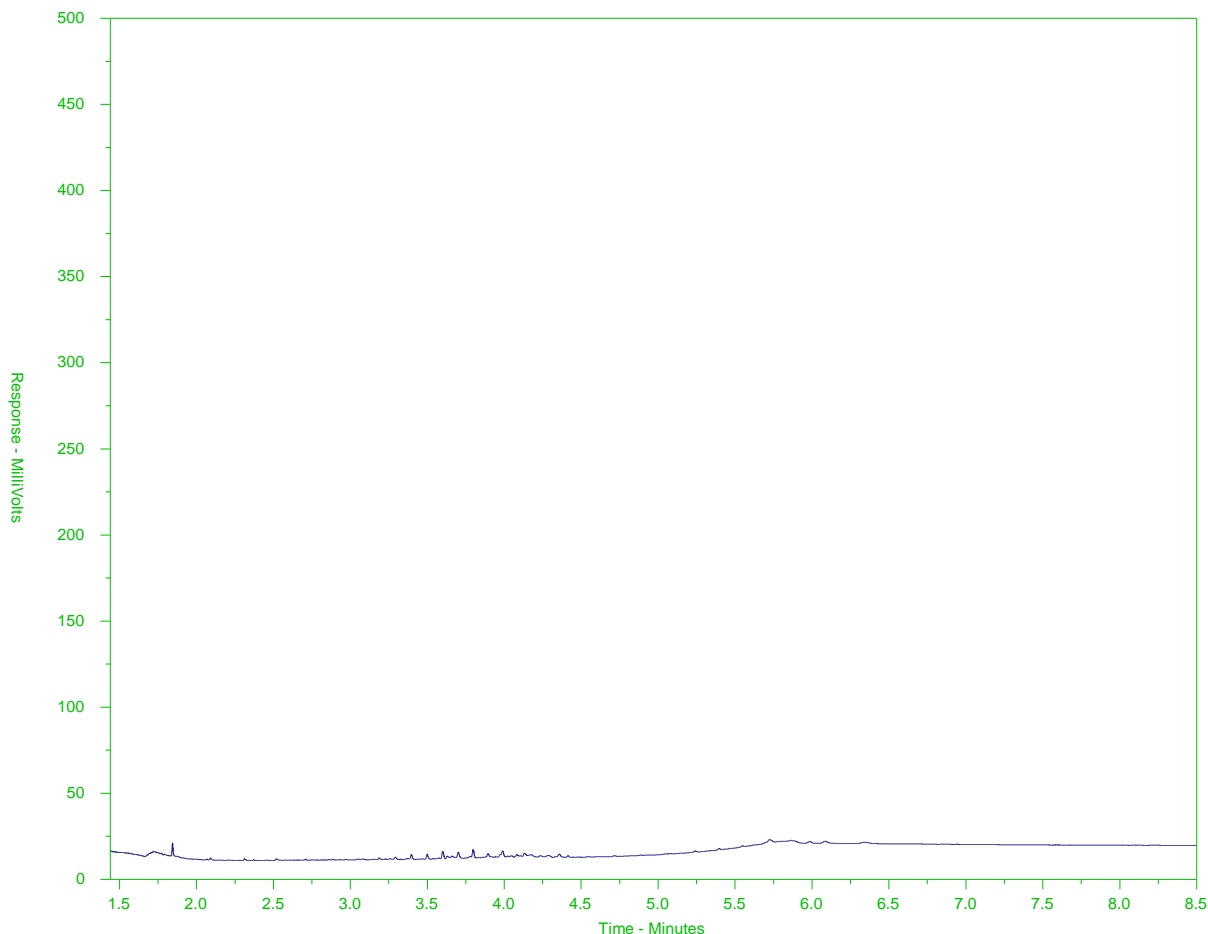
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: WG3051668-C-3#L2271535-C-3
Client Sample ID: HV19-07C5A4



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

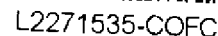
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Canada Toll Free: 1 800 668 9878



COC Number: 17 - 828879

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LINKS & FROM

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



STANTEC CONSULTING LTD.
ATTN: Tyler Joyce
500 - 4730 Kingsway
Burnaby BC V5H 0C6

Date Received: 13-MAY-19
Report Date: 11-JUN-19 14:29 (MT)
Version: FINAL REV. 2

Client Phone: 604-436-3014

Certificate of Analysis

Lab Work Order #: L2272171
Project P.O. #: 123512431.601.400
Job Reference: WMT
C of C Numbers: 17-828886
Legal Site Desc:

Comments: ADDITIONAL 06-JUN-19 15:29

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2272171-1 Soil 13-MAY-19 12:00 HV19-08SA4	L2272171-2 Soil 13-MAY-19 13:10 HV19-09SA1	L2272171-3 Soil 13-MAY-19 13:00 HV19-09SA5	L2272171-4 Soil 13-MAY-19 10:30 HV19-11SA4	L2272171-5 Soil 13-MAY-19 14:30 HV19-14SA2
Grouping	Analyte					
SOIL						
Physical Tests	Moisture (%)			14.7		
	pH (1:2 soil:water) (pH)			8.54		
Particle Size	General Texture Class			Coarse		
	MUST PSA % > 75um (%)			59.2		
Metals	Aluminum (Al) (mg/kg)			11900		
	Antimony (Sb) (mg/kg)			0.21		
	Arsenic (As) (mg/kg)			3.18		
	Barium (Ba) (mg/kg)			56.3		
	Beryllium (Be) (mg/kg)			0.19		
	Bismuth (Bi) (mg/kg)			<0.20		
	Boron (B) (mg/kg)			<5.0		
	Cadmium (Cd) (mg/kg)			0.072		
	Calcium (Ca) (mg/kg)			7220		
	Chromium (Cr) (mg/kg)			23.4		
	Cobalt (Co) (mg/kg)			7.46		
	Copper (Cu) (mg/kg)			18.6		
	Iron (Fe) (mg/kg)			18700		
	Lead (Pb) (mg/kg)			2.85		
	Lithium (Li) (mg/kg)			6.5		
	Magnesium (Mg) (mg/kg)			6360		
	Manganese (Mn) (mg/kg)			305		
	Mercury (Hg) (mg/kg)			<0.050		
	Molybdenum (Mo) (mg/kg)			0.28		
	Nickel (Ni) (mg/kg)			22.4		
	Phosphorus (P) (mg/kg)			491		
	Potassium (K) (mg/kg)			1090		
	Selenium (Se) (mg/kg)			<0.20		
	Silver (Ag) (mg/kg)			<0.10		
	Sodium (Na) (mg/kg)			495		
	Strontium (Sr) (mg/kg)			41.0		
	Sulfur (S) (mg/kg)			<1000		
	Thallium (Tl) (mg/kg)			<0.050		
	Tin (Sn) (mg/kg)			<2.0		
	Titanium (Ti) (mg/kg)			958		
	Tungsten (W) (mg/kg)			<0.50		
	Uranium (U) (mg/kg)			0.273		
	Vanadium (V) (mg/kg)			53.6		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2272171-1 Soil 13-MAY-19 12:00 HV19-08SA4	L2272171-2 Soil 13-MAY-19 13:10 HV19-09SA1	L2272171-3 Soil 13-MAY-19 13:00 HV19-09SA5	L2272171-4 Soil 13-MAY-19 10:30 HV19-11SA4	L2272171-5 Soil 13-MAY-19 14:30 HV19-14SA2
Grouping	Analyte					
SOIL						
Metals	Zinc (Zn) (mg/kg)			34.3		
	Zirconium (Zr) (mg/kg)			6.2		
TCLP Extractables	1st Preliminary pH (pH)	6.41	6.28		9.31	6.43
	2nd Preliminary pH (pH)	1.36	1.36		1.40	1.39
	Final pH (pH)	4.97	4.98		5.07	5.12
	Extraction Solution Initial pH (pH)	4.93	4.93		4.93	4.93
	Acenaphthene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Benzo(b&j)fluoranthene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050		<0.000050	<0.000050
TCLP Metals	1st Preliminary pH (pH)	6.41	6.28		9.31	6.43
	2nd Preliminary pH (pH)	1.36	1.36		1.40	1.39
	Final pH (pH)	4.92	4.96		5.06	5.02
	Extraction Solution Initial pH (pH)	4.93	4.93		4.93	4.93
	Aluminum (Al)-Leachable (mg/L)	0.40	0.49		0.29	10.0
	Antimony (Sb)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Arsenic (As)-Leachable (mg/L)	<0.010	<0.010		<0.010	<0.010
	Barium (Ba)-Leachable (mg/L)	<0.50	<0.50		<0.50	<0.50
	Beryllium (Be)-Leachable (mg/L)	<0.025	<0.025		<0.025	<0.025
	Boron (B)-Leachable (mg/L)	<0.50	<0.50		<0.50	<0.50
	Cadmium (Cd)-Leachable (mg/L)	<0.00050	<0.00050		0.00093	<0.00050
	Calcium (Ca)-Leachable (mg/L)	19.6	13.3		117	22.7
	Chromium (Cr)-Leachable (mg/L)	<0.010	<0.010		<0.010	<0.010
	Cobalt (Co)-Leachable (mg/L)	<0.025	<0.025		<0.025	<0.025

