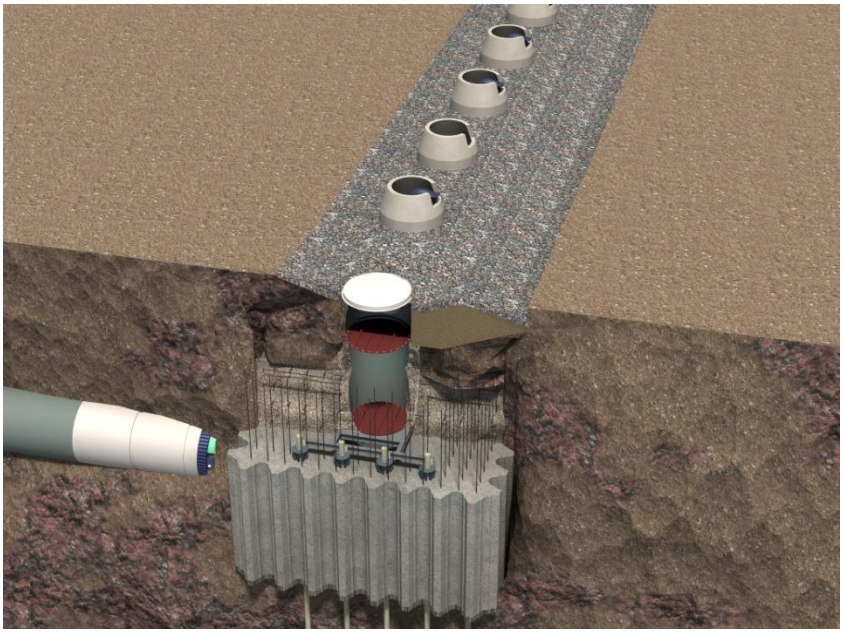
APPENDIX J
ENVIRONMENTAL STUDIES

J.1: Geo-Environmental Assessment Report

Part A: Report

Annacis Island WWTP New Outfall System

Vancouver Fraser Port Authority
Project and Environmental Review Application



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REPORT

21 December 2017

ANNACIS ISLAND WWTP TRANSIENT MITIGATION AND OUTFALL, DELTA, BC

Geo-Environmental Assessment

Submitted to:
Mr. John Newby, P.E.
CDM Smith
Suite 1001, 4710 Kingsway
Burnaby, BC
V5H 4M2

Report Number: 1525010-095-R-Rev0

Distribution:

1 e-Copy - CDM Smith Canada ULC

Golder Associates

Executive Summary

Golder Associates Ltd. (Golder) was retained by CDM Smith Canada ULC (CDM Smith) to provide geotechnical, environmental, geo-environmental and archaeological services for the Annacis Island Wastewater Treatment Plant (AIWWTP) outfall and transient mitigation system from pre-design (Phase A), to detailed design (Phase B) and through to construction (Phase C).

The AIWWTP provides secondary treatment of wastewater to 14 municipalities across the lower Mainland and is located on Annacis Island at 1299 Derwent Way, Delta, BC. The AIWWTP is currently being expanded to increase the secondary treatment capacity and a new outfall is required to augment or replace the existing outfall facilities.

The construction of the new outfall, including its components, will involve excavation of considerable volumes of soil and sediment. The main objective of the Geo-Environmental Assessment was to charachterize the quality of soil, sediment and groundwater that will be encountered during the project. The characterization will be primarily used to assess disposal options for materials that are displaced by the project construction.

Initial investigation of the two new gravity outfall alignments was carried out in 2015, as part of the preliminary design phase, and a Preliminary Geo-Environmental Assessment Report (PGEAR) was prepared summarizing the results of the investigation completed in December 2015. The scope of the Geo-Environmental Assessment, which was outlined in our 19 November 2016 Technical Memorandum[1], is to summarize the results of the geo-environmental assessment carried out in relation to the final preferred alignment referred to as Option 6 Outfall Alignment as follows:

- The interpreted generalized descriptions of the soil, groundwater, and sediment conditions that underlie the proposed Option 6 Outfall Alignment extending from the effluent to outfall shafts and the outfall shaft to riser shaft.
- Laboratory testing results of soil, groundwater and sediment samples collected for environmental analyses.
- Interpretation of the results.

An evaluation for the soil and the groundwater conditions underlying the Option 6 Outfall Alignment are summarized in the Geotechnical Interpretive Report (GIR) under a separate cover. Elements of the interpretation of subsurface conditions have been obtained from the GIR, and are reproduced herein.

[1] Golder Associates Ltd. *Supplementary Geotechnical and Environmental Investigation, Annacis Island WWTP Transient Mitigation and outfall, Delta BC*, prepared for CDM Smith, dated 16 November 2016.

Summary of the Geo-Environmental Assessment

The results of the Geo-Environmental Assessment of the Site, which was focused on the Option 6 Outfall Alignment including the in-river diffuser and riser shaft area, identified the following:

- The area of Annacis Island has been relatively recently developed, with initial fill placement and industrial development occurring in the last half of the 20th Century.
- The area of the Site is within a zone identified as containing landfilling, and is also in an area of dredged fill placement.
- The Site (landward portion) is also currently within an industrially-developed area. Environmental database records indicate that certain properties in the area handle a variety of chemicals, and that some releases of chemicals has occurred.
- The groundwater table generally occurs at or near the peat zone (approximately 3 to 5 metres below ground surface).
- The general stratigraphy encountered in the on-land area consisted of the following:
  - Surficial fill (typically sand; 2 metres (m) to 3 m in thickness), overlying.
  - Organic silt to clayey silt (varying from 0.5 m to 3 m in thickness), overlying.
  - Fraser River sands (thick sequence of sands, with thinly bedded sandy silts and clayey silts), overlying.
  - Deeper marine sediments (clayey silt to silty clay, gravel to sandy gravel), overlying.
  - Glacial deposits.

  The subsurface conditions in the offshore area are same as those encountered in the on-land area excluding the upper fill and the organic silt.
- As the construction work is scheduled to occur after 1 November 2017, soil, sediment and groundwater analytical results were compared to the Stage 10 Amendments to the Contaminated Sites Regulation (CSR).
- Soil samples collected and analysed from the nearshore area (SH16-06) and the Riser Shaft (BH16-08) showed exceedances above the applicable CSR industrial landuse (IL) standards for Chloride. No exceedances were found in the samples analyzed for PAHs, phenols, dioxins, furans, PCBs and pesticides. No significant volatile organic vapour readings from the soil were noted during soil sampling.

Groundwater samples collected from monitoring wells SH16-05S, showed exceedances above the applicable CSR drinking water (DW) standards for cobalt. Groundwater sample collected from the monitoring well SH16-05M, showed exceedances above the applicable CSR DW and aquatic life fresh and marine (AW-F/M) standards, for sodium. The two groundwater samples (including the duplicate) collected from the monitoring well SH16-06M, showed marginal exceedances for chloroform above the applicable CSR (DW and AW-F/M) standards. No exceedances above the applicable CSR standards were detected for phenols or PCBs. In addition, the groundwater sample collected from the monitoring well EW15-01, near the effluent shaft, drilled and installed as

part of the Preliminary Geo-Environmental Assessment carried out in 2015, showed marginal PAHs exceedances above the applicable CSR (DW) Standards. Groundwater samples tested during the geotechnical investigations have a salinity within the range of 0.015 to 0.060 percent. Fresh water has less than 0.05 percent salinity. Mixohaline (brackish) water has less than 0.030 percent salinity. Groundwater at tunnel depth ranges from fresh to slightly brackish.

- Surficial sediment samples collected from the area where the future in-river diffuser will be constructed, did not exhibit evidence of significant staining, odours or debris. Results of preliminary chemical analyses identified only one sample (SDS-8) with polycyclic aromatic hydrocarbon (PAHs) exceedances for acenaphthylene, benzo(a)anthracene, and benzo(a)pyrene above both CSR and CCME applicable standards. No exceedances for Metals, phenols or pesticides were found on the sediment samples collected and analyzed by the laboratory.

Discussion

On-Shore

The geo-environmental conditions along the proposed Option 6 Outfall Alignment were assessed, on a preliminary basis, using relatively widely-spaced investigation locations. The observations of soil conditions in boreholes drilled along the proposed alignment did not identify obvious indicators of significant contamination (i.e., no obvious staining, no identified odours, and limited debris in fill). Chloride was detected at concentrations exceeding CSR standards in soils samples collected from the on shore area. Activities in this area, and in particular along this linear alignment, could result in isolated areas of contamination that may not be detected using such widely-spaced locations. Therefore, while only chloride contamination has been detected, there remains some risk of encountering other contamination during construction. The presence of chloride in the soil may restrict disposal options to permitted disposal facilities.

With respect to groundwater, minor dissolved metals, Polycyclic Aromatic Hydrocarbons (PAHs), and Volatile Organic Compounds (VOCs) concentrations were detected and they exceeded the applicable standards, but the concentrations detected were not considered indicative of significant groundwater contamination. Water discharge considerations (and permitting and/or treatment) would also have to be assessed, if dewatering was to be needed.

Off-Shore

Sediment conditions in the area of construction of the future in-river diffuser, were only initially assessed to evaluate the general chemistry of the surficial sediments in this area, and that might be disturbed and considered for disposal as part of outfall construction.

The sediment sampling was also targeted to a relatively shallow depth of sediment below mud-line, and limited deeper samples were recovered as part of the geotechnical drilling carried out (BH16-08) within the Fraser River.

PAHs exceedances for both, CSR and CCME applicable standards, were detected in one of the samples collected within the proposed in-river diffuser construction area. While these concentrations were not substantially above guideline values, and they are usually associated with the industrial activities on the lower Fraser River, they could

have an influence on the possible disposal options for sediments removed during construction. Depending on the intended disposal method (assuming sediments are to be disturbed and removed), additional sampling and analyses may be required to characterize the sediment for the purposes of such disposal, On-land (landfill) or off-shore (ocean dumping) disposal options have their own requirements with respect to characterization. In addition, depending on the anticipated scope of excavation (areal extent, depth), it would also be prudent to collect and analyse representative samples from the entire zone of intended excavation, so that a clearer representation of the actual sediment conditions is obtained.

Study Limitations

This report (the "Report") was prepared for the exclusive use of CDM Smith for the express purpose of providing advice with respect to the environmental condition of the Site. In evaluating the site, Golder Associates Ltd. has relied in good faith on information provided by others as noted in the Report. We have assumed that the information provided is factual and accurate. We accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the sole responsibility of the third parties. If a third party require reliance on this Report, written authorization from Golder is required. Golder disclaims responsibility of consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

The scope and the period of Golder's assessment are described in this Report, and are subject to restrictions, assumptions and limitations. Except as noted herein, the work was conducted in accordance with the scope of work and terms and conditions within Golder's proposal. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report. Conditions may therefore exist which were not detected given the limited nature of the assessment Golder was retained to undertake with respect to the Site and additional environmental studies and actions may be required. In addition, it is recognized that the passage of time affects the information provided in the Report. Golder's opinions are based upon information considered at the time of the writing of the Report. It is understood that the services provided for in the scope of work allowed Golder to form no more than an opinion of the actual conditions at the Site at the time the site was visited, and cannot be used to assess the effect of any subsequent changes in any laws, regulations, the environmental quality of the Site or its surroundings.

The results of an assessment of this nature should in no way be construed as a warranty that the Site is free from any and all contamination from past or current practices.

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APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by CDM Smith Canada ULC (CDM Smith) to provide geotechnical, environmental, geo-environmental and archaeological services for the Annacis Island Wastewater Treatment Plant (AIWWTP) outfall and transient mitigation system from pre-design (Phase A), to detailed design (Phase B) and through to construction (Phase C).

The AIWWTP provides secondary treatment of wastewater to 14 Municipalities in the Lower Mainland and is located on Annacis Island at 1299 Derwent Way, Delta, BC (refer to Figure 1 – Key Plan). The AIWWTP is currently being expanded to increase the secondary treatment capacity and a new outfall is required to augment or replace the existing outfall facilities.

Initial investigations were carried out along the proposed conceptual outfall alignments referred to as western and central alignments and a Preliminary Geo-Environmental Assessment Report (PGEAR) was prepared in 2015 summarizing the results of the initial investigations. Subsequently, the Option 6 Outfall alignment located some 200 m west of the existing outfall was selected as the preferred final alignment to allow the riser pipe and diffuser system to be located within the river channel where potential impact due to sedimentation is expected to be minimal.