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2272171-1 Soil 13-MAY-19 12:00 HV19-08SA4	L2272171-2 Soil 13-MAY-19 13:10 HV19-09SA1	L2272171-3 Soil 13-MAY-19 13:00 HV19-09SA5	L2272171-4 Soil 13-MAY-19 10:30 HV19-11SA4	L2272171-5 Soil 13-MAY-19 14:30 HV19-14SA2
Grouping	Analyte					
SOIL						
TCLP Metals	Copper (Cu)-Leachable (mg/L)	<0.0050	<0.0050		0.0337	0.0077
	Iron (Fe)-Leachable (mg/L)	<0.15	<0.15		3.50	7.01
	Lead (Pb)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Lithium (Li)-Leachable (mg/L)	<0.50	<0.50		<0.50	<0.50
	Magnesium (Mg)-Leachable (mg/L)	2.48	2.95		14.8	6.32
	Manganese (Mn)-Leachable (mg/L)	0.203	0.047		1.86	0.145
	Mercury (Hg)-Leachable (mg/L)	<0.0010	<0.0010		<0.0010	<0.0010
	Molybdenum (Mo)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Nickel (Ni)-Leachable (mg/L)	<0.050	<0.050		<0.050	<0.050
	Selenium (Se)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Silver (Ag)-Leachable (mg/L)	<0.00025	<0.00025		<0.00025	<0.00025
	Thallium (Tl)-Leachable (mg/L)	<0.00050	<0.00050		<0.00050	<0.00050
	Titanium (Ti)-Leachable (mg/L)	<0.050	<0.050		<0.050	0.323
	Uranium (U)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	<0.0050
	Vanadium (V)-Leachable (mg/L)	<0.0050	<0.0050		<0.0050	0.0266
	Zinc (Zn)-Leachable (mg/L)	<0.15	<0.15		<0.15	<0.15
Volatile Organic Compounds	VOC Sample Container			Field MeOH		
	Benzene (mg/kg)			<0.0050		
	Ethylbenzene (mg/kg)			<0.015		
	Methyl t-butyl ether (MTBE) (mg/kg)			<0.20		
	Styrene (mg/kg)			<0.050		
	Toluene (mg/kg)			<0.050		
	ortho-Xylene (mg/kg)			<0.050		
	meta- & para-Xylene (mg/kg)			<0.050		
	Xylenes (mg/kg)			<0.075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)			77.3		
	Surrogate: 1,4-Difluorobenzene (SS) (%)			90.2		
Hydrocarbons	EPH10-19 (mg/kg)			<200		
	EPH19-32 (mg/kg)			<200		
	LEPH (mg/kg)			<200		
	HEPH (mg/kg)			<200		
	F1 (C6-C10) (mg/kg)			<10		
	F1-BTEX (mg/kg)			<10		
	F2 (C10-C16) (mg/kg)			<30		
	F2-Naphth (mg/kg)			<30		
	F3 (C16-C34) (mg/kg)			<50		
	F3-PAH (mg/kg)			<50		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2272171-1 Soil 13-MAY-19 12:00 HV19-08SA4	L2272171-2 Soil 13-MAY-19 13:10 HV19-09SA1	L2272171-3 Soil 13-MAY-19 13:00 HV19-09SA5	L2272171-4 Soil 13-MAY-19 10:30 HV19-11SA4	L2272171-5 Soil 13-MAY-19 14:30 HV19-14SA2
Grouping	Analyte					
SOIL						
Hydrocarbons	F4 (C34-C50) (mg/kg)			<50		
	Volatile Hydrocarbons (VH6-10) (mg/kg)			<100		
	VPH (C6-C10) (mg/kg)			<100		
	Chrom. to baseline at nC50			YES		
	Surrogate: 2-Bromobenzotrifluoride (%)			88.5		
	Surrogate: 2-Bromobenzotrifluoride, F2-F4 (%)			96.8		
	Surrogate: 3,4-Dichlorotoluene (SS) (%)			82.2		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/kg)			<0.0050		
	Acenaphthylene (mg/kg)			<0.0050		
	Anthracene (mg/kg)			<0.0040		
	Benz(a)anthracene (mg/kg)			<0.010		
	Benzo(a)pyrene (mg/kg)			<0.010		
	Benzo(b&j)fluoranthene (mg/kg)			<0.010		
	Benzo(b+j+k)fluoranthene (mg/kg)			<0.015		
	Benzo(g,h,i)perylene (mg/kg)			<0.010		
	Benzo(k)fluoranthene (mg/kg)			<0.010		
	Chrysene (mg/kg)			<0.010		
	Dibenz(a,h)anthracene (mg/kg)			<0.0050		
	Fluoranthene (mg/kg)			<0.010		
	Fluorene (mg/kg)			<0.010		
	Indeno(1,2,3-c,d)pyrene (mg/kg)			<0.010		
	1-Methylnaphthalene (mg/kg)			<0.050		
	2-Methylnaphthalene (mg/kg)			<0.010		
	Naphthalene (mg/kg)			<0.010		
	Phenanthrene (mg/kg)			<0.010		
	Pyrene (mg/kg)			<0.010		
	Quinoline (mg/kg)			<0.050		
	Surrogate: Acenaphthene d10 (%)			83.9		
	Surrogate: Chrysene d12 (%)			82.1		
	Surrogate: Naphthalene d8 (%)			79.9		
	Surrogate: Phenanthrene d10 (%)			77.3		
	B(a)P Total Potency Equivalent (mg/kg)			<0.020		
	IACR (CCME) (mg/kg)			<0.15		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L2272171-1	L2272171-2	L2272171-4	L2272171-5	
		Description	Soil	Soil	Soil	Soil	
		Sampled Date	13-MAY-19	13-MAY-19	13-MAY-19	13-MAY-19	
		Sampled Time	12:00	13:10	10:30	14:30	
		Client ID	HV19-08SA4	HV19-09SA1	HV19-11SA4	HV19-14SA2	
Grouping	Analyte						
WASTE							
Waste Characterizations	Benzene (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	Toluene (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	Ethylbenzene (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	meta- & para-Xylene (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	ortho-Xylene (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	
	Xylenes (mg/L)		<0.0075	<0.0075	<0.0075	<0.0075	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Molybdenum (Mo)	DUP-H	L2272171-3
Duplicate	Strontium (Sr)	DUP-H	L2272171-3
Matrix Spike	Aluminum (Al)-Leachable	MS-B	L2272171-1, -2, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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EPH-TUMB-FID-VA Soil EPH in Solids by Tumbler and GCFID BC MOE EPH GCFID

Analysis is in accordance with BC MOE Lab Manual method "Extractable Petroleum Hydrocarbons in Solids by GC/FID", v2.1, July 1999. Soil samples are extracted with a 1:1 mixture of hexane and acetone using a rotary extraction technique modified from EPA 3570 prior to gas chromatography with flame ionization detection (GC-FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

F1-BTX-CALC-VA Soil F1-Total BTX CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F1 (C6-C10) and F1-BTEX, a subsample of the sediment/soil is extracted with methanol and analysed by purge & trap GC/FID. The F1-BTEX result is then calculated as follows:

F1-BTEX: F1 (C6-C10) minus benzene, toluene, ethylbenzene and xylenes (BTEX).

F1-HSFID-VA Soil CCME F1 by headspace GCMS CCME CWS PHC (Pub# 1310)

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. The F1 fraction concentration is measured using flame ionization detection.

F2F3-PAH-CALC-VA Soil F2&F3 minus PAHs [Calculation] CCME CWS PHC TIER 1 (2001)

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For F2 (C10-C16) and F3 (C16-C34), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds prior to analysis by on-column GC/FID. The F2-Naph and F3-PAH results are then calculated as follows:

1. F2-Naph: F2 (C10-C16) minus naphthalene.
2. F3-PAH: F3 (C16-C34) minus selected PAHs (phenanthrene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and pyrene).

F2F4-TUMB-H/A-FID-VA Soil CWS F2-F4 Hydrocarbons by Tumbler GCFID CCME PETROLEUM HYDROCARBONS

This analysis is carried out in accordance with the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2000." For C10 to C50 hydrocarbons (F2, F3, F4) and gravimetric heavy hydrocarbons (F4G-sg), a subsample of the sediment/soil is extracted with 1:1 hexane:acetone using a rotary extractor. The extract undergoes a silica-gel clean-up to remove polar compounds. F2, F3 & F4 are analyzed by on-column GC/FID, and F4G-sg is analyzed gravimetrically.

Notes:

1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where F4 (C34-C50) and F4G-sg results are reported for a sample, the larger of the reported values is used for comparison against the relevant CCME standard for F4.
7. The gravimetric heavy hydrocarbon results (F4G-sg), cannot be added to the C6 to C50 hydrocarbon results.
8. This method is validated for use.
9. Data from analysis of quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram.

HG-200.2-CVAF-VA Soil Mercury in Soil by CVAAS EPA 200.2/1631E (mod)

Soil samples are digested with hot nitric and hydrochloric acids, followed by CVAAS analysis. This method is fully compliant with the BC SALM strong acid leachable metals digestion method.

HG-TCLP-CVAFS-VA Soil Mercury by CVAAS (TCLP) EPA 1311/245.7

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using atomic absorption spectrophotometry (EPA 245.7).

LEPH/HEPH-CALC-VA Soil LEPHs and HEPHs BC MOE LEPH/HEPH

Reference Information

LEPHs and HEPHs are measures of Light and Heavy Extractable Petroleum Hydrocarbons in soil. Results are calculated by subtraction of applicable PAH concentrations from EPH10-19 and EPH19-32, as per the BC Lab Manual LEPH/HEPH calculation procedure.

LEPHs = EPH10-19 minus Naphthalene and Phenanthrene.

HEPHs = EPH19-32 minus Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and Pyrene.

MET-200.2-CCMS-VA Soil Metals in Soil by CRC ICPMS EPA 200.2/6020A (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H₂S) may be excluded if lost during sampling, storage, or digestion.

MET-TCLP-CCMS-VA Soil Metals by ICPMS (TCLP) EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter. Instrumental analysis of the digested extract is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TCLP-P13-CCMS-VA Soil Metals by ICPMS (TCLP) BCMOE Protocol 13 & EPA 1311/6020A

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA) and Protocol 13 for Contaminated Sites - Screening Level Risk Assessment - 2008, published by the BCMOE. In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #2 (glacial acetic acid). The extract is then filtered through a 0.6 to 0.8 micron glass fibre filter and analysed using inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MOISTURE-VA Soil Moisture content CCME PHC in Soil - Tier 1 (mod)

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of two hours.

PAH-TCLP-ME-MS-VA Soil PAH's IN TCLP LEACHATE EPA 1311/3511/8270 (MOD)

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). In summary, the sample is extracted at a 20:1 liquid to solids ratio for 16 to 20 hours using either extraction fluid #1 (glacial acetic acid, water and sodium hydroxide) or extraction fluid #2 (glacial acetic acid), depending on the pH of the original sample. The extract is filtered, extracted with hexane, and analyzed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-TMB-H/A-MS-VA Soil PAH - Rotary Extraction (Hexane/Acetone) EPA 3570/8270

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3570 & 8270, published by the United States Environmental Protection Agency (EPA). The procedure uses a mechanical shaking technique to extract a subsample of the sediment/soil with a 1:1 mixture of hexane and acetone. The extract is then solvent exchanged to toluene. The final extract is analysed by capillary column gas chromatography with mass spectrometric detection (GC/MS). Surrogate recoveries may not be reported in cases where interferences from the sample matrix prevent accurate quantitation. Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Benzo(a)pyrene Total Potency Equivalents [B(a)P TPE] represents the sum of estimated cancer potency relative to B(a)P for all potentially carcinogenic unsubstituted PAHs, and is calculated as per the CCME PAH Soil Quality Guidelines reference document (2010).

PH-1:2-VA Soil pH in Soil (1:2 Soil:Water Extraction) BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-MUST-SK Soil % Particles > 75um (Coarse/Fine) ASTM D422-63-SIEVE

An air-dried sample is reduced to < 2 mm size and mixed with a dispersing agent (Calgon solution). The sample is washed through a 200 mesh (75 µm) sieve. The retained mass of sample is used to determine % sand fraction.

Reference: ASTM D422-63

VH-HSFID-VA Soil VH in soil by Headspace GCFID BC Env. Lab Manual (VH in Solids)

Reference Information

This analysis involves the extraction of a subsample of the sediment/soil with methanol. Aliquots of the methanol extract are then added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is analyzed for Volatile Hydrocarbons (VH) by capillary column gas chromatography with flame-ionization detection (GC/FID). The methanol extraction and VH analysis are carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Volatile Hydrocarbons in Solids by GC/FID" (Version 2.1 July 1999).

VH-SURR-FID-VA	Soil	VH Surrogates for Soils	BC Env. Lab Manual (VH in Solids)
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VOC7-L-HSMS-VA	Soil	VOCs in soil by Headspace GCMS	EPA 5035A/5021A/8260C
-----------------------	------	--------------------------------	-----------------------

The soil methanol extract is added to water and reagents, then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-TCLP-VA	Waste	BTEX in Waste by TCLP	USEPA Method 1311
---------------------	-------	-----------------------	-------------------

This analysis is carried out in accordance with the extraction procedure outlined in "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods Volume 1C" SW-846 EPA Method 1311, published by the United States Environmental Protection Agency (EPA). A representative sample of waste is extracted in a Zero Headspace Extractor at a 20:1 liquid to solids ratio for 16 to 20 hours using extraction fluid #1. Following extraction, the liquid extract is separated from the solid phase by filtration and preserved. The extract, with added reagents, is then heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Soil	VOC7 and/or VOC Surrogates for Soils	EPA 5035A/5021A/8260C
----------------------------	------	--------------------------------------	-----------------------

VPH-CALC-VA	Soil	VPH is VH minus select aromatics	BC MOE VPH
--------------------	------	----------------------------------	------------

VPHs measures Volatile Petroleum Hydrocarbons in soil. Results are calculated by subtraction of specific Monocyclic Aromatic Hydrocarbons from VH6-10, as per the BC Lab Manual VPH calculation procedure.

VPHs = VH6-10 minus Benzene, Toluene, Ethylbenzene, Xylenes, and Styrene

XYLENES-CALC-VA	Soil	Sum of Xylene Isomer Concentrations	EPA 8260B & 524.2
------------------------	------	-------------------------------------	-------------------

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

XYLENES-TCLP-CALC-VA	Waste	Sum of Xylene Isomer Concentrations	CALCULATION
-----------------------------	-------	-------------------------------------	-------------

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
----------------------------	---------------------

SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
----	---

VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA
----	---

Chain of Custody Numbers:

17-828886

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour 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.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

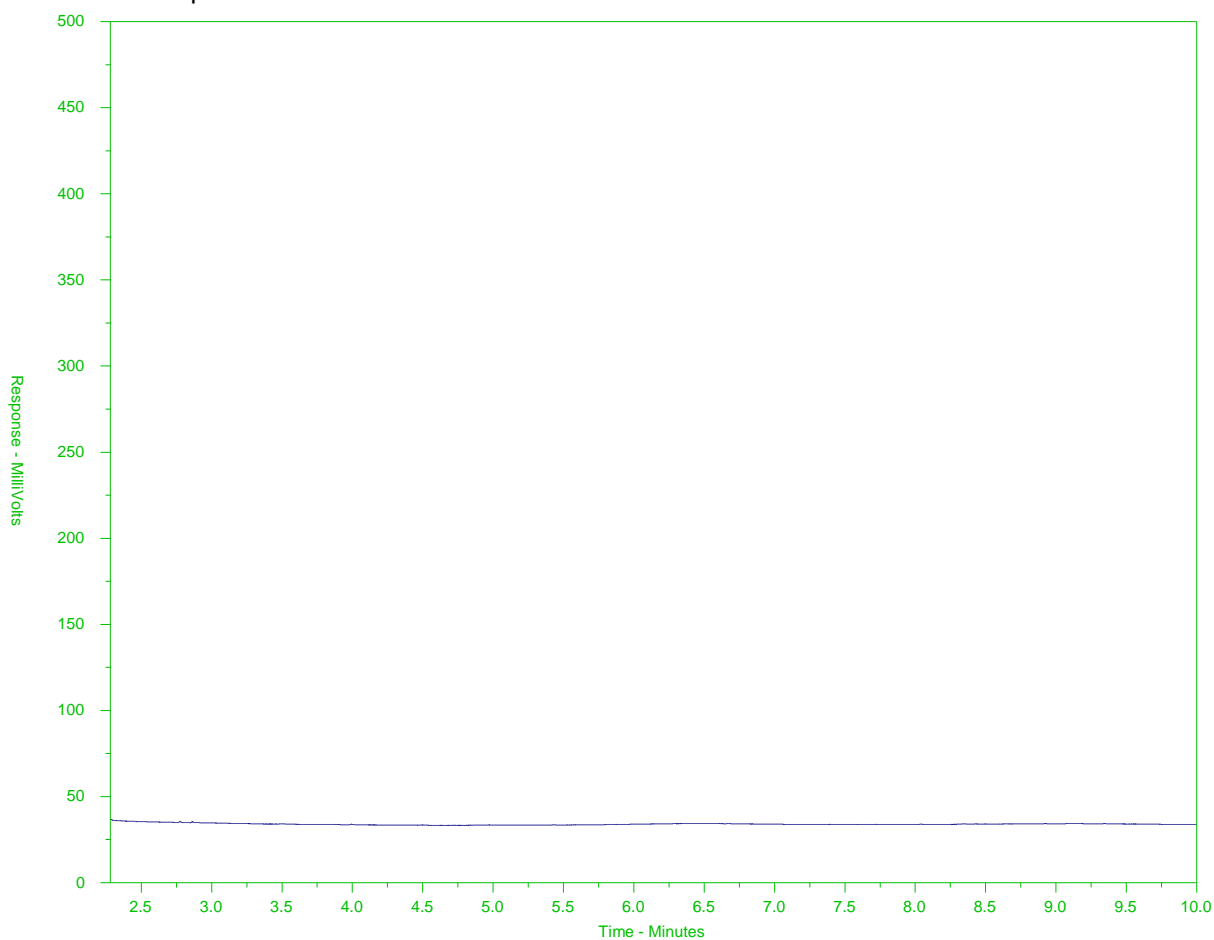
Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

BC EPH **HYDROCARBON DISTRIBUTION REPORT**

ALS Sample ID: L2272171-3
Client Sample ID: HV19-09SA5



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

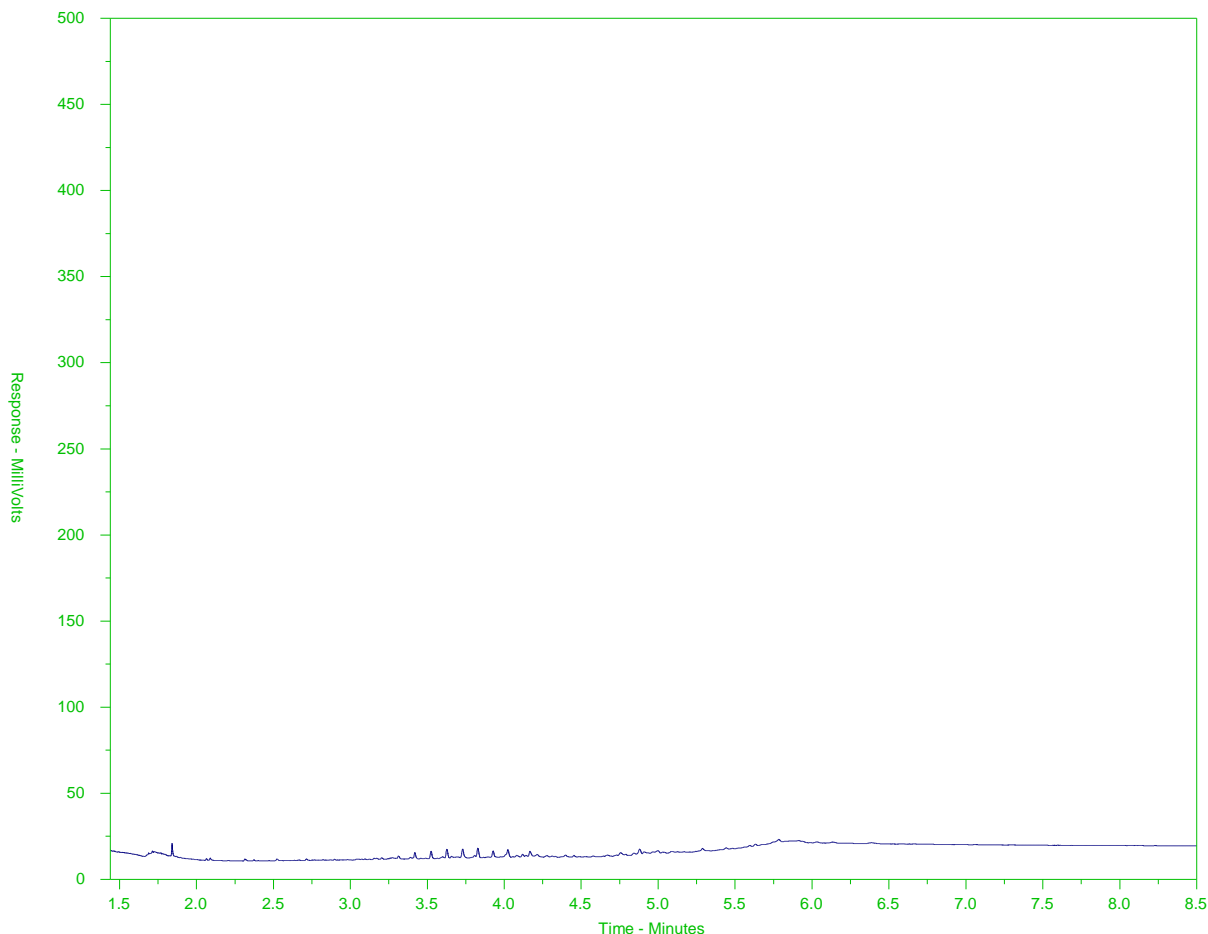
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2272171-C-3
Client Sample ID: HV19-09SA5