2.0 SITE CONDITIONS AND PROPOSED EXPANSION

The Annacis Island Wastewater Treatment Plant (AIWWTP) provides secondary treatment of wastewater to a significant number of residents in Metro Vancouver and is located on Annacis Island at 1299 Derwent Way, Delta, BC (See Figure 1). The AIWWTP is currently being expanded to increase the secondary treatment capacity and a new outfall is required to augment or replace the existing outfall facilities. The conceptual design recommended two new proposed gravity outfall options following central and western alignments, as shown on Figure 2, to increase the capacity.

A single outfall located about 200 m west of the existing outfall referred to as the Option 6 Outfall Alignment is selected as the preferred alignment. The proposed alignment traverses underneath the nearby buildings to allow the riser pipe and diffuser system to be located within the river channel where potential impact due to sedimentation is expected to be minimal. The Option 6 outfall alignment is also shown on Figure 2.

The outfall segment from the outfall shaft to the riser shaft as well as a segment of the effluent conduit leading to the effluent shaft from the outfall shaft, which are together referred to herein as outfall corridor would be tunnelled. A new level control gate structure, near the existing Amil Gate would also be constructed as part of the new outfall system. A riser shaft and a discharge pipe system with a length of about approximately 300 m would be installed close to the navigational channel within the river to discharge the effluent. The discharge pipe system would be installed below mudline by dredging to the proposed grade.

Based on the available design information, the construction of the new outfall, including its components, will involve excavation of considerable volumes of soil and sediment. The anticipated volumes are estimated at:

- In-river diffuser: approximately 45,000 cubic metres of sediment.
- Shaft sites (2): approximately 7,900 cubic metres of soil.
- Tunnel: approximately 11,500 cubic metres of soil.
- Property where outfall shaft will be located: none anticipated.

This alignment and layout represents a significant departure from the alignment originally investigated as part of the 2015 Preliminary Geo-Environmental Assessment. Consequently, an additional investigation was carried out focusing on the following components

- **Riser Shaft:** Located within the Fraser River, will connect the tunnel to the in-river diffuser.
- **Outfall Shaft:** Sixteen (16) metre diameter shaft located within a private property to the south of the AIWWTP property. Shaft will connect to the tunnel, located approximately 30 metres below ground surface, and to two other shaft sites.
- **Effluent Shaft:** Nine (9) metre diameter shaft located on the AIWWTP property and to the northeast of the Outfall Shaft. The Effluent Shaft will also connect to the underground tunnel, located approximately 30 metres below ground surface.
- **Investigatory Borehole(s)**: Located between the Outfall Shaft and the Fraser River, drilled to the depth of the tunnel (approximately 30 metres below ground surface), to investigate subsurface conditions along the tunnel alignment.

The current investigation includes a limited geo-environmental investigation at the potential future shaft location associated with the conveyance system from the Stage V expansion of the treatment plant to the proposed outfall and the results of the investigation are presented in a separate report.

2.1 Study Objectives and Scope of Work

The construction of the new outfall, including its components, will involve excavation of considerable volumes of soil and sediment. The main objective of the Geo-Environmental Assessment was to charachterize the quality of soil, sediment and groundwater that will be encountered during the project. The characterization will be primarily used to assess disposal options for materials that are displaced by the project construction.

The scope of this Geo-Environmental Assessment Report is to summarize the geo-environmental assessment results obtained as part of the work recently conducted at the site, including:

- The interpreted generalized descriptions of the soil, groundwater, and sediment conditions that underlie the proposed new Option 6 Outfall Alignment.
- Laboratory testing results of soil, groundwater and sediment samples collected for environmental analysis.
- Interpretation of the results.

3.0 GENERAL RESULTS OF RECENT GEOTECHNICAL INVESTIGATION

General surficial geological information for the area of the Site is available from the Geological Survey of Canada (Surficial Geology Map GSC No. 1484A, dated 1980). This map was referenced as part of the recent geotechnical assessment program, and a portion of this map, together with the proposed outfall alignments, is shown on Figure 3. This map shows that the Site is located within the Fraser River Estuary, with surficial soils largely comprising Fraser River Sediments and Quaternary fills.

Golder has carried out geotechnical investigations in four different phases with the first three phase focusing on the various conceptual alignments and the last phase focusing on the preferred final alignment (i.e., Option 6 outfall alignment).

The Phase I investigation was conducted between 2 July 2015 and 17 July 2015, and consisted of four mud-rotary boreholes, two Cone Penetration Tests (CPTs), and one Seismic CPT (SCPT). The Phase II Investigation comprised both offshore and on-land investigations which were carried out between 16 September 2015 and 13 October 2015. The offshore investigation consisted of four mud-rotary boreholes paired with CPTs and the on-land investigation consisted of two mud-rotary boreholes paired with CPTs. The Phase III investigation comprised on-land geotechnical and hydrogeological investigations along the western outfall and the future conveyance alignment corridors. It was conducted between 20 March 2016 and 29 May 2016, and included five mud-rotary boreholes, four sonic boreholes, three auger holes and five SCPTs.

The Phase IV investigation, along the Option 6 Outfall Alignment, was carried out between 21 November 2016 and 19 December 2016, and consisted of three mud-rotary boreholes, three sonic holes, and 5 SCPTs. The results of this geotechnical investigation are documented in a separate report.

The geo-environmental investigation was carried out as part of the Phase IV investigation and was intended to provide chemistry data with respect to the soil, groundwater, and sediment that may be encountered and/or excavated as part of the construction work. However, due to the nature of the construction anticipated, it will not be possible to sample each area in detail, but efforts were made to obtain a sufficient number of representative samples so as to infer conditions along the shaft and tunnel alignments, and within potential dredging areas. Furthermore, soil sampling was conducted as part of the geotechnical investigation program, on locations SH16-05 (Outfall Shaft); SH16-06 (Nearshore Borehole); BH16-08 (Riser Shaft); AH17-01 (Effluent Shaft), and SH16-07(potential future shaft location as noted previously).

Observations made during the geotechnical investigation program, potentially relevant to interpretation of geo-environmental conditions, were as follows:

- The general stratigraphy encountered in the on-land area consisted of the following:
  - Surficial fill (typically sand; 2 metres (m) to 3 m in thickness), overlying.
  - Organic silt to clayey silt (varying from 0.5 m to 3 m in thickness), overlying.
  - Fraser River sands (thick sequence of sands, with thinly bedded sandy silts and clayey silts), overlying.
  - Deeper marine sediments (clayey silt to silty clay, gravel to sandy gravel), overlying.
  - Glacial deposits.

The subsurface conditions in the offshore area are same as those encountered in the on-land area excluding the upper fill and the organic silt.

- The natural groundwater level at the site is expected to vary with the water level in the river, change in season, snowmelt and amount of precipitation. Based on the information collected from the drilling program, between 2 July 2015 and 13 October 2015, 20 March 2016 and 29 May 2016, and between 21 November 2016 and 19 December 2016, as well as from monitoring of the monitoring wells installed across the site, the groundwater levels on land vary between Elevations 100 m and 101 m relative to the CVD28-GVRD datum.

3.1 Initial Geo-Environmental Review

The initial geo-environmental information review consisted of the acquisition and assessment of readily-available environmental information from a limited number of sources, to assess, on a preliminary basis, the environmental conditions in the area of the Site and proposed investigation. The initial assessment involved:

- Review of published surficial geological mapping of the area;
- Review of historical aerial photographs; and
- Review of environmental information contained in publicly-accessible environmental databases.

3.1.1 Published Surficial Geology

The surficial geology in the area of the Site is illustrated in the Geological Survey of Canada's Surficial Geology Map (GSC No. 1484 A, 1980; refer to Figure 3-1). Based on the information contained on this map, the Site is located on an island within the Fraser River and is generally underlain by Fraser River Sediments (deltaic and distributary channel fill sediments overlying and cutting estuarine sediments and overlain, in part of the mapped area, by overbank sediments. The other important feature noted on the map is that much of the central, southern and western areas of the island have identified landfilling areas.

3.1.2 Historical Aerial Photographs

Historical aerial photographs were obtained and reviewed as part of the initial geo-environmental assessment. Aerial photographs for the Site and surrounding area were obtained from the University of British Columbia's Geographical Information Centre, and were available for selected years, from 1947 to 2009.

Based on the historical aerial photograph review, the following was noted:

- Much of Annacis Island was either undeveloped or historically used for agricultural land use, for most of the first half of the 20th Century.
- Initial development on Annacis Island started in the mid to late 20th Century, and progressed from east to west.

- Commencement of preload (dredged fill) placement in the area of the Site was observed in the 1963 aerial photographs, and by 1974, most of the Site area had been preloaded.
- Construction of the Annacis Island Waste Water Treatment Plant was observed in the latter half of the 20th Century (~1970s +/-).
- By 1986, industrial development of Annacis Island was clearly visible, and expanding, from east to west.
- By 1991, the landward area at and surrounding the Site had been developed with warehouse-type facilities, and the treatment plant had also undergone a series of upgrades and expansions up to that time.

3.1.3 Environmental Databases

Golder contracted EcoLog ERIS to search available federal, provincial, and private-sector environmental databases for the Site and within 250 m from the centre of the Site. The complete database report is included in Appendix G, including a separate listing for entries contained within the provincial Site Registry database. Findings of the EcoLog ERIS report are summarized below:

- A number of entries in the environmental databased researched were identified in relatively close proximity to the Site and/or the area where potential trench excavation is likely to occur. In particular, the following entries were considered of relevance to the conditions at or near the trench area:
  - 1365 Derwent Way (ACME Strapping / Samuel Strapping) – use of solvents, metal working operations, industrial machinery, equipment supplies.
  - 1385 Derwent Way (no identification – Greater Vancouver Sewerage and Drainage District (GVS&DD)) – pole storage yard.
  - 508 Eaton Place (Lockheed Haggerty Engineering) – equipment manufacturing, machinery.
  - 1299 Derwent Way (AIWWTP) – wastewater treatment plant, chloroform, effluent discharges, exceedances of permitted limits.
  - 1279 Derwent Way (Magnacharge Battery Corporation) – batteries, acids, electrical wiring, motor vehicle parts.
- Under the Site Registry database (BC Ministry of Environment), the following properties are listed that are considered to be in close proximity to the Site:
  - 1279 Derwent Way (Magnacharge Battery) – Site ID 320 – remediation completion report submitted. Contamination associated with releases from batteries.
  - 1385 Derwent Way (AIWWTP) – Site ID 340 – site investigation report submitted. Contamination associated with treated pole storage, and other features.

4.0 SEDIMENT SAMPLING SUMMARY

In order to construct the two in-river components planned as part of the new Option 6 Outfall Alignment (Riser Shaft and in-River Diffuser), removal and handling of dredged sediment will be required.

The proposed dredge pocket where the in-river diffuser will be constructed, it's an approximate rectangular prism in shape and will be located below the high-tide line in the lower Fraser River, adjacent to the navigational channel (St. Mungo's Bend) to the south of Annacis Island, Delta, BC (Figure 2). The location is downstream of the existing AIWWTP outfall and within the potential influence of the salt wedge as it migrates upstream from the mouth under seasonal low flow conditions.

In December 2016, Golder drilled a mud-rotary borehole (BH16-08) at the proposed riser shaft location in the middle of the proposed dredge pocket. In addition, in March 2017, Golder collected several surficial sediment samples using a Van Veen sampler, from the proposed dredge pocket where the in-river diffuser will be constructed (SDS-1 to SDS-17). Sediment sampling locations are shown on Figure 2.

Observations made during the sediment sampling program, potentially relevant to interpretation of geo-environmental conditions, were as follows:

- Though the sample yield was low at depths down to approximately 6 to 7 meters below mudline (bml), borehole log data for BH16-08 indicated the riverbed comprised of sands of varying texture for approximately 5.5 bml. The sands were very loose near the surface but became more compact with depth.
- Below 5.5 m, the Fraser River Sand deposit continued to increase in relative density with depth, with trace amounts of silt.
- Materials recovered at depths greater than or equal to 25 m bml the sand layer was underlain by a marine deposit mostly comprised of silty clay material.

The surficial sediment material retrieved from the samplers generally consisted of the following:

- Grey to dark grey fine to medium SAND, with a trace of silt, gravel and organics.

5.0 GEO-ENVIRONMENTAL INVESTIGATION

The scope of work, methods and results of the geo-environmental investigation are summarized in this section. For the purposes of this geo-environmental Investigation, the "Site" is considered to be the northern portion of the project area, where the Option 6 Outfall Alignment tunnels will be excavated, as well as the area in the Fraser River, where the new in-river diffuser will be constructed and shallow sediment conditions were assessed.