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34		nC50
174°C	287°C		481°C		575°C
346°F	549°F		898°F		1067°F
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →			
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

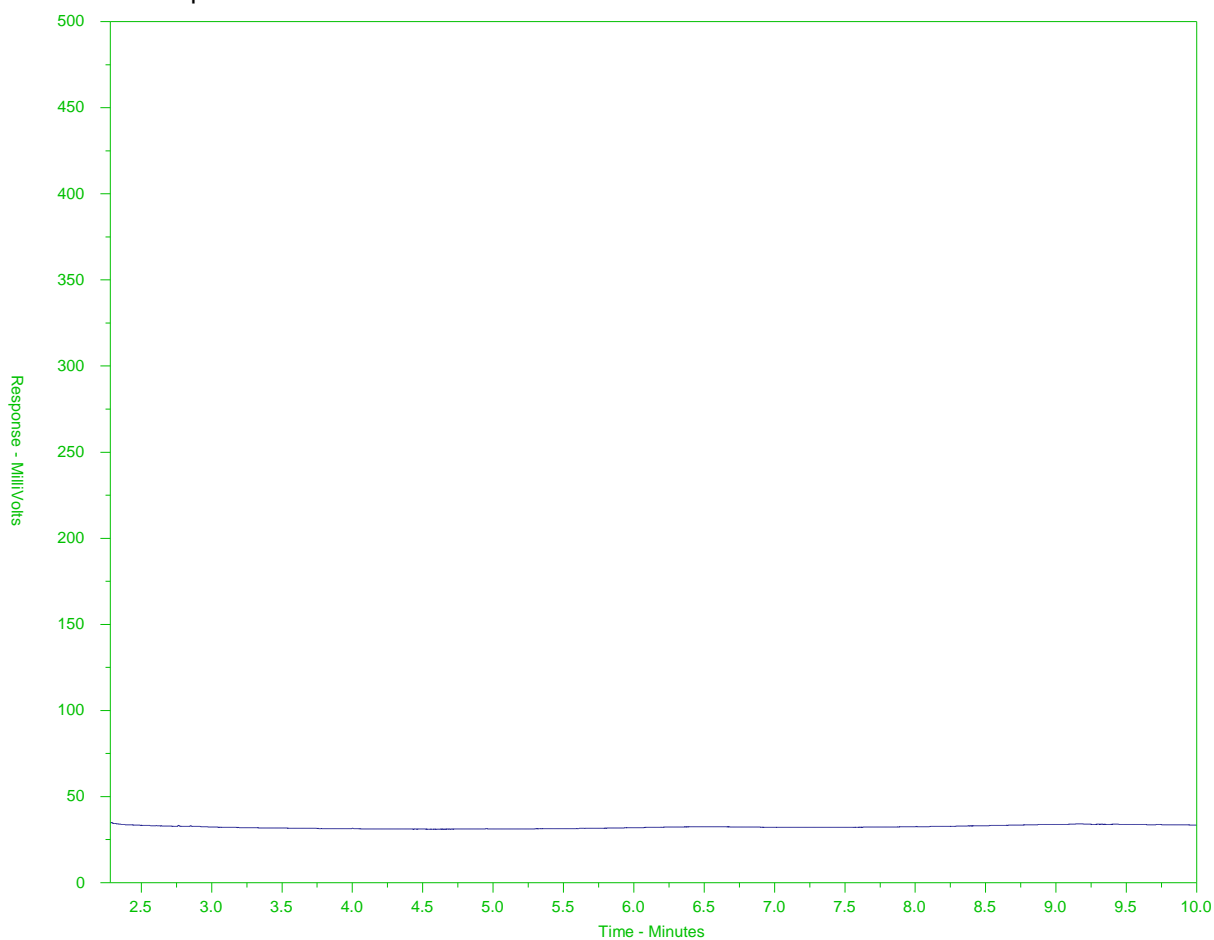
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

BC EPH HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: WG3051949-3#L2272171-3
Client Sample ID: HV19-09SA5



← EPH10-19 →		← EPH19-32 →	
nC10	nC19	nC32	
174°C	330°C	467°C	
346°F	626°F	873°F	
← Gasoline →		← Motor Oils/ Lube Oils/ Grease →	
← Diesel/ Jet Fuels →			

The BC EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Note: This chromatogram was produced using GC conditions that are specific to the ALS Canada EPH method. Refer to the ALS Canada EPH Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



Chain of Custody (COC) / Analytical
Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com



COC Number: 17 - 828886

Page 1 of 1

Report To		Report Format / Distribution		Below - Contact your AM to confirm all E&P TATs (surcharges may apply)	
Company:	STANTEC CONSULTING	Select Report Format:	<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input checked="" type="checkbox"/> EDD (DIGITAL)	Regular [R]	Standard TAT If received by 3 pm - business days - no surcharges apply
Contact:	TYLER JOYCE / ACCTS PAYABLE	Quality Control (QC) Report with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4 day [P4-20%]	1 Business day [E - 100%]
Phone:	604 436 3014	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked		3 day [P3-25%]	Same Day, Weekend or Statutory holiday [E2 -200%] (Laboratory opening fees may apply)
Company address below will appear on the final report		Select Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	2 day [P2-50%]	
Street:	500 4730 KINGSWAY AVE.	Email 1 or Fax	EDD@stantec.com	Date and Time Required for all E&P TATs: dd-mm-yy hh:mm	
City/Province:	BURNABY	Email 2	tyler.joyce@stantec.com	For tests that can not be performed according to the service level selected, you will be contacted.	
Postal Code:	V5H0C6	Email 3	jodi.johnston@stantec.com	Analysis Request	
Invoice To	Same as Report To	Invoice Distribution		Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below	
Copy of Invoice with Report	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Select Invoice Distribution:	<input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX	NUMBER OF CONTAINERS	
Company:	Stantec Consulting	Email 1 or Fax	SAP@stancor.com	SAMPLES ON HOLD	
Contact:	Accounts Payable / T. Joyce	Email 2	tyler.joyce@stantec.com	SUSPECTED HAZARD (see Special Instructions)	
Project Information		Oil and Gas Required Fields (client use)			
ALS Account # / Quote #:	Q74015	AFE/Cost Center:	PO#		
Job #:	WMT	Major/Minor Code:	Routing Code:		
PO / AFE:	(1235) 123512431.601.400	Requisitioner:			
LSD:		Location:			
ALS Lab Work Order # (lab use only):		ALS Contact:	BEEN MACK		
		Sampler:	JODI JOHNSTON		
ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	
	HV19-08SA4	13-May-19	1200	Soil	4
	HV19-09SA1		1310		4
	HV19-09SA5		1300		4
	HV19-11SA4		1030		4
	HV19-14SA2	13-May-19	1430	Soil	6
Drinking Water (DW) Samples ¹ (client use)		Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)		SAMPLE CONDITION AS RECEIVED (lab use only)	
Are samples taken from a Regulated DW System? <input type="checkbox"/> YES <input type="checkbox"/> NO				Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>	
Are samples for human consumption/ use? <input type="checkbox"/> YES <input type="checkbox"/> NO				Ice Packs <input checked="" type="checkbox"/> Ice Cubes <input checked="" type="checkbox"/> Custody seal intact Yes <input type="checkbox"/> No <input type="checkbox"/>	
				Cooling Initiated <input checked="" type="checkbox"/>	
				INITIAL COOLER TEMPERATURES °C	
				FINAL COOLER TEMPERATURES °C	
				18°	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)	
Released by:	JODI JOHNSTON	Date:	13-May-19	Received by:	Cell
Time:	15:25	Date:		Date:	May 13
Time:		Date:		Date:	3:16

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

JUNE 2017 PRINT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

APPENDIX Q

Soil Conservation Service Curve Number Calculations

SCS Curve Number Analysis - Transmountain Expansion Project - 1235 12431
 NRCS (SCS) Curve Number Determination
 Westridge Terminal Facility

Hydrologic Soil Group

C

Capilano Sediments and Vashon Drift (Armstrong and Hickock 1979)

TABLE OF CURVE NUMBERS (CN's)									Source **
Land Use	Hydrologic Condition	Hydrologic Soil Type							
		A	AB	B	BC	C	CD	D	
Meadow	"Good" *2	30	44	58	64.5	71	74.5	78	USDA
Woods	"Good" *3	30	42.5	55	62.5	70	73.5	77	USDA
Lawns	"Good" *4	39	50	61	67.5	74	77	80	USDA
Fallow/Bare Soil		77	81.5	86	88.5	91	92.5	94	USDA
Crop		30	44	58	64.5	71	74.5	78	USDA
Brush		48	57.5	67	72	77	80	83	USDA
Wetland/Lake		95	95	95	95	95	95	95	USDA
Impervious		98	98	98	98	98	98	98	USDA

^{*1} USDA - United States Department of Agriculture (2004), National Engineering Handbook, Part 630 Hydrology

^{*2} Meadow - continuous grass, protected from grazing and generally mowed for hay

^{*3} Good: Woods are protected from grazing, and litter/brush adequately cover soil

^{*4} Good: Lawns in good condition, grass cover >75%

HYDROLOGIC SOIL TYPE (%) - Existing Conditions								
Catchment	Hydrologic Soil Type							TOTAL
	A	AB	B	BC	C	CD	D	
West WTP (Phase 3.1)					100			100
East WTP (Phase 3.2&3)					100			100
Foreshore WTP (Phase 3.4.1&2)					100			100

LAND USE (%) - Existing Conditions									
Catchment	Meadow	Woodlot	Lawns	Fallow/Bare Soil	Crop	Brush	Wetland/Lake	Impervious	Total
West WTP (Phase 3.1)			9	70				20	100
East WTP (Phase 3.2&3)		10		13				77	100
Foreshore WTP (Phase 3.4.1&2)				100					100

CURVE NUMBER (CN) - Existing Conditions									
Catchment	Meadow	Woodlot	Lawns	Fallow/Bare Soil	Crop	Brush	Wetland/Lake	Impervious	Weighted CN
West WTP (Phase 3.1)			7	64				20	91
East WTP (Phase 3.2&3)		7		12				76	94
Foreshore WTP (Phase 3.4.1&2)				91					91

Notes:

AMC II assumed

Hydrological Soil Groups taken from USDS National Engineering Handbook | Part 630 Hydrology

Armstrong, J.E. and S.R. Hickock. 1979. Surficial Geology, Vancouver, British Columbia. Geological Survey of Canada, "A" Series Map, Ottawa, ON.