The assessment of geo-environmental conditions involved the following elements:

- The monitoring of the drilling works of the four onshore (4) boreholes along the proposed Option 6 Outfall Alignment, Outfall Shaft (SH16-05), Effluent Shaft (AH17-01) and SH16-06.
- The monitoring of the drilling works in the Fraser River of the Riser Shaft (BH16-08) and the collection of representative shallow sediment samples (SDS-1 to SDS-17) for chemical analysis, where the new in-river diffuser will be constructed.

- The collection and submission of representative soil and groundwater samples from the boreholes and installed monitoring wells, for selected chemical analyses:
  - SH16-05 (Outfall Shaft), 11 soil samples were collected from depths of between 0.3 m and 32.0 metres and analyzed for metals (11 samples), PAHs (11 samples), phenols (8 samples), dixons and furans (5 samples) and PCBs (7 samples).
  - AH17-01 (Effluent Shaft), 8 soil samples were collected from depths of between 0.3 m and 14.9 metres and analyzed for metals (8 samples), PAHs (7 samples), phenols (4 samples), and PCBs (4 samples).
  - SH16-06 (Option 6 Outfall Alignment), 3 soil samples were collected from depths of between 30.5 m and 34.1 metres and analyzed for metals (3 samples), PAHs (2 samples), phenols (2 samples), dixons and furans (1 samples) and PCBs (2 samples).
  - BH16-08 (Riser Shaft), 4 soil samples were collected from depths of between 7.6 m and 21.9 metres and analyzed for metals (3 samples), PAHs (3 samples), phenols (4 samples), dixons and furans (2 samples) PCBs (1 samples) and pesticides (1 sample).
  - SH16-05S (Outfall Shaft), one groundwater samples collected from a depth of 8.0 to 10.7 metres and analyzed for metals, PAHs, VOCs, phenols and PCBs.
  - SH16-05M (Outfall Shaft), one groundwater samples collected from a depth of 30.8 to 33.5 metres and analyzed for metals, PAHs, VOCs, phenolss and PCBs.
  - SH16-06S (Option 6 Outfall Allingment), one groundwater samples collected from a depth of 8.0 to 10.7 metres and analyzed for metals, PAHs, VOCs, phenols and PCBs.
  - SH16-06S (Option 6 Outfall Allingment), one groundwater samples collected from a depth of 30.8 to 33.5 metres and analyzed for metals, PAHs, VOCs, phenols and PCBs.

ALS Laboratories (ALS) of Burnaby, British Columbia was selected as the analytical laboratory for this assessment program. ALS is a professional environmental testing laboratory, and is appropriately certified by the Canadian Association for Laboratory Accreditation for the analyses considered for this assessment program.

5.1 Regulatory Framework

In British Columbia, environmental matters pertaining to contaminated sites generally fall under the jurisdiction of BC MoE, pursuant to the *Environmental Management Act* (EMA, SBC 2003, Chapter 53 assessed 23 October 2003, as amended on 30 October 2017). The two key regulations under the EMA that relate to the assessment and remediation of contaminated sites are the Contaminated Sites Regulation (CSR; BC Reg. 375/96, O.C. 1480/96 and M271/2004, as updated [includes amendments up to BC Reg. 253/2016, updated to 1 November 2017]), and the Hazardous Waste Regulation (HWR; BC Reg. 63/88, O.C. 268/88, as updated [includes amendments up to BC Reg. 243/2016, updated to 1 November 2017]).

The CSR provides numerical standards for the evaluation of soil, groundwater, soil and sediments quality that were selected to assess environmental quality for the Site. While the standards are designed to identify contaminated sites or confirm adequate remediation they are also used for classifying soil, sediment and groundwater for disposal by landfill operators, etc.

BC MoE issued draft Stage 10 Amendments to the Contaminated Sites Regulation on 27 October 2016. The changes, which will include updated soil, water and vapour standards, will come into effect on 1 November 2017. As the construction work will likely occur after 1 November 2017, analytical results have been compared to the draft CSR Stage 10 Amendment standards.

For federal lands, the Canadian Council of Ministers of the Environment (CCME) has defined Environmental Quality Guidelines (EQGs) for soil, sediment, surface water and air to assess potential chemical impacts. These guidelines are presented in a CCME compendium document titled, “Canadian Environmental Quality Guidelines” (CCME 1999, last major revision 2008). CCME guidelines may be relevant if soil or sediment disposal on federally reulated property is considered.

The following sub-sections outline the federal and provincial standards / guidelines considered relevant to this study.

5.1.1 Provincial Standards

The standards listed in the CSR and HWR provide numerical concentrations for the evaluation of soil, groundwater, soil vapour and sediment quality, and the identification of remediation requirements. The following subsections present a general summary of these provincial standards.

5.1.1.1 Soil

The CSR soil[2] standards are divided into eight categories based on land use, including: natural wild lands (WL_N), reverted wildlands (WL_R), agricultural (AL), urban park (PL), low density residential (RL_{LD}), high density residential (RL_{HD}), commercial (CL) and industrial (IL) land uses. The standards are further subdivided into matrix numerical standards (Schedule 3.1 Part 1) generic numerical soil standards to protect human health (Schedule 3.1 Part 2) and generic numerical soil standards to protect ecological health (Schedule 3.1 Part 3). For the matrix numerical standards, these standards are linked to site-specific factors associated with the protection of human health and the environment.

The site-specific factors associated with the protection of human health include:

- Intake of contaminated soil.
- Groundwater used for drinking water.

[2] Note that the definition of “soil” under the Environmental Management Act and CSR is as follows: “soil” includes: (a) unconsolidated mineral or organic material, (b) rock, (c) fill, and (d) sediment deposited on land.

The site-specific factors associated with environmental protection include:

- Toxicity to soil invertebrates and plants.
- Livestock ingesting soil and fodder.
- Major microbial functional impairment.
- Groundwater flow to surface water used by aquatic life.
- Groundwater used for livestock watering.
- Groundwater used for irrigation.

The applicability of any particular standard is dependent upon the use of the subject site, now or in the future, the land use at or near the site, and the groundwater and/or surface water use at or near the site. If a particular site-specific factor is determined to be not applicable to a particular site, the standard associated with that site-specific factor may be disregarded. However, there are two site-specific factors that apply at all sites: intake of contaminated soil, and toxicity to soil invertebrates and plants.

Based on the location of the Site, the land use and zoning in the surrounding area, the inferred future use of the land and the inferred groundwater use and conditions in the area of the Site, the following standards were considered applicable for soil:

- Land Use standard:
  - Industrial Land Use (IL) – based on current and anticipated future use (waste water treatment plants are defined as Industrial Land Use under the CSR, and most of the new option 6 alignment outfall and associated structures, are located either within the AIWWTP property, or the industrial zoned area of Annacis Island).
- Site-Specific Factors:
  - Intake of Contaminated Soil (I: applicable to all sites).
  - Toxicity to Soil Invertebrates and Plants (T: applicable to all sites).
  - Protection of Drinking Water (DW: based on MoE guidance, and currently insufficient information to discount this use).
  - Protection of Aquatic Life (AW: both freshwater (F) and marine (M) standards referenced, as the extent of the saline wedge intrusion at this point in the river is unclear).

Irrigation water use (IW) and livestock watering use (LW) were discounted, based on known and observed conditions in the area of the Site.

5.1.1.2 Water

Generic Numerical Water Standards are divided into four categories: Aquatic Life (AW), Irrigation (IW), Livestock Watering (LW) and Drinking Water (DW). The Aquatic Life standards are also sub-divided into two categories: standards for the protection of freshwater aquatic life and standards for the protection of marine aquatic life. The Generic Numerical Water Standards are presented in Schedule 3.2 of the CSR.

As with the soil standards, the applicability of any particular standard is dependent upon the use of the water (surface water, groundwater) at the subject site or on adjacent sites, now or in the future. If a particular use is determined to be not applicable to a particular site, the standard associated with that use may be disregarded.

Water use standards referenced were consistent with those for the soil standards (i.e., DW and AW-F and AW-M were considered relevant).

5.1.1.3 Sediment

Generic Numerical Sediment Criteria are presented in Schedule 3.4 of the CSR. These standards are divided into freshwater and marine and estuarine standards, and are sub-divided, based on environment classification (either sensitive or typical).

Sediment is defined in the Environmental Management Act and CSR as particulate material that usually lies below water. Therefore, shallow particulate matter collected from beneath the Fraser River would be considered sediment, under this definition.

For sediment, the current CSR standards are divided into two general groups – freshwater sediment and marine and estuarine sediment. The Site is located within a river estuary, and it is known that the saline wedge within the river system is capable of migrating to a point in close proximity to the Site. Therefore, for the purposes of sediment evaluation, both the marine and estuarine standards and freshwater standards were referenced, for sensitive environments.

We note that sediment deposited on land is considered to meet the definition of “soil” under the Environmental Management Act and CSR.

5.1.1.4 Hazardous Waste Regulation (HWR)

The HWR is the other primary document used to evaluate soil and water quality for transport and disposal. The HWR specifies requirements for the siting, construction, operation, performance, management, maintenance and closure of facilities for the storage, use, treatment and disposal of Hazardous Waste. The regulation outlines testing protocols for Hazardous Waste and provides standards for whether materials should be considered Hazardous Waste.

The HWR provides standards to determine whether a material, based on its chemical composition and/or concentration, would classify the waste as a Hazardous Waste. The HWR also contain standards associated with the composition of leachate from waste materials, and whether the leachate composition would classify the waste as a Hazardous Waste. These leachate quality standards can also be applied to assessment of water quality.

5.1.2 Federal Guidelines

The Site is situated on lands under provincial jurisdiction, and therefore the CSR standards for both soil and groundwater were considered the relevant environmental quality standards for evaluation of soil and groundwater quality at the Site. However, in the case of the Fraser River, this area could also be considered under federal jurisdiction, due to navigable waters and fish-bearing environments and, therefore, federal sediment guidelines were also considered potentially applicable.

The CCME EQG contain a limited set of sediment quality guidelines (CCME SedQG) including chemical concentration guidelines for certain metals, hydrocarbons (in particular, polycyclic aromatic hydrocarbons), and other compounds. The CCME sediment quality guidelines are primarily divided into categories based on water quality/use: freshwater and marine. The guidelines are then subdivided into Interim Sediment Quality Guidelines (ISQG) and Probable Effects Levels (PEL). Consequently, for the evaluation of sediment quality, the CCME EQGs for both marine and freshwater, ISQG and PEL, were also referenced.

Environment and Climate Change Canada manages a permit system to control the disposal of waste and other matters into the ocean. When a substance is loaded onto a barge and released into the marine or estuarine environment, it is likely to be considered disposal at sea. Disposal at sea is prohibited without a permit and is controlled by the Canadian Environmental Protection Act, 1999 (CEPA 1999). Only substances listed in Schedule 5 of CEPA 1999 are eligible for consideration.

5.2 Geo-Environmental Investigation

The results of the geo-environmental investigation conducted at the Site are summarized in the following sections. Appended, following the text of this report, can be found the information related to the investigation work, including the record of borehole logs; groundwater development and sampling forms; and soil, groundwater and sediment analysis results.

5.2.1 Health and Safety

Prior to undertaking the field investigation program, a health and safety plan was developed in conjunction with other fieldwork taking place at the Site. The plan addressed potential health and safety issues that had been identified on the Site, and provided mitigation measures to address those potential risks. It also included the completion of a BC One Call to assess the presence of on-Site utilities. The Health and Safety Plan was implemented throughout the duration of the investigation. Prior to the subsurface investigation, Golder retained Quadra Utility Locating Ltd. to provide utility locating services for the proposed drilling locations, clearing the presence of any potential underground utilities.

5.2.2 Drilling and Monitoring Well Installation

5.2.2.1 Borehole Drilling and Soil Sampling

The geo-environmental investigation was carried out between 21 November 2016 and 19 December 2016 and consisted of three (3) mud-rotary boreholes, (3) two sonic holes, and five (5) SCPTs. From those locations, the two sonic holes (SH16-05 and SH16-06) and one mud-rotary borehole (BH16-08) were selected for the collection of geo-environmental samples. In addition, an auger hole (AH17-01) was drilled on 16 February 2017, in the area where the Effluent Shaft will be constructed, for the collection of representative geo-environmental samples. Figure 2 shows the locations of test holes.

The mud-rotary boreholes (BHs) and sonic holes (SHs) were put down using track and truck-mounted drilling equipment, while the auger hole (AH) was drilled using a solid stem auger. Both rigs were supplied and operated by Mud Bay Drilling Co. Ltd. (Mud Bay). The upper 2 to 3 m of the sonic holes were daylighed by Badger Daylighting Ltd to clear for potential underground services.

Soil samples within the daylighted portion of the holes were collected using a long-handled angled shovel (or “spoon”), from deepest to shallowest locations by scraping against the sidewall of the holes. Soil samples were also collected below the daylighted portion of the sonic holes with a double-cased system using an inner core barrel and a larger override casing. A split-spoon sampler was used to collect soil samples form the mud rotary hole. For the auger holes soil samples were collected directly from thhe soild stem auger flights. The inner core barrel, split spoon and auger flights were decontaminated between uses.

As the boreholes were advanced, discrete soil samples were collected at regular depth intervals from the sonic soil cores and the solid-stem auger flights. The samples were logged in the field by Golder personnel who recorded the subsurface soil conditions and evidence of contamination in field notes.

The soils encountered were visually assessed for the presence of indicators of contamination (i.e., staining, odours, debris), and were also described with respect to composition, in accordance with Golder’s soil description protocol. Record of Borehole Logs, detailing the soil conditions encountered, sampling intervals and monitoring well construction details, are presented in Appendix A.

Representative soil samples were collected and placed by hand in clean, 125 millilitre (mL) laboratory supplied sample jars. Upon filling, each jar was sealed, appropriately labelled, and placed in a cooler with ice packs for shipment to the analytical laboratory. Nitrile gloves were used to transfer the soil sampled to the jars, and a new set of gloves was used for collection of each sample.

5.2.2.2 Monitoring Well Installation

During drilling activities, locations SH16-05, and SH16-06 were completed as nested monitoring wells. Three (3) nested monitoring wells were installed at different depths (Shallow, Medium and Deep) at SH16-05 and while two (2) nested monitoring wells (Shallow and Medium) were installed at SH16-06. Monitoring well construction details are included in the borehole logs attached in Appendix A.

Upon completion of drilling, soil description and soil sample collection, the boreholes were backfilled to a depth considered suitable for installation of the groundwater monitoring well. The monitoring wells were constructed of 51 millimetre diameter (2 inch) clean segments of Schedule 40 PVC pipe. Each length of pipe was threaded, such that no glues would be required to assemble the well. The lower 1.5 metres (5 feet) of the well was supplied with

a slotted section of PVC (No. 10 slot), and the remainder of the well was constructed using solid PVC pipe. The annulus between the well pipe and the borehole was filled with clean, silica sand to a depth of approximately 0.3 m above the top of the screened interval. At the top of this sand pack, a seal consisting of hydrated bentonite was placed to approximately 0.6 to 1.2 m below ground surface. The top of each installation was then completed with sand and a steel protective cover that was concreted in-place.

5.2.2.3 Soil Field Screening and Sample Selection

Soil samples collected were visually assessed and screened for the presence of organic vapours using a portable photo-ionization detector (PID), calibrated to 100 parts per million isobutylene gas. Field screening was carried out by the dry headspace method, whereby a plastic headspace bag was filled with a consistent amount of soil (approximately one quarter full). The sample bag was tied, the soil agitated and then let sit for at least 5 minutes before measuring vapours in the headspace above the soil. Soil descriptions and vapour readings are presented on the Record of Borehole Logs contained in Appendix A.

Soil samples were collected either at regular depth intervals and/or within each distinct soil unit encountered. Samples selected for analysis were chosen, based on:

- Evidence of potential contamination (staining, odours, debris).
- Location relative to areas of potential concern.
- Depth of sample.
- Unit in which the sample was collected.
- General coverage of the area of investigation.
- Professional judgment.

All samples were submitted directly to the analytical laboratory, following collection. Chain-of-Custody procedures were followed for all soil sample submissions.

5.2.2.4 Groundwater Sampling and Analyses

Following installation of the groundwater monitoring wells, each monitoring well was first developed, by aggressive pumping, to remove any drilling-induced contamination and to consolidate the sand pack around the well to create an effective filtering medium. Development of each monitoring well continued until the well dried up at least twice, or a minimum of six well volumes were removed and the well water cleared sufficiently.

After development, the monitoring wells were left for a period of approximately one week, to allow recovery of water levels. After this interval, only the shallow (S) and medium (M) monitoring wells were purged, using low flow techniques, and then sampled for selected chemical analyses. Collection of groundwater samples from the deep (D) monitoring wells was not warranted, as they were installed deeper than the cote were the Option 6 Alignment tunnels and related structures will be constructed.

The purging of the monitoring wells involved a low-flow technique using a peristaltic pump set at approximately 0.25 Litres per minute. This low flow technique was utilized to minimize the agitation of the well water, and prevent re-suspension of fine particulate that could affect the analyses. The purged water was monitored using field instruments, during the purging process. The purging ceased once the measured parameters (pH, electrical conductivity, temperature, dissolved oxygen) had stabilized, or the well was observed to be drying up. Upon completion of the purging process, water samples, where possible, were collected from each well. Details of the groundwater development and sampling forms can be found in Appendix B.

The groundwater from each monitoring well was placed directly into laboratory-supplied containers. Where instructed, field preservatives were added to the samples. The only exception was for the samples for dissolved metals analyses that were first passed through a 0.45 micron field filter before being placed in the indicated containers, and addition of the field preservative. Upon collection, each container was sealed, appropriately labeled and placed in a cooler with ice packs for transport to the analytical laboratory.

The groundwater samples were submitted to the analytical laboratory on the same day as they were collected, with the submission accompanied by appropriately-completed Chain-of-Custody forms.

5.2.3 Sediment Sampling and Analysis

For the collection of the surficial sediment samples within the in-River Diffuser area, a standard Van Veen Grab Sampler was used for sediment collection further weighted with four 10 lb metal plates. The additional weight reduced the effect of the current on the Van Veen Grab Sampler and increased the depth of the sediment grab.

As described in the BC Field Sampling Manual (BC MoE 2013a), only those grab samples that met the following acceptability criteria, were retained for analysis:

- The sampler was fully closed and did not contain large rocks or other debris.
- There was an adequate penetration depth (*i.e.,* at least 15 cm to retrieve an undisturbed 10 cm upper horizon).
- The sample was not overfilled or disturbed, and sampler was not deployed on an angle (sediment surface did not touch the top of the sampler, and was relatively flat).
- The sampler was not leaking (there was overlying water present and no visible leaks).

The sediment samples collected that met the applicable criteria described above, were transferred to the soil jars by hand using clean, nitrile gloves, and a new set of nitrile gloves was used for collection of each sediment sample. Upon filling, the sample jars were sealed, appropriately labelled, and then stored in a cooler, with ice packs, for shipment to the laboratory.

The sediment material, upon opening the sampler, was visually logged and assessed for the presence of indicators of contamination (i.e., staining, debris, odours). Soil type and content were documented in the Sediment Sampling Forms, provided in Appendix C.

The sediment material retrieved from the samplers generally consisted of grey to dark grey fine to medium sand, with a trace of silt, gravel and organics. No noticeable or obvious staining or odours were observed in the samples.

5.2.4 Results of Soil, Groundwater and Sediment Chemical Analysis

5.2.4.1 Soil

The results of analyses of soil samples collected from the Site are detailed in the Certificates of Analysis provided by ALS, and that contained in Appendix D. The results of analyses are also summarized on Tables 4 to 9, at the end of this report. This table also contains the current CSR soil standards for industrial (IL) land use, for the site-specific factors identified previously.

Representative soil samples were analyzed for one or more of the following parameters: Anions, metals, polycyclic aromatic hydrocarbons (PAHs), phenols, dioxins, furans, PCBs, and pesticides.

A summary of the soil samples collected during the present Geo-Environmental Assessment which exceeded the applicable CSR IL standards, is provided below in Table 1.

Table 1: Soil samples with concentrations exceeding applicable CSR IL Standards

Location	Parameter	Depth (m bgs)	Most Conservative CSR Standard (µg/g)	Concentration (ug/g)
SH16-06	Chloride	31.7 - 32.0	100 (DW)	299
		32.6 - 32.9		219
		33.8 - 34.1		686
BH16-08	Chloride	7.6 - 8.2	100 (DW)	571
		9.1 - 9.8		724
		18.3 - 18.9		816
		19.8 - 20.4		812

Notes: m bgs = meters below ground surface, µg/g = microgram per gram, G = generic numerical soil standard, DW = drinking water, AW = aquatic life.

As shown in Table 1, no exceedances above the applicable CSR IL standards were detected for PAHs, phenols, dioxins, furans, PCBs, or pesticides.

No volatile organic compound analyses were conducted on the soil samples, as organic vapour readings collected at the time of sampling likely did not indicate the presence of such compounds.

5.2.4.2 Groundwater

Groundwater geochemical parameters were monitored during the purging and sampling of the groundwater monitoring wells. A summary of the hydrogeological and/or hydro-geochemical conditions, as observed during this monitoring, is as follows:

- Depth to groundwater: approximately 2.46 m to 3.25 m below ground surface (mbgs).
- Temperature: 10.8 to 13.5 degrees Celsius.

- pH: 6.84 to 9.04 pH units.
- Electrical Conductivity: 114 to 1,299 microSiemens per centimetre.
- Dissolved Oxygen: 0.04 to 7.17 milligrams per litre.

The results of analyses of groundwater samples collected from the Site are detailed in the Certificates of Analysis provided by ALS, and that contained in Appendix E. The results of analyses are also summarized on Tables 12 to 15, at the end of this report. These tables also contain the current CSR groundwater standards for aquatic life (AW-F: freshwater and AW-M: marine) and drinking water (DW).

Groundwater samples collected were analyzed for one or more of the following parameters: anions, dissolved metals, PAHs, volatile organic compounds (VOCs), phenols, and PCBs.

A summary of the groundwater samples collected during the Geo-Environmental Assessment, which exceeded the applicable CSR standards, is provided below in Table 2.

Table 2: Groundwater samples with concentrations exceeding applicable CSR Standards

Location	Parameter	Most Conservative CSR Standard (ug/L)	Concentration (ug/L)
SH16-05S	Cobalt	1 (DW)	1.72
SH16-05M	Sodium	200,000 (DW)	215,000
	LEPHs	500 (AW-F)	1,900
SH16-06M (FDA)	Chloroform	20 (DW)	31.2
SH16-06M (FD)	Chloroform	20 (DW)	30.6
EW15-01[(a)]	Benzo(a)anthracene	0.07 (DW)	0.15
	Benzo(a)pyrene	0.01 (DW)	0.137
	Benzo(b)fluoranthene	0.07 (DW)	0.129
	Pyrene	0.2 (DW)	0.57

Notes: AW-F = freshwater aquatic life, AW-M = marine aquatic life, DW= drinking water, FDA = field duplicate available, FD = field duplicate, mg/L = milligram per litre. (a) Monitoring well installed and sampled as part of the 2015 Preliminary Geo-Environmental Assessment, where the Effluent Shaft it's planned to be excavated.

As shown in Table 2, no exceedances above the applicable CSR standards were detected for phenols or PCBs.

Note that SH16-05M was resampled August 12, 2017 to confirm December 8, 2016 LEPH results. The December 8, 2016 LEPH results were considered suspect, as SH16-05S, closer to ground surface, had a LEPH concentration at less than detection, which limited how contamination at depth could be present. Sampling notes indicated this well nest was down-gradient of a truck unloading facility and with the heavy rains occurring during sampling, a sheen was observable on run-off water in the vicinity of the well nest. Re-sampling confirmed that the December 8, 2016 result reflected inadvertent cross-contamination. LEPH concentrations measured in on August 12, 2017 are less than detection. LEPHs are no longer considered to be exceeding the CSR standards at well SH16-05M. Both results are presented in Table 13.

5.2.4.3 Sediment

The results of sediment sample analyses are presented in the Certificates of Analysis contained in Appendix F. The results are also summarized in Tables 18 to 20, at the end of this report. On those tables, the current inferred applicable environmental quality standards for marine and estuarine sediment from the British Columbia Ministry of Environment's (BC MoE's) Contaminated Sites Regulation (CSR) are included, for reference, in addition to the Canadian Council of Ministers of the Environment (CCME) Guidelines for Marine and Estuarine Sediment. The CSR standards include those standards for both sensitive and typical sites. The CCME guidelines also include those guidelines related to interim sediment quality guidelines (ISQG) and probable effects levels (PEL).