ATTACHMENT 5

Information Requirements Table – Westridge Phase 3

Information Requirements Table for Liquid Waste

Application Tracking Number: 378470
 Authorization Number: 3678
 [Trans Mountain Pipeline ULC /Westridge Phase 3]

Applicant Summary		Ministry of Environment	
Application Tracking #	378470	Prepared by:	Breanne Hill and Kym Keogh
Authorization #	3678	Title	Environmental Protection Officer and Environmental impact Biologist
Applicant / Facility Name	Trans Mountain Pipeline ULC	Date	March 13, 2019

The *Information Requirements Table (IRT) for Liquid Waste* is a tool used by Ministry of Environment staff to document specific guidance and instructions given to an applicant pursuing authorization to discharge under the *Environmental Management Act*.

Note - this document was developed to capture all the items and complexities concerning liquid waste especially for large or highly sensitive projects across a variety of sectors where complex guidance and instruction might be necessary.

Accordingly, for any given application, not all the items will apply and not all required items will warrant detailed discussion of methods and other concerns.

As part of the Preliminary Application Phase, MOE will discuss with the applicant the items listed in this table to determine what will be required in support of their final application. A tick mark in the “Required” column of the table indicates an information item to be included into the application package as agreed to by both parties or as directed by MOE. Should it be determined that specific methods will be used to derive this information, this will be specified with a tick mark in the “Methods” column. Specific methods may not be necessary for applications that will not require a subject matter expert review. In cases where complex impact assessments are to be undertaken, agreement on the methods used will be required. For simple methods, the methods used could be discussed with the applicant in a meeting and noted as agreed to in the table. For more complex methods, the applicant may be required to submit a “Methods Package” by an agreed date for MOE review, comment and acceptance. Once methods are accepted by MOE they should be either described in the “Methods” column or a reference made to the document describing the Methods Package.

If required, this document will form part of an Application Instruction Document (AID) which documents application submission requirements for the applicant. The AID is issued by the Director after a preliminary application meeting has occurred.

The MOE will be assessing this application against this table and it is expected that the applicant does the same prior to any preliminary meetings and/or prior to any final submissions. The Ministry will be screening the final received application against the requirements noted in the AID to ensure it is complete before resources are dedicated to a full, detailed review.

Information Requirements Table for Liquid Waste

Application Tracking Number: 378470
 Authorization Number: 3678
 [Trans Mountain Pipeline ULC /Westridge Phase 3]

Information	Requirements	Comments	Location in Final Application
1 PROJECT DESCRIPTION			
1.1 Describe the project including proposed facilities and processes.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 1.2.1, 1.2.2, and 1.2.3 Figure 1-2
1.2 Provide a company overview.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 1.1.1
1.3 Identify the project location including site and surrounding land uses, watershed and water uses.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Figures 1-1 and 1-2 Section 3.2.10
1.4 Describe relevant regulatory processes outside of EMA (Environmental Assessment, concurrent applications, etc.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 1.1.2
1.5 Describe the project permitting history and list related reports.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Include Approval information	<ul style="list-style-type: none"> Section 1.2.5
1.6 Describe the products and markets.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 1.2.1 and 1.2.2
1.7 Describe major activities, infrastructure and waste management related to: <ul style="list-style-type: none"> Site preparation and Construction Operations Closure and Post-closure. 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> In general terms, describe the larger project and how the authorization being applied for fits in the sequence of scheduled project phases. Describe the specific activities to be undertaken for the applied authorization. 	<ul style="list-style-type: none"> Sections 1.2.5 and 1.2.6 Section 2.0 – all sub-sections
1.8 Provide a detailed map of the project location and surrounding watershed and potential environmental receptors.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Figures 1-1 and 1-2
1.9 Provide a detailed Site Plan with all proposed discharge and monitoring points.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Figure 4-1
1.10 Provide process flow diagrams with respect to wastes and emissions.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Figure 2-3 Section 1.2.3
1.11 Describe specific before and after conditions for permit amendment applications.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Specifically regarding the removal of discharge points and new effluent pathways.	<ul style="list-style-type: none"> Sections 1.2.3, 1.2.4, 1.2.5 and 1.2.6 Section 4 – all sub-sections
1.12 List of qualified professionals and their related qualifications.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Include authors for each section and their related qualifications	<ul style="list-style-type: none"> QP Table – to be submitted under separate cover
2 ENVIRONMENTAL SETTING – METEOROLOGY AND CLIMATE			
2.1 Provide a detailed map showing the location of all site-specific and regional meteorological stations in relation to project facilities	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 3.2.1 Figure 1-1
2.2 Describe relevant meteorological and climate information sources for parameters such as precipitation, temperature and evaporation.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Provide information on 2, 5, 10 and 100 year 24-hour storm events at the site specifically looking at the high precipitation events that occurred in the last 10 years. Include a graph of rainfall over the last 10 years that can be used to identify key seasonal periods. 	<ul style="list-style-type: none"> Section 3.2.1 Table 3-1 Figures 3-1 and 3-2

Information Requirements Table for Liquid Waste

Application Tracking Number: 378470
Authorization Number: 3678
[Trans Mountain Pipeline ULC /Westridge Phase 3]

Information	Requirements	Comments	Location in Final Application
2.3 Submit all climate data in an appendix (electronic preferred) including site photos, precipitation, temperature, snow water equivalent, etc. and provide monthly and annual summaries of relevant climatic parameters.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
2.4 Identify information gaps and describe site-specific meteorological data collection methods proposed to augment existing regional data.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
3 ENVIRONMENTAL SETTING – HYDROLOGY, OCEANOGRAPHY, AND HYDROGEOLOGY			
<div>3.1 Provide a detailed hydrologic analysis of key surface drainages within the project area, to define seasonal flow regimes of local drainages. The analysis must include:<ul style="list-style-type: none">Describe pre-project topography and surface drainage features.Monthly and annual stream flow/runoff summaries and critical low flow metrics;Identification all data gaps and assumptions,Describe and justify baseline study design, methods of hydrometric station installation, sampling methods and QA/QC procedures, following guidance in Water and Air Baseline Guidance Document for Mine Proponents and Operators.Provide detailed maps showing all drainage basins (local and regional) that will be affected by the proposed project, areas of groundwater discharge, wetlands and notable topographic features.Include all hydrological data in an appendix (electronic preferred), including rating curves, manual measurements, plots of site-specific discharge, site photos, etc.Provide a conceptual hydrologic or water balance model for the site illustrating worst case scenarios for low and high flows.Provide calibration/validation statistics and plots for hydrological model.Identify spatial or temporal gaps in the database, and provide record periods for all gauging stations (regional and project specific).For projects with life span greater than 20 years, include an assessment of the potential impacts of climate change on the project water balance.</div>	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none">Detail where water (stormwater, surface water and ground water) is collected and how it is funnelled through the site to Burrard Inlet.Flow rates for the discharge locations are required as they are tied to the evaluation of impacts on Burrard Inlet, the capacity of the treatment plants and the ability of the ditches to effectively convey the discharge to the receiving environment.Provide rationale for storm event selection, including impacts of extreme storm events on both flow quantity and effluent quality (TSS levels).Include discussion as to how the glacial marine soils relate to the model.Include discussion on water that flows onto the site from outside the property boundary.Validation of the hydrologic model may be submitted as a supplemental filing at a later date, but it will be required for First Nations consultation and for the technical review.	<div>Information Bullets<ul style="list-style-type: none">Figure 1-2 and Section 3.2.2Section 3.2.2 and Figure 3-2Sections 3.2.1, 3.2.2 and 3.3.1Figure 1-2, Section 3.3.1.1, Figures 3-11 to 3-13Section 3.3.1.1 and Figures 3-11 to 3-13Discussed in Section 3.3.1.3. A supplemental filing will be submitted to provide additional calibration/validation.Section 3.2.1</div> <div>Comments Bullets<ul style="list-style-type: none">Sections 3.2.2 and 3.3.1; Figures 3-11 to 3-13Sections 3.3.1.2, 3.3.1.4, and 3.3.1.5Sections 3.2.1, 3.3.1.1 and 3.3.1.2.Section 3.3.1.1.Section 1.2.3Comment noted</div>
<div>3.2 Provide a detailed analysis of key oceanographic factors that may influence the discharge in the marine or estuarine environment. The analysis must include:<ul style="list-style-type: none">Analysis of bathymetric features,Tidal flux and currents,</div>	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none">Characterize the oceanographic factors within a 500 m radius of the existing outfalls.	<ul style="list-style-type: none">Section 3.2.4

Information Requirements Table for Liquid Waste

Application Tracking Number: 378470
Authorization Number: 3678
[Trans Mountain Pipeline ULC /Westridge Phase 3]