Sediment samples collected were analyzed for one or more of the following parameters: anions, metals, PAHs, phenols, and pesticides.

A summary of the sediment samples collected during the Geo-Environmental Assessment, which exceeded the applicable CSR and/or CCME standards, is provided below in Table 3.

Table 3: Sediment samples with concentrations exceeding applicable CSR and/or CCME Standards

Location	Parameter	Most Conservative CSR Standard (ug/g)	Most Conservative CCME Standard (ug/g)	Concentration (ug/g)
SDS-8	Acenaphthylene	0.079 (AW-M)	0.00587 (AW-F/M)	0.0076
	Benzo(a)anthracene	0.24 (AW-F)	0.0317 (AW-F)	0.034
	Benzo(a)pyrene	0.47 (AW-M)	0.0319 (AW-F)	0.031

Notes: AW-F = freshwater aquatic life, AW-M = marine aquatic life, ug/g = microgram per gram.

As shown in Table 3, no exceedances above the applicable CSR standards were detected for metals, phenols or pesticides.

5.2.5 Quality Assurance / Quality Control

5.2.5.1 QA/QC Procedures

To document that the sampling and analytical data were interpretable, meaningful and reproducible, conformance to a Golder quality assurance and quality control (QA/QC) program was followed. This involved using QA/QC measures in both the collection (field program) and analysis (laboratory) of samples. The following discussion includes a brief summary of the QA/QC measures implemented by Golder during the field program and during the data review, as well as the QA/QC measures implemented by the analytical laboratory.

The quality assurance (QA) measures used in the collection, preservation and shipment of samples included the following management controls:

- Sampling methods were consistent with established Golder protocols and provincial requirements.
- Field notes were recorded during each stage of the investigation.
- Sample locations were recorded, marked in the field.
- Samples were subsequently transported to the laboratory using Golder chain-of-custody procedures.

The quality control (QC) measures established for the field program included the following technical aspects:

- Submission of field duplicate samples (i.e., paired sample analyses). A field duplicate sample is a second sample of a certain media (e.g., soil, sediment or water) from the same location that is submitted to the analytical laboratory under a separate label such that the laboratory has no prior knowledge that it is a duplicate.
- The relative percent difference (RPD) between paired sample results was used to assess duplicate sample data. The RPD is a measure of the variability between two outcomes from the same procedure or process and is calculated by:

$$RPD(\%) = absolute\left(\frac{(x_1 - x_2)}{average(x_1, x_2)}\right) \times 100$$

  where x_1 is the original sample result and x_2 is the paired analysis result.

- Where the concentration of a given parameter is less than five times the method detection limit (MDL), the laboratory results are considered to be less precise and the RPD is not calculated. For parameters with concentrations less than five times the MDL, the difference factor (DF) between paired analyses results is calculated by:

$$DF = absolute\left(\frac{(x_1 - x_2)}{MDL}\right)$$

  where x_1 is the original sample result and x_2 is the paired analysis result.

Golder's internal data quality objectives (DQOs) for environmental samples are as follows:

- An RPD less than or equal to 35% (or 50% for PAHs) for soil and/or sediment samples submitted for analysis.
- An RPD less than or equal to 20% for groundwater samples submitted for analysis.
- A DF less than or equal to 2.0.

Where the DQO was exceeded, further investigation of the data quality was required. Data not meeting the DQOs were examined on a case-by-case basis.

The following DQOs and criteria were established for the laboratory analytical program:

- The chemical laboratory that was used must have achieved proficiency certification by the Canadian Association for Laboratory Accreditation Inc. (CALA) for the analyses conducted.
- Laboratory paired analyses results should be within laboratory-applied certified values for inorganic elements and organic compounds.

- Analytical recovery results for reference materials or spiked standards should be within laboratory-applied certified values for inorganic elements and organic compounds.
- Analytical blanks should be less than the detection limits used for the specific analysis.
- Each laboratory analytical batch should include at least one analytical blank, one matrix spike and one laboratory duplicate sample.

Reports from the laboratory were reviewed internally prior to submission to Golder. If internal QA/QC problems were encountered, the field samples and internal QA/QC samples were re-analyzed. Data quality issues identified by the laboratory were communicated to Golder at the time of data delivery.

5.2.5.2 QA/QC Results

Three field duplicate samples were collected and analysed for soil samples, one field duplicate was collected and analysed for groundwater, and two field duplicates were collected and analysed for sediment. Duplicate samples represented an analysis rate of 5.2% for soil, 10.5% for sediment and 14.2% for groundwater.

The results of the field duplicate analyses are presented on the QA/QC Tables 10 and 11 (Soils); Tables 16 and 17 (Groundwater); and Table 21 (Sediments), appended at the end of this report.

In summary, the RPD and/or DF values that were calculated as part of the QA/QC program met the DQOs outlined for this assessment, with the following exceptions:

- Antimony for the pair of samples SDS-11 (FDA) and DUP-3 (FD), had an DF value of 2.20, exceeding the DQO.
- Mercury and Molybdenum for the pair of samples SDS-3 (FDA) and DUP-1 (FD), had a RPD value of 111 % and 70 % respectively, exceeding the DQO.

The elevated variability of the parameter listed above is likely attributable to within sample heterogeneity. However, CSR standards and CCME guidelines do not currently exist for antimony and molybdenum, and therefore, the variability of those parameters does not adversely affect the interpretation of the analytical results.

ALS Environmental performed the chemical analyses of the confirmatory soil samples collected during the remediation program. ALS is certified by CALA for the analytical methods used for this program. In general, each ALS sample analysis batch included at least one method blank, one laboratory duplicate and one reference or control sample.

Overall, the results of the QA/QC procedures and analyses indicate that the data is considered suitable for interpretation of environmental conditions.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General Summary

The results of the Geo-Environmental Investigation of the Site identified the following:

- The area of Annacis Island has been relatively recently developed, with initial fill placement and industrial development occurring in the last half of the 20th Century.
- The area of the Site is within a zone identified as containing landfilling, and is also in an area of dredged fill placement.
- The Site (landward portion) is also currently within an industrially-developed area. Environmental database records indicate that certain properties in the area handle a variety of chemicals, and that some releases of chemicals has occurred.
- The groundwater table generally occurs at or near the peat zone (approximately 3 to 5 metres below ground surface).
- The general stratigraphy encountered in the area consisted of the following:
  - Surficial fill (typically sand; 2 metres (m) to 3 m in thickness), overlying.
  - Organic silt to clayey silt (varying from 0.5 m to 3 m in thickness), overlying.
  - Fraser River sands (thick sequence of sands, with thinly bedded sandy silts and clayey silts), overlying.
  - Deeper marine sediments (clayey silt to silty clay, gravel to sandy gravel), overlying.
  - Glacial deposits.
- Some minor debris, but no significant staining or odours, were noted in the surficial fill (sand).
- Soil samples collected and analysed from the nearshore area (SH16-06) and the Riser Shaft (BH16-08) showed exceedances above the applicable CSR industrial landuse (IL) standards for chloride. No exceedances were found in the samples analyzed for PAHs, phenols, dioxins, furans, PCBs and pesticides. No significant volatile organic vapour readings from the soil were noted during soil sampling.
- Groundwater samples collected from monitoring well SH16-05S showed exceedances above the applicable CSR (DW) standards for cobalt. Groundwater sample collected from the monitoring well SH16-05M, showed exceedances above the applicable CSR (DW and AW-F/M) standards for sodium. The two groundwater samples (including the duplicate) collected from the monitoring well SH16-06M, showed marginal exceedances for chloroform above the applicable CSR (DW and AW-F/M) standards. No exceedances above the applicable CSR standards were detected for phenols or PCBs. In addition, the groundwater sample collected from the monitoring well EW15-01, drilled and installed as part of the Preliminary Geo-Environmental Assessment carried out in 2015, showed marginal PAHs exceedances above the applicable CSR (DW) Standards.
- Surficial sediment samples collected from the area where the future in-River Diffuser will be constructed, did not exhibit evidence of significant staining, odours or debris. Results of preliminary chemical analyses identified only one sample (SDS-8) with PAHs exceedances for acenaphthylene, benzo(a)anthracene, and benzo(a)pyrene above both CSR and CCME applicable standards. No exceedances for metals, phenols or pesticides were found on the sediment samples collected and analyzed by the laboratory.

6.2 Discussion

6.2.1 On-Shore

The geo-environmental conditions along the proposed Option 6 Outfall Alignment were assessed using relatively widely-spaced investigation locations. The observations of soil conditions in boreholes drilled along the proposed alignment did not identify obvious indicators of significant contamination (i.e., no obvious staining, no identified odours, and limited debris in fill). However, chloride was measured in soil at concentrations varying from 219 to 816 mg/kg, exceeding the CSR standard of 100 mg/kg. Activities in this area, and in particular along this linear alignment, could result in isolated areas of contamination that may not be detected using such widely-spaced locations. Therefore, while significant contamination has not been detected, there remains some risk of encountering contamination during construction.

With respect to groundwater, minor dissolved metals, PAHs, and VOCs concentrations were detected that exceeded the applicable standards, but the concentrations detected were not considered indicative of significant groundwater contamination. Water discharge considerations (and permitting and/or treatment) would also have to be assessed, if dewatering was to be needed.

6.2.2 Off-Shore

Sediment conditions in the area of construction of the future in-River Diffuser, were only initially assessed to evaluate the general chemistry of the surficial sediments in this area, and that might be disturbed and considered for disposal as part of outfall construction.

The sediment sampling was also targeted to a relatively shallow depth of sediment below mud-line, and limited deeper samples were recovered as part of the geotechnical drilling carried out (BH16-08) within the Fraser River.

PAHs exceedances for both, CSR and CCME applicable standards, were detected in one of the samples collected within the proposed in-River Diffuser construction area. While these concentrations were not substantially above standards or guideline values, and they are usually associated with the industrial activities on the lower Fraser River, they could have an influence on the possible disposal options for sediments removed during construction. Depending on the intended disposal method (assuming sediments are to be disturbed and removed), additional sampling and analyses may be required to characterize the sediment for the purposes of such disposal, On-land (landfill) or off-shore (ocean dumping) disposal options have their own separate requirements with respect to characterization. In addition, depending on the anticipated scope of excavation (areal extent, depth), it would also be prudent to collect and analyse representative samples from the entire zone of intended excavation, so that a clearer representation of the actual sediment conditions is obtained.

7.0 CLOSURE

We trust that this report meets your immediate requirements. If you have any questions regarding the content of this report, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