Information	Requirements	Comments	Location in Final Application
<ul style="list-style-type: none">Temperature gradients,Salinity.			
<p>3.3 Provide a detailed hydrogeologic analysis of key surface drainages within the project area, to define seasonal flow regimes of local drainages. The analysis must include:</p> <ul style="list-style-type: none">Describe aquifers and aquitards within and downstream of the project property, including the geological units in which groundwater occurs and the units' characteristics.Describe and justify baseline study design, methods and QA/QC procedures, following guidance in Water and Air Baseline Guidance Document for Mine Proponents and Operators.Provide a minimum of 1 year of water level data from observation wells and assess all relevant units for aquifer characteristics (e.g. storativity, hydraulic conductivity, etc.).Provide piezometric contour maps depicting groundwater flow direction and hydro-stratigraphic cross-sections.Develop and provide methods and outcomes of a conceptual hydrogeological model (considering seasonal variation) of the project area.Identify gaps and justify the assumptions in the conceptual hydrogeological model.Provide calibration/validation statistics and plots for the groundwater model.Conduct a sensitivity analysis for any groundwater flow and level modeling, considering variation in hydraulic conductivity, wet and dry conditions, etc.Provide all well logs, pump/slug test results, core pictures etc. in an appendix.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none">Determine direction of groundwater flow along the tunnel pathway.Determine amount of groundwater flow seasonally and during precipitation events and how that will affect the water treatment plants.Describe geological features along and around the tunnel pathway, including glacial marine soils.If observation wells are installed and monitored then QA/QC procedures and well logs need to be includedDescribe areas where large amounts of groundwater may be storedProvide data or prediction on groundwater quantity along the length of the tunnel route.Include previous and new data	<p>Information Bullets</p> <ul style="list-style-type: none">Section 3.2.3.1 and Appendix NHydrogeologic parameters - Section 3.2.3.2; Water level - Section 3.2.3.2, Figures 3-4 and 3-5 and Appendix NHydrostratigraphic cross-section - Figure 3-4, Section 3.2.3.2; a piezometric contour map is not available as data are along a linear alignment.Section 3.2.3.2Section 3.2.3.2 and Appendix NSection 3.2.3.2 and Figure 3-6Section 3.2.3.2 and Appendix N (including citations)Appendix N (including citations) <p>Comments Bullets</p> <ul style="list-style-type: none">Section 3.2.3.2 and Figure 3-4Section 3.2.3.2Section 3.2.3.2 and Figure 3-4Appendix NIf unexpected groundwater is encountered, the tunnel boring machine will return to pressurized mode within approximately one minute and therefore large quantities of groundwater will not need to be stored – see Section 2.1.10.Section 3.2.3.2

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			<ul style="list-style-type: none"> Section 3.2.3.2 and Appendix N
4 ENVIRONMENTAL SETTING –WATER AND SEDIMENT QUALITY			
4.1 Provide a baseline groundwater quality report . The report may be based on existing water quality data. If existing data is not sufficient additional baseline water quality sampling may be required. The report must: <ul style="list-style-type: none"> Describe and justify baseline study design, methods, analysed parameters and QA/QC procedures. Provide rationale, if design and methods differs from those described in <i>Water and Air Baseline Guidance Document for Mine Proponents and Operators</i>. Provide data summaries (using appropriate statistics) that characterize spatial and temporal variations and identify location, frequency, duration and magnitude of applicable standards or environmental quality guideline exceedances. Identify downstream groundwater users. Provide a detailed map with groundwater sampling locations, potential seepage areas, proposed or existing discharge points and potential areas of disturbance. Identify data gaps and identify and justify the assumptions in the report. Identify and discuss QA/QC concerns related to the data following the procedures in the B.C. Field Sampling Manual. 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Provide data or predictions of groundwater quality along the length of the tunnel route. Proved summary statistics for the quality (total and dissolved metals, TOC, etc.) of the groundwater that will be entering into the water treatment plants during tunnel excavation. Include previous and new data 	Information Bullets <ul style="list-style-type: none"> Section 3.2.3.1 and Appendix N Section 3.2.3.3 Section 3.2.3.3, Tables 3-3 and 3-4, Appendix N Figures 3-3, 3-7, 3-11, 3-12, 3-13, 4-1 Section 3.3.2.1 and Appendix N Appendix N Comments Bullets <ul style="list-style-type: none"> Section 3.2.3.3 and Appendix N Section 3.2.3.3 and Appendix N Section 3.2.3.3, Table 3-3 and Appendix N
4.2 Provide a baseline surface water quality report . The report may be based on existing water quality data. If existing data is not sufficient additional baseline water quality sampling may be required. The report must: <ul style="list-style-type: none"> Describe and justify baseline study design, methods, analysed parameters and QA/QC procedures. Provide rationale, if design and methods differs from those described in <i>Water and Air Baseline Guidance Document for Mine Proponents and Operators</i>. Multiple years of data are highly recommended. Identify data gaps and identify and justify the assumptions in the report. Identify downstream surface water users. 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Provide summary statistics of marine water quality showing the range of variation, particularly for parameters relevant to the proposed discharge. Provide water quality data (metals, nutrients, TEH) of the stormwater upstream (as close to the property line as possible), and also water quality data of any effluent (e.g. water in the western CP ditch) prior to discharge from the site, to establish current conditions. Describe interactions between streams entering the site (at the property line) and stormwater runoff from construction areas Submit sampling locations to ENV for approval, prior to the start of the sampling program Sampling results may be submitted as a supplemental filing at a later date, but it will be required for First Nations consultation and for the technical review. 	Information Bullets <ul style="list-style-type: none"> Section 3.2.5 and Appendix O Appendix M Section 3.2.5 and Appendix O Section 3.2.10 Appendix O Appendix O Figure 3-8 and Appendix O Appendix O Comments Bullets <ul style="list-style-type: none"> Appendix O Appendix O

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<ul style="list-style-type: none"> Provide data summaries (using appropriate statistics) that characterize spatial and temporal variations and identify location, frequency, duration and magnitude of applicable standards or environmental quality guideline exceedances. For lakes provide limnological characterizations, at a representative deep station for each basin. Sampling design should be adequate to support determination of trophic status. Provide raw data in tables, including applicable method detection limits (in appendices – electronic preferred). Provide a detailed map with surface water sampling locations in relation to proposed or existing discharge locations and areas of disturbance. Identify and discuss QA/QC concerns related to the data, following the procedures in the BC Field Sampling Manual 			<ul style="list-style-type: none"> Sections 3.2.5, 3.3.4, and 3.3.5 Comment noted All sampling results have been included in Appendix O and are described in the TAR. A supplemental filing is not required for IRT #4.2.
4.3 Provide a baseline sediment quality report . The report may be based on existing sediment quality data. If existing data is not sufficient an additional baseline sediment quality sampling may be required. The report must: <ul style="list-style-type: none"> Describe and justify baseline study design, methods, parameters analysed and QA/QC procedures, following guidance in <i>Water and Air Baseline Guidance Document for Mine Proponents and Operators</i>. Identify data gaps and identify and justify the assumptions in the report. Provide data summaries (using appropriate statistics) that characterize spatial and temporal variations and identify location, frequency, duration and magnitude of applicable standards or environmental quality guideline exceedances. Provide raw data in tables, including applicable method detection limits (in appendices – electronic preferred) Provide a detailed map with sediment sampling locations, and proposed or existing discharge locations and areas of disturbance. Identify and discuss QA/QC concerns related to the data, following the procedures in the BC Field Sampling Manual. 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> In terms of this site, the term “sediment” applies to soils. Information on marine sediments is NOT required. Provide an analysis of soils that was completed for the sizing of the water treatment plants – Include previous and new data – 	Information Bullets <ul style="list-style-type: none"> Section 3.2.6 and Appendix P Section 3.2.6 and Appendix P Appendix P Appendix P Figures 3-9 and 3-10 Appendix P Comments Bullets <ul style="list-style-type: none"> Comment noted Comment noted Appendix P and Section 3.3.1.1 Appendix P
5 ENVIRONMENTAL SETTING – AQUATIC LIFE INDICATORS			
5.1 Provide a baseline aquatic life indicator report . The report may be based on existing sediment quality data. If existing data is not sufficient an additional baseline aquatic life sampling may be required. The report must: <ul style="list-style-type: none"> Describe and justify baseline study design, methods, measuring endpoints, parameters analysed and QA/QC procedures, following 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Characterize receiving environment biota and habitat, including the occurrence of species that may be sensitive to the proposed waste discharge, within 500 m of discharge locations. Include species that may only use this area for part of their life cycle (i.e. salmonids) Describe the proposed outfall location in relation to the Rockfish Conservation Area 28 - East Burrard Inlet. 	Information Bullets <ul style="list-style-type: none"> Section 3.2.7 and Stantec 2013 – HYPERLINK Comments Bullets <ul style="list-style-type: none"> Section 3.2.7

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<p>guidance in <i>Water and Air Baseline Guidance Document for Mine Proponents and Operators</i>, including tissue residues. Multiple years of data are highly recommended.</p> <ul style="list-style-type: none">Identify data gaps and identify and justify the assumptions in the reportProvide a detailed map with sampling locations, and proposed or existing discharge locations and areas of disturbance. Include other water and sediment quality sample locations, if appropriateProvide raw data in tables, including applicable method detection limits (in appendices – electronic preferred).Provide data summaries (using appropriate statistics to determine biological significance) that characterize spatial and temporal variations and identify location, frequency, duration and magnitude of effects on aquatic resources.Demonstrate that the baseline aquatic life monitoring program is sufficiently robust to assist future monitoring in detecting a biologically significant predetermined change.		<ul style="list-style-type: none">Describe the proposed outfall location in relation to any marine parks or public use areas in Burnaby and North Vancouver.	<ul style="list-style-type: none">Section 3.2.10.3Section 3.2.10.2 and 3.2.10.3
6 LIQUID WASTE DISCHARGES AND TREATMENT			
<p>6.1 Provide a description of pollution control works and treatment efficiencies.</p>	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none">Soils information should be included for areas that will be affected by Phase 3 in relation to proposed level(s) of treatment and proposed TSS discharge limit(s).Provide information on water treatment plant peak capacity and how that is related to the precipitation that occurs on site. Discuss occurrences where the precipitation received on site could not be treated at the water treatment plants and what contingency measures would be used to protect the environment.Provide details of any proposed wastewater treatment plant (WTP) equipment, including treatment process and capabilities, residuals management, etc. For WTP(s), show the respective collection area and storm events used to size the equipment.Provide information on specific erosion and sediment control methods that will be used.	<p>Comments Bullets</p> <ul style="list-style-type: none">Section 3.2.6Sections 3.3.1.2 and 3.3.1.4Sections 2.4 and 3.2.1, Figure 2-3, Appendices H, I and JSection 2.3, Appendices D and E
<p>6.2 Provide an effluent inventory table that includes for each contaminant and point of discharge, including stormwater:</p> <ul style="list-style-type: none">% change (if an amendment),Maximum and average contaminant discharge rate and concentration for each contaminant,Maximum and average flow,Operating durations (i.e. hours per day, days per year) and frequency.Discharge point location in decimal degrees, to the fourth decimal place.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	The required information must be included in the TAR	<ul style="list-style-type: none">Discharge Factor Forms x 6, Section 4.1Sections 4.2, 4.3 and 4.4, Table 4-3Section 4.1Section 4.1; WTPs may discharge throughout the day depending on weather conditions. Personnel will be onsite to monitor the operation of a WTP 24 hours a day.

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			<ul style="list-style-type: none"> Table 4-3 and Discharge Factor Forms
6.3 Provide process flow diagrams with waste streams	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Include details on collection, treatment, sampling and discharge works. Provide information about how the effluent flowing from the WTPs will be conveyed to the discharge points. 	<ul style="list-style-type: none"> Sections 2.4, 2.5 and Appendix G Section 2.3, Appendices D and E
6.4 Describe the proposed source control.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Describe any erosion sediment control features and related source control measures. Describe measures to control runoff from shotcrete 	<ul style="list-style-type: none"> Section 2.3, Appendices D and E Section 2.4.6
6.5 Characterize and/or predict raw water quality for all site-waters, including source, quantity, chemistry and toxicity; describe methodology.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Include tunnel groundwater water quality Include water quality as it leaves the WTPs 	<ul style="list-style-type: none"> Sections 3.2.3.3 and 3.2.5 Sections 3.3.4 and 4.2
6.6 Best Achievable Technology Assessment by QP and/or assessment of Best Practices http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/pulp-paper-wood/best_achievable_control_tech.pdf	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Provided to ENV earlier, but please include in TAR for completeness	<ul style="list-style-type: none"> Appendix C
6.7 Manufacturer specifications for pollution control works.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Appendices H, I, J, K and L
6.8 Detailed site plan that includes locations and coordinates (as appropriate) for each point and non-point discharge. Coordinates must be in decimal degrees and to the fourth decimal place.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 4.4, Figure 4-1 and Table 4-3
6.9 Provide explanation and detailed design for effluent discharge works including specifications for the method of discharge and media i.e. discharge to ground or surface water (fresh, marine).	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> If it is possible that flows from extreme storm events could exceed the capacity of the WTP(s), provide an interpretive analysis of risk to the receiving environment of untreated flows under such circumstances. Include pathways for the effluent discharge and the capacity of the discharge pathway to handle the increase in effluent. If using the CP Rail ditch, provide information about the capacity of the ditch for managing the discharged volumes to the ditch or any rationale about infiltration to ground, infilling or subsurface erosion (piping). Provide data to demonstrate that the ditches and the culverts are capable of handling potential increased flows. 	<ul style="list-style-type: none"> Sections 2.4.5.2, 2.5, 3.3.4 and 3.3.5 Section 3.3.1.5
6.10 Describe the proposed sampling and flow measuring facilities at discharge points.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Include specifics on how the flow will be measured, the parameters that will be measured, the frequency of measurements, and QA/QC.	<ul style="list-style-type: none"> Sections 2.3, 2.4.3 and 2.4.4 and Appendix G
6.11 Explain the storm water management system and provide detailed design for proposed storm water works.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 2.3, Appendices D and E
6.12 For open air treatment system components, storage tanks, lagoons and ponds, specify and justify the design flood events for structural integrity and for removal of suspended solids.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Not applicable
6.13 Describe any proposed use of settling aids, including a toxicity evaluation.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Include a discussion on Rainbow Trout LC 50 tests and how they will be used to determine chitosan toxicity.	<ul style="list-style-type: none"> Section 2.4.1, Appendix H
6.14 Describe and characterize treatment process residuals.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 2.4.4.3, Appendix K

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6.15 Provide a site-specific erosion and sedimentation control plan.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Appendix D
6.16 A copy of the for-construction (or as-built) design drawings for the wastewater facility, including the discharge works, certified, signed and stamped by a qualified professional;	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Ensure that the design of each WTP system is carried out through an engineered process to ensure that the system meets the requirements/specifications of the project. That process should be signed off by a QP A qualified professional must ensure that ditches and other conveyance systems are designed and constructed as per certified drawings. Detailed design drawings are not required for the submission but must be available upon request. 	<ul style="list-style-type: none"> TMEP acknowledges this comment and confirms that this guidance will be followed.
6.17 Certification by Qualified Professionals - QP sign-off certifying that the wastewater facility as designed and/or as-constructed is capable of meeting the proposed discharge requirements	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> TMEP acknowledges this comment and confirms that this guidance will be followed.
6.18 Specify the treatment design criteria including treatment capacity, retention times, and input and output water quality.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 2.4.3, 2.4.4 and 3.3.1.1
6.19 Provide project and treatment system construction and commissioning schedule and related notification requirements.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Table 1-4, Sections 2.1 and 4.4
6.20 Provide a detailed description of any use of reclaimed water (effluent), including: <ul style="list-style-type: none"> Provide a detailed description of the intended use Planned or potential public and/or worker exposure. Evaluate the implications for effluent quality based on potential exposure and user safety. 	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
7 IMPACT ASSESSMENT			
7.1 Identify the receptors that may be at risk due to project related activities.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Identify the marine receptors that may be at risk due to the activities. Consider risk of pH, TSS, turbidity, metals and TEH.	<ul style="list-style-type: none"> Section 3.3 and its subsections
7.2 Identify and justify spatial and temporal boundaries for effects predictions.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Section 3.3.5
7.3 Identify critical contaminant sources.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Throughout Section 2.1; Sections 3.2.3.3, 3.2.5 and 3.2.6
7.4 Validate proposed effluent quality requirements based on a thorough assessment of discharge loading, cumulative effects against receiving environment criteria/guidelines.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 3.3.4 and 3.4.5
7.5 Summarize potential impacts by media and location, using tables.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Media is defined as soil, water, plants, and animals	<ul style="list-style-type: none"> Section 3.3 and its sub-sections
7.6 Illustrate graphically the pathways from contaminant sources to receptors.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Figures 3-11, 3-12, 3-13
7.7 Summarize risk to surface, groundwater aquatic resources and general water users.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 3.3.4, 3.3.2.2, and 3.3.8
7.8 Discuss risk reduction options and adaptive management strategies.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none"> Sections 2.1.10, 2.1.11.5, 2.2 and Table 2-3, mitigations throughout Section 3.3

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7.9 Consider the potential cumulative effects of the discharge on the receiving environment when combined with other local activities and conditions.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Identify other discharges to the water that may combine with the effluent from the site to cause a greater impact. Discuss the effect of disturbances in the marine environment such as vessel traffic. Summarize the Tsleil-Waututh Burrard Inlet Action Plan goals and explain how the mitigation measures align with the goals. 	<ul style="list-style-type: none"> Sections 3.3.4, 3.3.5 and 3.3.8 Table 3-6
7.10 Identify the potential impacts of projected climate change scenarios on the projects operations, closure and post closure phases.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	Not applicable for this short term construction project	n/a
7.11 For impact assessment related to groundwater provide: <ul style="list-style-type: none"> Provide predicted effects on groundwater, surface water, interaction between ground and surface water, water uses and receptors, A conceptual model to describe the contaminant transport through groundwater or surface water from source to receptors and establish a risk assessment process. Estimate probabilities of occurrence of each pathway/exposure combination, estimate risk and develop a matrix to manage risk. Identify data gaps, and uncertainty in models, and how they will be addressed. 	Required <input type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Provide summary of NEB conditions and/or management plans related to potential for tunnel groundwater to impact surface water or groundwater along the tunnel route. Describe how the borer is expected to minimize the effect of tunnel activity on groundwater quantity and quality offsite Groundwater users would include domestic, irrigational, agricultural, and industrial categories 	Information Bullets <ul style="list-style-type: none"> Sections 3.3.2, 3.3.4.1, 3.3.5 and 3.3.8 Sections 3.2.3.2 and 3.3.2 Section 3.3.2 Section 3.3.2.3 Comments Bullets <ul style="list-style-type: none"> Section 3.3.2.2 Sections 3.3.2.2 and 3.3.8, and Appendix N Comment noted
7.12 For impact assessment related to surface water provide: <ul style="list-style-type: none"> Describe and justify impact prediction approach, including study boundaries and assessment (e.g., drinking water quality; aquatic life) and measurement endpoints (chemical, toxicological or biological). Identify key discharges, seepages, or disturbance regimes and associated contaminants. Develop conceptual models or frameworks to describe the transport of key contaminants from source to receptors. Describe and justify modelling methods to predict how surface water quantity and quality may be affected within, and downstream of, the property. Make calculations and tabulated data available for government review. Describe predicted effects of project related activities on water balance, flows and water levels. Identify whether current regional trends or projected changes in stream flow or climate could potentially affect dilution, water management infrastructure, ability to provide sufficient water covers where required, etc., during and after the life of the project. Determine the extent of the initial dilution zone (IDZ) for all proposed discharges, including: methodology and rationale. Provide predicted incremental changes over existing receiving environment water and sediment quality at critical points in the receiving environment and during critical time periods. 	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none"> Discuss predicted effluent toxicity in terms of the 96-hr rainbow trout LC50 pass/fail test. Ask and answer the final two bullets (predicted changes in aquatic resource and risks to other receptors). Provide a review of applicable water quality guidelines and objectives (CCME, BCWQGs, and Burrard Inlet Water Quality Objectives) as a basis for proposing authorization discharge limits. Where turbidity curtains are being used, discuss if IDZ modelling is appropriate, and for which parameters (i.e. TSS vs pH) demonstrate that effluents will not cause acute and/or chronic toxicity, the focus should be on metals, pH and other contaminants that could move through the turbidity curtains Identify if there will be any changes to water quality at nearby recreational areas and parks identified in Section 5.1 above. 	Information Bullets <ul style="list-style-type: none"> Section 3.3.4 Sections 2.1.9, 2.1.11, 3.3.3, and 3.3.4 Section 3.3.1 and 3.3.2 Section 3.3.1 Section 3.3.4 Section 3.3.4 Section 3.3.4 Sections 3.3.2, 3.3.4, and 3.3.5 Section 3.2.5 Section 3.2.7 Section 3.2.7 Section 3.2.7 Comments Bullets <ul style="list-style-type: none"> Section 2.4 Comment noted Section 4.3 Section 3.3.4 Section 3.3.4 Sections 3.3.5 and 3.3.8