Alvaro Garrido Hernan-Gomez, Ldo., Eurogeologist
Environmental Geologist

Robert McLenehan, PEng
Principal, Senior Hydrogeologist

AGH/REM/lih

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Supplementary Geo-Environmental Investigation
Table 4 - Results of Soil Analyses - Metals
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05
Sample Name	CSR Standards IL	MCS	02053-09	02053-11	02053-12	03020-01	03020-02	03020-05	03020-06	03020-10	03020-11	03020-12	02042-02	02042-03
Sample Date			16/02/2017	16/02/2017	16/02/2017	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016
Sample Depth			0.3-0.6 m	1.8-2.1 m	1.8-2.1 m	2.4-2.7 m	3-3.3 m	5.5-5.8 m	6.4-6.7 m	11-11.3 m	12.2-12.5 m	12.2-12.5 m	14.9-15.2 m	16.5-16.8 m
Duplicate				FDA	FD						FDA	FD		
Parameter														
Physical Parameters														
pH (pH units)			7.43	7.77	7.75	7.54	6.10	6.51	-	-	6.90	7.22	7.36	-
Moisture (%)			6.13	8.58	8.82	19.8	50.0	18.5	16.5	18.1	16.6	18.1	22.7	19.3
grain size 0.004 - 0.063 mm (Silt)			-	4.5	-	-	-	-	-	-	-	-	-	-
grain size 0.063 - 2 mm (Sand)			-	94.5	-	-	-	-	-	-	-	-	-	-
Sieve - #10 (>2.00mm)			-	< 1.0	-	-	-	-	-	-	-	-	-	-
Sieve - #200 (>0.075mm)			-	-	-	-	-	-	-	96.5	-	-	-	98.6
Texture			-	Sand	-	-	-	-	-	Coarse	-	-	-	Coarse
Saturation			29.2	-	-	-	132	-	31.4	-	32.1	31.9	31.6	-
Clay Content			-	< 1.0	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon			-	-	-	-	-	0.145	-	-	0.074	0.068	0.235	-
Anions and Nutrients														
Bromide (Br)			< 0.50	-	-	< 0.50	-	< 0.50	-	-	-	-	< 0.50	-
Chloride (Cl)	100	DW	6.70	-	-	< 5.0	13.0	8.0	3.28	-	3.00	3.06	2.56	-
Fluoride (F)	750000	HH	2.75	-	-	2.09	-	0.29	-	-	-	-	< 0.20	-
Nitrate (as N)			< 0.050	-	-	0.234	-	< 0.050	-	-	-	-	< 0.050	-
Nitrite (as N)	25000	HH	< 0.010	-	-	< 0.010	-	< 0.010	-	-	-	-	< 0.010	-
Sulfate (SO4)			< 10	-	-	< 10	-	< 10	-	-	-	-	< 10	-
Metals														
Antimony	40	EH	0.22	0.24	0.26	0.22	0.60	0.24	-	-	0.22	0.22	0.36	-
Arsenic	10	AW-F	3.05	3.59	3.89	2.72	6.04	2.69	-	-	1.60	1.51	3.15	-
Barium	350	DW	53.0	79.4	81.8	53.8	148	44.4	-	-	65.4	52.4	94.3	-
Beryllium	1	AW-F	0.19	0.19	0.20	0.18	0.39	0.21	-	-	0.19	0.21	0.27	-
Cadmium	1	AW-F	0.112	0.125	0.155	0.109	0.449	0.128	-	-	0.156	0.155	0.183	-
Chromium	250	T	24.7	23.9	23.8	25.0	42.5	33.8	-	-	32.1	36.7	34.3	-
Cobalt	25	AW-F	7.30	7.69	8.69	6.88	11.8	9.75	-	-	8.20	7.81	10.8	-
Copper	150	AW-M	13.4	14.3	15.7	13.2	36.3	15.9	-	-	15.2	13.8	20.3	-
Lead	800	DW	2.12	2.37	2.53	2.30	12.4	2.52	-	-	2.25	2.22	3.67	-
Mercury	75	T	< 0.050	< 0.050	< 0.050	0.0296	0.0778	0.0259	-	-	0.0200	0.0213	0.0275	-
Molybdenum	15	DW	0.36	0.38	0.40	0.49	1.61	0.25	-	-	0.25	0.24	0.96	-
Nickel	**70**	AW-M	31.2	32.8	36.0	29.8	44.9	43.1	-	-	37.9	36.5	40.5	-
Selenium	1	AW-F	< 0.20	< 0.20	< 0.20	< 0.20	0.55	< 0.20	-	-	< 0.20	< 0.20	0.20	-
Silver	40	EH	< 0.10	< 0.10	< 0.10	< 0.10	0.10	< 0.10	-	-	< 0.10	< 0.10	< 0.10	-
Sodium	1000	T	5.0	-	-	-	11.3	-	3.0	-	4.5	4.7	5.0	-
Thallium	2	AW-F	< 0.050	0.056	0.060	< 0.050	0.155	< 0.050	-	-	< 0.050	< 0.050	0.062	-
Tin	300	EH	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	-	-	< 2.0	< 2.0	< 2.0	-
Uranium	30	DW	0.254	0.311	0.343	0.284	1.08	0.271	-	-	0.286	0.288	0.479	-
Vanadium	100	DW	41.2	33.6	37.0	39.5	48.8	42.7	-	-	49.3	51.1	50.4	-
Zinc	150	AW-F	34.8	36.8	40.5	34.7	60.2	41.5	-	-	38.6	37.6	50.8	-

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

m bgs = metres below ground surface

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).

Land Use abbreviations: IL (Industrial)

MCS = most conservative standard based on applicable site-specific standards

Referenced site-specific factors include: T = Toxicity to Invertebrates and Plants; AW = Groundwater Flow to Surface Water used by Aquatic Life, F = Fresh Water Aquatic Life and M = Marine Aquatic Life; DW = Drinking Water; HH = Human Health; EH = Ecological Health

- = not analyzed

< = less than laboratory reporting limit

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-06	SH16-06	SH16-06	SH16-06	BH16-08	BH16-08	BH16-08	BH16-08	BH16-08	BH16-08
Sample Name			02042-06	02042-07	02042-10	02042-11	02043-03	02043-04	02047-01	02047-02	02047-03	02047-04	02048-01	02048-02	02048-07	02048-08	02048-09	02048-10
Sample Date			23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	26/11/2016	26/11/2016	26/11/2016	26/11/2016	27/12/2016	27/12/2016	27/12/2016	27/12/2016	27/12/2016	27/12/2016
Sample Depth			20.1-20.4 m	21.3-21.6 m	25.3-25.6 m	26.5-26.8 m	30.2-30.5 m	31.7-32 m	30.5-30.8 m	31.7-32 m	32.6-32.9 m	33.8-34.1 m	7.6-8.2 m	9.1-9.8 m	16.8-17.4 m	18.3-18.9 m	19.8-20.4 m	21.3-21.9 m
Duplicate																		
Parameter	CSR Standards IL	MCS																
Physical Parameters																		
pH (pH units)			6.43	-	-	7.05	8.18	8.36	8.82	8.34	-	8.44	8.59	8.41	8.46	8.28	-	8.66
Moisture (%)			23.5	19.6	22.8	23.5	20.9	20.8	15.5	30.5	19.5	19.7	22.1	17.9	20.5	19.1	21.0	18.9
grain size 0.004 - 0.063 mm (Silt)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
grain size 0.063 - 2 mm (Sand)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sieve - #10 (>2.00mm)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sieve - #200 (>0.075mm)			-	-	-	-	-	95.4	-	45.3	-	-	-	-	-	-	-	-
Texture			-	-	-	-	-	Coarse	-	Fine	-	-	-	-	-	-	-	-
Saturation			33.9	-	36.3	-	35.3	34.9	-	35.1	29.7	-	-	29.5	-	26.9	28.0	-
Clay Content			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon			0.125	-	-	0.140	0.23	0.138	-	0.52	0.081	-	0.161	-	0.135	-	-	< 0.064
Anions and Nutrients																		
Bromide (Br)			-	-	-	< 0.50	-	< 0.50	-	-	-	2.21	2.00	-	-	2.75	2.48	-
Chloride (Cl)	100	DW	1.78	-	13.0	34.9	68.2	75.0	-	**299**	**219**	**686**	**571**	**724**	-	**816**	**812**	-
Fluoride (F)	750000	HH	-	-	-	< 0.20	-	< 0.20	-	-	-	< 0.20	< 0.20	-	-	0.47	< 0.20	-
Nitrate (as N)			-	-	-	< 0.050	-	< 0.050	-	-	-	< 0.050	< 0.050	-	-	< 0.050	< 0.050	-
Nitrite (as N)	25000	HH	-	-	-	< 0.010	-	< 0.010	-	-	-	0.013	< 0.010	-	-	0.029	< 0.010	-
Sulfate (SO4)			-	-	-	< 10	-	< 10	-	-	-	60	146	-	-	215	121	-
Metals																		
Antimony	40	EH	0.20	-	-	0.22	0.34	0.26	0.21	-	-	0.23	0.22	-	0.22	-	-	0.26
Arsenic	10	AW-F	1.91	-	-	2.20	2.59	2.18	3.12	-	-	2.27	2.58	-	2.83	-	-	3.11
Barium	350	DW	52.7	-	-	52.4	76.7	48.5	40.8	-	-	65.6	52.9	-	53.1	-	-	44.7
Beryllium	1	AW-F	0.20	-	-	0.20	0.23	0.22	0.18	-	-	0.18	0.20	-	0.19	-	-	0.20
Cadmium	1	AW-F	0.116	-	-	0.095	0.123	0.087	0.065	-	-	0.060	0.073	-	0.240	-	-	0.063
Chromium	250	T	30.4	-	-	29.6	30.9	34.7	25.1	-	-	23.2	29.0	-	23.2	-	-	30.5
Cobalt	25	AW-F	7.81	-	-	7.91	9.31	8.37	7.23	-	-	7.81	7.62	-	7.58	-	-	8.13
Copper	150	AW-M	13.9	-	-	14.3	18.3	15.6	13.8	-	-	16.3	15.1	-	15.3	-	-	17.0
Lead	800	DW	2.11	-	-	2.16	3.06	2.33	2.04	-	-	2.48	2.46	-	2.18	-	-	2.57
Mercury	75	T	0.0158	-	-	0.0191	0.0197	0.0161	0.0186	-	-	0.0175	0.0218	-	0.0189	-	-	0.0157
Molybdenum	15	DW	0.23	-	-	0.27	0.29	0.26	0.24	-	-	0.22	0.38	-	0.37	-	-	0.40
Nickel	**70**	AW-M	32.0	-	-	33.1	35.5	36.0	28.1	-	-	33.0	33.9	-	33.1	-	-	34.3
Selenium	1	AW-F	< 0.20	-	-	< 0.20	< 0.20	< 0.20	< 0.20	-	-	< 0.20	< 0.20	-	< 0.20	-	-	< 0.20
Silver	40	EH	< 0.10	-	-	< 0.10	< 0.10	< 0.10	< 0.10	-	-	< 0.10	< 0.10	-	< 0.10	-	-	< 0.10
Sodium	1000	T	4.1	-	16.4	-	4.1	3.0	-	146	94.2	-	-	424	-	424	400	-
Thallium	2	AW-F	< 0.050	-	-	< 0.050	< 0.050	< 0.050	< 0.050	-	-	< 0.050	< 0.050	-	< 0.050	-	-	< 0.050
Tin	300	EH	< 2.0	-	-	< 2.0	< 2.0	< 2.0	< 2.0	-	-	< 2.0	< 2.0	-	< 2.0	-	-	< 2.0
Uranium	30	DW	0.241	-	-	0.290	0.404	0.255	0.221	-	-	0.236	0.281	-	0.354	-	-	0.271
Vanadium	100	DW	44.3	-	-	47.8	48.1	52.1	46.0	-	-	40.3	43.0	-	41.7	-	-	49.4
Zinc	150	AW-F	37.8	-	-	38.1	43.2	38.3	35.0	-	-	36.0	40.9	-	37.4	-	-	39.8

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

m bgs = metres below ground surface

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).

Land Use abbreviations: IL (Industrial)

MCS = most conservative standard based on applicable site-specific standards

Referenced site-specific factors include: T = Toxicity to Invertebrates and Plants; AW = Groundwater Flow to Surface Water used by Aquatic Life, F = Fresh Water Aquatic Life and M = Marine Aquatic Life; DW = Drinking Water; HH = Human Health; EH = Ecological Health

- = not analyzed

< = less than laboratory reporting limit

Supplementary Geo-Environmental Investigation
Table 4 - Results of Soil Analyses - Metals
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01
Sample Name	CSR Standards IL	MCS	02052-01	02052-03	02052-04	02052-06	02052-07	02052-09	02052-10	02052-12	02053-01	02053-03	02053-04	02053-05
Sample Date			16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017
Sample Depth			0.3-0.6 m	1.8-2.1 m	2.4-2.7 m	4.3-4.6 m	5.2-5.5 m	7.3-7.6 m	8.2-8.5 m	10.4-10.7 m	11.3-11.6 m	12.2-12.5 m	13.4-13.7 m	14.6-14.9 m
Duplicate														
Parameter														
Physical Parameters														
pH (pH units)			9.87	7.88	-	6.60	6.23	7.03	-	7.04	6.91	-	7.24	-
Moisture (%)			10.0	3.82	3.78	23.4	25.1	18.2	23.9	24.1	21.5	26.3	20.2	26.9
grain size 0.004 - 0.063 mm (Silt)			-	2.0	-	48.1	-	6.7	-	-	6.7	-	-	-
grain size 0.063 - 2 mm (Sand)			-	97.4	-	39.3	-	91.8	-	-	92.4	-	-	-
Sieve - #10 (>2.00mm)			-	< 1.0	-	< 1.0	-	< 1.0	-	-	< 1.0	-	-	-
Sieve - #200 (>0.075mm)			-	-	-	-	-	-	-	-	-	-	-	-
Texture			-	Sand	-	Loam	-	Sand	-	-	Sand	-	-	-
Saturation			30.3	-	28.8	-	-	-	38.9	34.2	-	54.2	-	42.7
Clay Content			-	< 1.0	-	12.6	-	1.6	-	-	< 1.0	-	-	-
Total Organic Carbon			-	0.065	-	-	0.785	-	0.598	0.137	-	0.663	-	0.35
Anions and Nutrients														
Bromide (Br)			< 0.50	-	< 0.50	-	-	-	< 0.50	< 0.50	-	< 0.50	-	< 0.50
Chloride (Cl)	100	DW	< 5.0	-	1.59	-	-	-	4.45	3.79	-	13.7	-	5.88
Fluoride (F)	750000	HH	0.37	-	0.39	-	-	-	0.30	0.22	-	0.40	-	0.25
Nitrate (as N)			0.490	-	0.756	-	-	-	< 0.050	< 0.050	-	0.149	-	0.160
Nitrite (as N)	25000	HH	0.061	-	< 0.010	-	-	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010
Sulfate (SO4)			307	-	< 10	-	-	-	< 10	< 10	-	< 10	-	< 10
Metals														
Antimony	40	EH	2.03	0.22	-	0.58	0.59	0.24	-	0.30	0.29	-	0.24	-
Arsenic	10	AW-F	5.64	2.86	-	5.80	6.16	1.94	-	1.83	2.62	-	2.06	-
Barium	350	DW	72.5	50.8	-	156	118	59.5	-	72.8	69.1	-	60.0	-
Beryllium	1	AW-F	0.21	0.18	-	0.43	0.33	0.20	-	0.20	0.21	-	0.21	-
Cadmium	1	AW-F	0.160	0.127	-	0.124	0.399	0.124	-	0.131	0.126	-	0.160	-
Chromium	250	T	31.3	24.0	-	58.8	46.1	27.5	-	27.3	27.6	-	31.2	-
Cobalt	25	AW-F	7.11	7.13	-	16.6	18.9	7.55	-	8.29	12.2	-	7.96	-
Copper	150	AW-M	24.9	13.1	-	38.7	33.7	14.6	-	15.3	16.1	-	14.7	-
Lead	800	DW	15.0	2.20	-	6.43	6.02	2.48	-	2.67	2.70	-	2.42	-
Mercury	75	T	< 0.050	0.098	-	0.062	< 0.050	< 0.050	-	< 0.050	< 0.050	-	< 0.050	-
Molybdenum	15	DW	0.80	0.37	-	1.34	0.80	0.26	-	0.25	0.40	-	0.23	-
Nickel	**70**	AW-M	22.2	28.4	-	55.9	73.0	31.8	-	34.6	44.1	-	34.2	-
Selenium	1	AW-F	< 0.20	< 0.20	-	0.25	0.52	< 0.20	-	< 0.20	< 0.20	-	< 0.20	-
Silver	40	EH	0.12	< 0.10	-	0.13	0.12	< 0.10	-	< 0.10	< 0.10	-	< 0.10	-
Sodium	1000	T	3.5	-	4.7	-	-	-	7.7	6.9	-	7.0	-	8.6
Thallium	2	AW-F	< 0.050	< 0.050	-	0.100	0.119	< 0.050	-	< 0.050	< 0.050	-	0.054	-
Tin	300	EH	2.2	< 2.0	-	< 2.0	< 2.0	< 2.0	-	< 2.0	< 2.0	-	< 2.0	-
Uranium	30	DW	0.465	0.252	-	0.872	0.791	0.294	-	0.335	0.353	-	0.283	-
Vanadium	100	DW	49.4	42.2	-	64.1	50.4	42.2	-	40.6	42.9	-	45.5	-
Zinc	150	AW-F	57.7	34.5	-	63.2	66.6	38.0	-	39.5	42.8	-	37.9	-

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

m bgs = metres below ground surface

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).

Land Use abbreviations: IL (Industrial)

MCS = most conservative standard based on applicable site-specific standards

Referenced site-specific factors include: T = Toxicity to Invertebrates and Plants; AW = Groundwater Flow to Surface Water used by Aquatic Life, F = Fresh Water Aquatic Life and M = Marine Aquatic Life; DW = Drinking Water; HH = Human Health; EH = Ecological Health

- = not analyzed

< = less than laboratory reporting limit

Supplementary Geo-Environmental Investigation
Table 5 - Results of Soil Analyses - PAHs
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-06	SH16-06	BH16-08	BH16-08	BH16-08	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01
Sample Name			02053-09	02053-11	02053-12	03020-01	03020-02	03020-05	03020-11	03020-12	02042-02	02042-06	02042-11	02043-03	02043-04	02047-01	02047-04	02048-01	02048-07	02048-09	02052-01	02052-03	02052-06	02052-09	02052-12	02053-01	02053-05
Sample Date			16/02/2017	16/02/2017	16/02/2017	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	26/11/2016	26/11/2016	27/12/2016	27/12/2016	27/12/2016	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017
Sample Depth	CSR Standards IL	MCS	0.3-0.6 m	1.8-2.1 m	1.8-2.1 m	2.4-2.7 m	3-3.3 m	5.5-5.8 m	12.2-12.5 m	12.2-12.5 m	14.9-15.2 m	20.1-20.4 m	26.5-26.8 m	30.2-30.5 m	31.7-32 m	30.5-30.8 m	33.8-34.1 m	7.6-8.2 m	16.8-17.4 m	19.8-20.4 m	0.3-0.6 m	1.8-2.1 m	4.3-4.6 m	7.3-7.6 m	10.4-10.7 m	11.3-11.6 m	14.6-14.9 m
Duplicate				FDA	FD				FDA	FD																	
Parameter																											
Field																											
PID			< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1	< 0.1	< 0.1	0.3	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons (PAHs)																											
Acenaphthene	15000	HH	< 0.050	< 0.050	< 0.050	< 0.0050	0.0086	< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Acenaphthylene			< 0.050	< 0.050	< 0.050	< 0.0050	0.0212	< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Anthracene	30	T	< 0.050	< 0.050	< 0.050	< 0.0040	0.0332	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(a)anthracene	10	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.075	< 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	0.078	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(a)pyrene	50	I	< 0.050	< 0.050	< 0.050	< 0.010	0.059	< 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	0.083	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(b)fluoranthene	10	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.095	< 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	0.094	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[b,j,k]fluoranthene			-	-	-	< 0.015	0.135	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	-	-	-	-	-	-	-
Benzo(g,h,i)perylene			< 0.050	< 0.050	< 0.050	< 0.010	0.033	< 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	0.087	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(k)fluoranthene	10	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.041	< 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	0.074	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Chrysene	900	HH	< 0.050	< 0.050	< 0.050	< 0.010	0.065	< 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	0.123	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dibenzo(a,h)anthracene	10	EH	< 0.050	< 0.050	< 0.050	< 0.0050	0.0082	< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoranthene	200	T	< 0.050	< 0.050	< 0.050	< 0.010	0.168	< 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	0.206	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluorene	9500	HH	< 0.050	< 0.050	< 0.050	< 0.010	< 0.030	< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Indeno(1,2,3-c,d)pyrene	10	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.040	< 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	0.084	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	20	T	< 0.050	< 0.050	< 0.050	< 0.010	0.016	< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	50	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.090	< 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	0.087	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Pyrene	100	EH	< 0.050	< 0.050	< 0.050	< 0.010	0.142	< 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	0.239	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-methylnaphthalene	950	HH	< 0.050	< 0.050	< 0.050	< 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	< 0.010	< 0.010	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
EPH (C10-C19)			< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	-	-	-	-	-	-	-	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200
LEPH (C10-C19) Less PAHs	2000	HH	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	-	-	-	-	-	-	-	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200
EPH (C19-C32)			< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	-	-	-	-	-	-	-	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200
HEPH (C19-C32) Less PAHs	5000	HH	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	-	-	-	-	-	-	-	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200
Petroleum Hydrocarbons - F2 (C10-C16)			-	-	-	-	-	< 30	< 30	< 30	< 30	185	175	< 30	< 30	271	< 30	-	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons - F3 (C16-C34)			-	-	-	-	-	< 50	< 50	< 50	< 50	84	73	< 50	< 50	105	< 50	-	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons - F4 (C34-C50)			-	-	-	-	-	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	-	-	-	-	-	-	-	-	-	-
Benzo(a)pyrene Total Potency Equivalence (TPE)			-	-	-	< 0.020	0.094	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	-	-	-	-	-	-
Index of Additive Cancer Risk (IACR)			-	-	-	< 0.15	1.32	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	-	-	-	-	-	-	-

Notes:
Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.
m bgs = metres below ground surface
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Standards shown from the *Contaminated Sites Regulation*. ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).
Land Use abbreviations: IL (Industrial)
MCS = most conservative standard based on applicable site-specific standards
Referenced site-specific factors include: T = Toxicity to Invertebrates and Plants; HH = Human Health; EH = Ecological Health
ppm = parts per million
The standard for EPH_{C10-19} is equivalent to LEPHs, and the standard for EPH_{C19-32} is equivalent to HEPHs when no LEPHs or HEPHs analysis is undertaken, and the equivalent standard is indicated by the use of *italics*.
- = not analyzed
< = less than laboratory reporting limit
EPH_{C10-19} = extractable petroleum hydrocarbons, carbon range 10-19
EPH_{C19-32} = extractable petroleum hydrocarbons, carbon range 19-32
LEPH = light extractable petroleum hydrocarbons
HEPH = heavy extractable petroleum hydrocarbons

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-06	SH16-06	BH16-08	BH16-08	BH16-08	BH16-08	AH17-01	AH17-01	AH17-01	AH17-01
Sample Name			02053-09	02053-11	02053-12	03020-02	03020-05	03020-11	03020-12	02042-06	02043-03	02043-04	02047-02	02047-03	02048-02	02048-07	02048-08	02048-10	02052-03	02052-09	02053-01	02053-04
Sample Date	CSR Standards IL	MCS	16/02/2017	16/02/2017	16/02/2017	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	26/11/2016	26/11/2016	27/12/2016	27/12/2016	27/12/2016	27/12/2016	16/02/2017	16/02/2017	16/02/2017	16/02/2017
Sample Depth			0.3-0.6 m	1.8-2.1 m	1.8-2.1 m	3-3.3 m	5.5-5.8 m	12.2-12.5 m	12.2-12.5 m	20.1-20.4 m	30.2-30.5 m	31.7-32 m	31.7-32 m	32.6-32.9 m	9.1-9.8 m	16.8-17.4 m	18.3-18.9 m	21.3-21.9 m	1.8-2.1 m	7.3-7.6 m	11.3-11.6 m	13.4-13.7 m
Duplicate				FDA	FD			FDA	FD													
Parameter																						
Soil Phenols																						
Phenol	6.5	DW	< 0.020	< 0.020	< 0.020	< 0.030	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2-methylphenol (o-cresol)	10	EH	< 0.020	< 0.020	< 0.020	< 0.050	< 0.030	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
3-methylphenol (m-cresol)	10	EH	< 0.020	< 0.020	< 0.020	< 0.090	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.040	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.090	< 0.090
4-methylphenol (p-cresol)	10	EH	< 0.020	< 0.020	< 0.020	< 0.10	< 0.080	< 0.090	< 0.10	< 0.060	< 0.040	< 0.040	< 0.020	< 0.020	< 0.030	< 0.040	-	< 0.060	< 0.020	< 0.030	< 0.030	< 0.050
2,4 dimethylphenol	10	EH	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Chlorinated Phenols																						
2-chlorophenol (Ortho)	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 2.1	< 0.020	< 0.020	< 0.020	< 0.15	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
3-chlorophenol (Meta)	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.030	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
4-chlorophenol (Para)	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
4-chloro-3-methylphenol	25000	HH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3-dichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,4 & 2,5-dichlorophenol			< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,6 dichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
3,4 dichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
3,5 dichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,4-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,5-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,6-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,4,5-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,4,6-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
3,4,5-trichlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,4,5-tetrachlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,4,6-tetrachlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
2,3,5,6-tetrachlorophenol	5	EH	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Pentachlorophenol	0.1	AW-F	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	-	< 0.020	< 0.020	< 0.045	< 0.020	< 0.020	< 0.020

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.
m bgs = metres below ground surface
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).
Land Use abbreviations: IL (Industrial)
MCS = most conservative standard based on applicable site-specific standards

Referenced site-specific factors include: AW = Groundwater Flow to Surface Water used by Aquatic Life, F = Fresh Water Aquatic Life; DW = Drinking Water; HH = Human Health; EH = Ecological Health