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<ul style="list-style-type: none">Conduct a sensitivity analysis for the water quality model that considers a range of hydro-climatic conditions (wet and dry events) that are representative of the streamflow variability in the project area.Identify sites, parameters and time periods, when water or sediment quality is expected to exceed B.C. Water Quality Guidelines, existing Water Quality Objectives, or provincial or federal Sediment Quality Guidelines.Demonstrate through a weight of evidence approach that effluents or seepages will not cause acute and/or chronic toxicity.Estimate probabilities of occurrence of each pathway/exposure combination and develop a risk assessment matrix or other process to prioritize and manage risk.Identify data gaps and uncertainties and describe how they would be addressed in adaptive management and environmental monitoring programs.Describe and discuss the potential for bioaccumulation or bioconcentration of contaminants, and the associated risk to assessment endpoints (i.e., fish health, fish reproduction, consumers of fish, etc.).Predict changes in aquatic resources at species, community and/or ecosystem levels as appropriate due to water quality and water quantity changes.Identify risks to other receptors, including wildlife, livestock, and human health.			
8 MONITORING PLANS			
8.1 Discharge Monitoring (source)	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Discharge and receiving envionrment plans should be combined into the Effluent Monitoring Plan required in Section 9.8 below.	<ul style="list-style-type: none">Appendix GA Compliance Monitoring Plan will be submitted at a later date.
8.2 Continuous Process Monitoring	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
8.3 Aquatic / Environmental Effects Monitoring Plan	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
8.4 Receiving Environment Monitoring Plan	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Discharge and receiving envionrment plans should be combined into the Effluent Monitoring Plan required in Section 9.8 below.	<ul style="list-style-type: none">Appendix GA Compliance Monitoring Plan will be submitted at a later date.

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8.5 Describe proposed data assessment techniques and reporting, including reporting frequency and content.	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none">Appendix GA Compliance Monitoring Plan will be submitted at a later date.
8.6 Quality Assurance Requirements	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Discharge monitoring must include replicate sampling and field blanks at intervals recommended by the lab (i.e., 20% of all samples).	<ul style="list-style-type: none">Appendix GA Compliance Monitoring Plan will be submitted at a later date.
9 MANAGEMENT PLANS			
9.1 Operations and Maintenance Manual - Detailed operational procedures and preventative maintenance program, operator training and qualifications, inspection schedule, inventory of replacement parts, description of automated systems, warnings and alarms, including response and notification procedures.,	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none">Section 2.4.4, Appendices I, J and K
9.2 Reclaimed Water Use Plan	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.3 Treatment Residuals Management Plan	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none">Appendix K
9.4 Commissioning Plan - Contains the notification, operational procedures and monitoring required to commission the facility.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.5 Maintenance Start-up and Shutdown Plan	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.6 Contingency plan - Describes emergency procedures for the facility, stand-by or emergency power requirements, procedures for notifying a health officer when necessary, actions to take if the effluent fails to meet quality requirements, and alternate disposal or storage options (for reclaimed water when use is not possible)..	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	<ul style="list-style-type: none">Discuss adaptive management in the context of an extreme storm event—describe contingencies.Include a discussion on possible soil movementInclude a discussion on contingencies for extreme pH eventsInclude contingency plan for possible large influx of groundwater high in dissolved metals (from tunnel boring)	Trans Mountain has proposed contingency measures in various project-related management plans and guidance documents (e.g., construction water quality monitoring plan, spill contingency plan, and emergency response plan). These contingency measures are currently undergoing review by BC ENV.
9.7 Episode Management Plan - spills, nuisance, litter, odour, fire, flooding,	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	If covered under an NEB condition, please provide plan as an appendix	<ul style="list-style-type: none">See Table 2-3 and footnote to Section 2.4
9.8 Effluent monitoring plan - the effluent and receiving environment monitoring program, including frequency, notification and reporting requirements	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>	Please provide recommendations for permit monitoring requirements for both quality and quantity. This plan includes the Discharge Monitoring Plan (8.1) and Receiving Environment Monitoring Plan (8.5).	<ul style="list-style-type: none">Appendix GA Compliance Monitoring Plan will be submitted at a later date.

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Information	Requirements	Comments	Location in Final Application
9.9 Irrigation Plan Documents the timing of reclaimed water use, maximum application rate and growing season based on the crop or vegetation, site specific loading, and nutrient and metals limits.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.10 Odour Control Plan	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.11 Financial Security Plan	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
9.12 Closure Plan - In the case of a temporary treatment system, details decommissioning procedures for the facility	Required <input checked="" type="checkbox"/> Methods <input type="checkbox"/>		<ul style="list-style-type: none">Section 2.4.4.6 and Appendix L
9.13 Erosion and Sediment Control Plan	Required <input checked="" type="checkbox"/>		<ul style="list-style-type: none">Appendices D and E
10 OTHER REQUIREMENTS			
10.1 Sewage Disposal (not Required if an MWR registration is being pursued as the MWR registration requirement address these concerns) Describe the disposal plan for sewage generated on-site.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
10.2 If sewage is proposed to be included in the effluent permit, provide justification and technical information supporting this discharge. Specify why sewage disposal is not proposed as a registration under the Municipal Wastewater Regulation.	Required <input type="checkbox"/> Methods <input type="checkbox"/>	n/a	n/a
10.3 Phase 2	Required <input checked="" type="checkbox"/>	<ul style="list-style-type: none">Include all Phase 2 activities in the Phase 3 TARInclude all baseline information and impact assessment for the activities in Phase 2Integrate where Phase 2 and Phase 3 will have a combined impact	<ul style="list-style-type: none">n/a – see Section 1.2.5
10.4 Tunnel Boring	Required <input checked="" type="checkbox"/>	<ul style="list-style-type: none">Describe how any PAG will be identified and managed on site. Include waste rock from the tunnel excavation.Describe where the waste rock will be taken for disposal, including EMA authorizations for that site.Include a discussion on the adequacy of the selected leak detection methods during the tunneling.Include how any tunnel water will be transported to the WTPs	<ul style="list-style-type: none">See Section 2.1.10
10.5 Hydrostatic Water	Required <input checked="" type="checkbox"/>	<ul style="list-style-type: none">Include information on how the tunnel pipelines will be hydrostatically testedInclude information on the potential contaminants of the hydrostatic test waterInclude information on the quantity and quality of the hydrostatic test water (will the water need to be held onsite?)Include information on the treatment of the hydrostatic test waterInclude information on proposed discharge of the hydrostatic test water (will the discharge be included in the annual permitted total or will a separate request be submitted)Discuss applicable water quality guidelines or comparable allowable concentrations from the Oil and Gas Waste Regulation for the dischare of hydrostatic test water.	<ul style="list-style-type: none">See Section 2.1.11, Section 2.4.2, Section 4.2.3

Guidance Documents to be considered when determining Information Items.

Required and appropriate Methods to be used:

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- [*British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, BC Ministry of Water, Land and Air Protection, 2013*](#)¹
- [*Effluent Permitting Process under the Environmental Management Act – An Overview for Mine Project Applicants, BC Ministry of Environment, April 2013*](#)²
- *Developing a Mining Sediment and Erosion Control Plan, BC Ministry of Environment, December 2014*
- [*Guidance for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining \(draft\), BC Ministry of Environment, Lands and Parks, May 9, 2001*](#)³
- [*Guidance on Applications for Permits Under the Environmental Management Act – Technical Assessment, BC Ministry of Environment, September 10, 2010*](#)⁴
- [*Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities, BC Ministry of Environment, April 2012*](#)⁵
- [*Manual of British Columbia Hydrometric Standards v.1, Ministry of Environment, March 12, 2009*](#)⁶
- [*Technical Guidance 6 on Contaminated Sites – Water Use Determination, Version 2, Ministry of Environment, July 2010.*](#)
- *Terms of Reference Environmental Impact Assessment And Technical Assessment Report for Environmental Management Act Effluent Permit Applications, BC Ministry of Environment, 2014*
- [*Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators, BC Ministry of Environment, October 9, 2012*](#)⁷

¹ <http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/sampling-methods-quality-assurance/bc-field-sampling-manual>

² http://www.env.gov.bc.ca/epd/industrial/mining/pdf/effluent_permitting_guidance_doc_mining_proponents_apr2013.pdf

³ http://www2.gov.bc.ca/assets/gov/topic/C0188F632AEC266B044F8A2B756F055F/industrial_waste/settling_ponds.pdf

⁴ <http://www2.gov.bc.ca/gov/DownloadAsset?assetId=7AD12B8CF1B94CF29619BD9871FB5740&filename=assessment.pdf>

⁵ http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/groundwater_modelling_guidelines_final-2012.pdf

⁶ http://www.for.gov.bc.ca/hts/risc/pubs/aquatic/hydrometric/man_BC_hydrometric_stand_V1.0.pdf

⁷ http://www2.gov.bc.ca/gov/DownloadAsset?assetId=E49A49E800814C8FB2D6868B7F119AD6&filename=water_air_baseline_monitoring.pdf