- = not analyzed
< = less than laboratory reporting limit

Supplementary Geo-Environmental Investigation
Table 7 - Results of Soil Analyses - Dioxins Furans
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-06	BH16-08	BH16-08
Sample Name			03020-06	03020-10	02042-03	02042-10	02043-04	02047-03	02048-01	02048-08
Sample Date	CSR Standards IL	MCS	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	26/11/2016	27/12/2016	27/12/2016
Sample Depth			6.4-6.7 m	11-11.3 m	16.5-16.8 m	25.3-25.6 m	31.7-32 m	32.6-32.9 m	7.6-8.2 m	18.3-18.9 m
Duplicate										
Parameter										
Dioxins & Furans										
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.0025	T	< 0.00000070	< 0.000000064	< 0.000000067	< 0.000000059	< 0.000000056	< 0.000000051	< 0.00000021	< 0.00000036
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin			< 0.00000013	0.000000130	< 0.000000045	0.000000140	< 0.000000047	< 0.000000036	< 0.00000010	< 0.00000023
Octachlorodibenzo-p-dioxin			0.00000168	0.00000493	0.00000200	0.00000613	0.00000230	0.00000145	0.00000208	0.00000751
Hexachlorinated Dibenzo-p-dioxins, Total			< 0.00000014	0.000000429	0.000000224	0.000000749	< 0.000000048	< 0.000000036	< 0.00000011	< 0.00000023
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin			0.00000021	0.000000584	0.000000270	0.000000817	0.000000238	0.000000150	0.00000032	0.00000058
Pentachlorinated Dibenzo-p-dioxins, Total			< 0.00000019	0.000000201	0.000000062	0.000000358	< 0.000000030	< 0.000000030	< 0.00000013	< 0.00000018
Heptachlorinated Dibenzo-p-dioxins, Total			< 0.00000013	0.000000584	< 0.000000042	0.00000200	0.000000728	0.000000250	0.00000032	0.00000058
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin			< 0.00000014	< 0.000000045	< 0.000000043	< 0.000000073	< 0.000000048	< 0.000000034	< 0.00000011	< 0.00000023
1,2,3,7,8-Pentachlorodibenzo-p-dioxin			< 0.00000019	< 0.000000031	< 0.000000050	0.000000070	< 0.000000030	< 0.000000030	< 0.00000013	< 0.00000018
Tetrachlorinated Dibenzo-p-dioxins, Total			< 0.00000070	0.000000318	< 0.000000067	0.000000438	< 0.000000056	< 0.000000051	< 0.00000021	< 0.00000036
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin			< 0.00000012	0.000000065	< 0.000000042	< 0.000000069	< 0.000000043	< 0.000000034	< 0.00000010	< 0.00000023
Tetrachlorinated Dibenzofurans, Total			< 0.00000076	< 0.000000046	< 0.000000050	0.000000366	0.000000229	0.000000040	< 0.00000022	< 0.00000035
Pentachlorinated Dibenzofurans, Total			< 0.00000020	< 0.000000025	< 0.000000025	< 0.000000025	< 0.000000026	< 0.000000025	< 0.000000090	< 0.00000015
Heptachlorinated Dibenzofurans, Total			< 0.00000011	< 0.000000033	< 0.000000033	< 0.000000026	< 0.000000026	< 0.000000033	< 0.00000011	< 0.00000017
Octachlorodibenzofuran			< 0.00000010	0.000000143	0.000000093	0.000000088	0.000000054	< 0.000000026	0.00000018	< 0.00000027
2,3,7,8-Tetrachlorodibenzofuran			< 0.00000076	< 0.000000046	0.000000079	0.000000225	0.000000105	0.000000071	< 0.00000022	< 0.00000035
1,2,3,4,7,8,9-Heptachlorodibenzofuran			< 0.00000011	< 0.000000033	< 0.000000033	< 0.000000026	< 0.000000026	< 0.000000033	< 0.00000011	< 0.00000017
Hexachlorinated Dibenzofurans, Total			< 0.00000019	< 0.000000033	< 0.000000030	0.000000066	< 0.000000030	< 0.000000048	< 0.000000095	< 0.00000016
2,3,4,7,8-Pentachlorodibenzofuran			< 0.00000014	< 0.000000022	< 0.000000021	< 0.000000021	< 0.000000021	< 0.000000020	< 0.000000080	< 0.00000013
1,2,3,7,8-Pentachlorodibenzofuran			< 0.00000020	< 0.000000025	< 0.000000025	< 0.000000025	< 0.000000026	< 0.000000025	< 0.000000090	< 0.00000015
1,2,3,6,7,8-Hexachlorodibenzofuran			< 0.00000014	< 0.000000020	< 0.000000020	< 0.000000024	< 0.000000020	< 0.000000032	< 0.000000073	< 0.00000013
2,3,4,6,7,8-Hexachlorodibenzofuran			< 0.00000011	< 0.000000023	< 0.000000020	< 0.000000026	< 0.000000020	< 0.000000034	< 0.000000071	< 0.00000011
1,2,3,4,6,7,8-Heptachlorodibenzofuran			< 0.000000067	< 0.000000023	< 0.000000023	0.000000027	< 0.000000019	< 0.000000023	< 0.000000084	< 0.00000011
1,2,3,4,7,8-Hexachlorodibenzofuran			< 0.00000019	< 0.000000023	< 0.000000021	< 0.000000027	< 0.000000021	< 0.000000035	< 0.000000085	< 0.00000014
1,2,3,7,8,9-Hexachlorodibenzofuran			< 0.00000017	< 0.000000033	< 0.000000030	0.000000066	< 0.000000030	< 0.000000048	< 0.000000095	< 0.00000016

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.
m bgs = metres below ground surface
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).
Land Use abbreviations: IL (Industrial)
MCS = most conservative standard based on applicable site-specific standards
Referenced site-specific factors include: T = Toxicity to Invertebrates and Plants
- = not analyzed
< = less than laboratory reporting limit

Location			SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-05	SH16-06	SH16-06	BH16-08	BH16-08	BH16-08	AH17-01	AH17-01	AH17-01	AH17-01	AH17-01
Sample Name			03020-06	03020-10	02042-03	02042-07	02042-10	02043-03	02043-04	02047-01	02047-04	02048-01	02048-07	02048-10	02052-04	02052-07	02052-10	02053-03	02053-05
Sample Date			23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	23/11/2016	26/11/2016	26/11/2016	27/12/2016	27/12/2016	27/12/2016	16/02/2017	16/02/2017	16/02/2017	16/02/2017	16/02/2017
Sample Depth			6.4-6.7 m	11-11.3 m	16.5-16.8 m	21.3-21.6 m	25.3-25.6 m	30.2-30.5 m	31.7-32 m	30.5-30.8 m	33.8-34.1 m	7.6-8.2 m	16.8-17.4 m	21.3-21.9 m	2.4-2.7 m	5.2-5.5 m	8.2-8.5 m	12.2-12.5 m	14.6-14.9 m
Duplicate																			
Parameter	CSR Standards IL	MCS																	
PCB																			
Total Polychlorinated Biphenyls (PCBs)	35	T	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1016			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1221			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1232			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1242			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1248			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1254			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1260			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1262			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Aroclor 1268			< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020

Notes:
Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.
m bgs = metres below ground surface
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments to 1 November 2017).

Land Use abbreviations: IL (Industrial)
MCS = most conservative standard based on applicable site-specific standards
Referenced site-specific factors include: I = Intake of Contaminated Soil; T = Toxicity to Invertebrates and Plants
- = not analyzed
< = less than laboratory reporting limit

Table 9 - Results of Soil Analyses - Pesticides
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			BH16-08
Sample Name			02048-01
Sample Date	CSR Standards IL	MCS	27/12/2016
Sample Depth			7.6-8.2 m
Duplicate			
Parameter			
Soil Pesticides			
Tributyltin	70,000	HH	< 1.0
Dibutyltin	70,000	HH	< 1.0
Dioctyltin			< 1.0
Diphenyltin			< 1.0
Monobutyltin			< 1.0
Monooctyltin			< 1.0
Monophenyltin			< 1.0
Tricyclohexyltin			< 1.0
Triphenyltin			< 1.0

Notes:

Results are expressed in micrograms per gram (ug/kg), unless otherwise indicated.
m bgs = metres below ground surface
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Standards shown from the Contaminated Sites Regulation
("CSR"; BC Reg. 375/96, including amendments to 1 November
Land Use abbreviations: IL (Industrial)
MCS = most conservative standard based on applicable site-specific standards
Referenced site-specific factors include: HH = Human Health
- = not analyzed
< = less than laboratory reporting limit

Sample Location	Units	SH16-07	SH16-07	RDL	RPD (%)	DF (unitless)	SH16-05	SH16-05	RDL	RPD (%)	DF (unitless)	SH16-07	SH16-07	RDL	RPD (%)	DF (unitless)
Sample Name		02044-05	02044-06				03020-11	03020-12				02053-11	02053-12			
Sample Collection Date		11/24/2016	11/24/2016				11/23/2016	11/23/2016				2/16/2017	2/16/2017			
Sample Depth		7 - 7.3 m	7 - 7.3 m				12.2 - 12.5 m	12.2 - 12.5 m				1.8 - 2.1 m	1.8 - 2.1 m			
Physical Parameters																
pH	pH units	7.25	7.24	0.10	0	n/c	6.90	7.22	0.10	5	n/c	7.77	7.75	0.10	0	n/c
Total Organic Carbon	%	0.135	0.101	0.050	n/c	0.68	0.074	0.068	0.050	n/c	0.12	-	-	-	-	-
Anions and Nutrients																
Bromide (Br)	mg/kg		< 0.50	0.50	n/c	n/c						-	-	-	-	-
Chloride (Cl)	mg/kg	10.1		0.70	n/c	n/c	3.00	3.06	0.60	2	n/c	-	-	-	-	-
Chloride (Cl)	mg/kg		9.8	5.0	n/c	n/c	-	-	-	-	-	-	-	-	-	-
Fluoride (F)	mg/kg		0.26	0.20	n/c	n/c	-	-	-	-	-	-	-	-	-	-
Nitrate (as N)	mg/kg		< 0.050	0.050	n/c	n/c	-	-	-	-	-	-	-	-	-	-
Nitrite (as N)	mg/kg		< 0.010	0.010	n/c	n/c	-	-	-	-	-	-	-	-	-	-
Sulfate (SO4)	mg/kg		< 10	10	n/c	n/c	-	-	-	-	-	-	-	-	-	-
Metals																
Antimony	mg/kg	0.29	0.25	0.10	n/c	0.4	0.22	0.22	0.10	n/c	0	0.24	0.26	0.10	n/c	0.2
Arsenic	mg/kg	1.63	1.58	0.10	3	n/c	1.60	1.51	0.10	6	n/c	3.59	3.89	0.10	8	n/c
Barium	mg/kg	54.9	64.9	0.50	17	n/c	65.4	52.4	0.50	22	n/c	79.4	81.8	0.50	3	n/c
Beryllium	mg/kg	0.19	0.19	0.10	n/c	0	0.19	0.21	0.10	n/c	0.2	0.19	0.20	0.10	n/c	0.1
Cadmium	mg/kg	0.112	0.102	0.050	n/c	0.2	0.156	0.155	0.050	n/c	0.02	0.125	0.155	0.050	n/c	0.6
Chromium	mg/kg	37.5	33.4	0.50	12	n/c	32.1	36.7	0.5	13	n/c	23.9	23.8	0.50	0	n/c
Cobalt	mg/kg	8.63	8.09	0.10	6	n/c	8.20	7.81	0.10	5	n/c	7.69	8.69	0.10	12	n/c
Copper	mg/kg	14.6	13.9	0.50	5	n/c	15.2	13.8	0.50	10	n/c	14.3	15.7	0.50	9	n/c
Lead	mg/kg	2.38	2.36	0.50	n/c	0.04	2.25	2.22	0.50	n/c	0.06	2.37	2.53	0.50	7	n/c
Mercury	mg/kg	0.0258	0.0243	0.0050	6	n/c	0.0200	0.0213	0.0050	n/c	0.26	< 0.050	< 0.050	0.050	n/c	0
Molybdenum	mg/kg	0.20	0.20	0.10	n/c	0	0.25	0.24	0.10	n/c	0.1	0.38	0.40	0.10	n/c	0.2
Nickel	mg/kg	44.4	41.2	0.50	7	n/c	37.9	36.5	0.50	4	n/c	32.8	36.0	0.50	9	n/c
Selenium	mg/kg	< 0.20	< 0.20	0.20	n/c	0	< 0.20	< 0.20	0.20	n/c	0	< 0.20	< 0.20	0.20	n/c	0
Silver	mg/kg	< 0.10	< 0.10	0.10	n/c	0	< 0.10	< 0.10	0.10	n/c	0	< 0.10	< 0.10	0.10	n/c	0
Sodium	mg/kg	7.7		1.0	n/c	n/c	4.5	4.7	1.0	n/c	0.2	-	-	-	-	-
Thallium	mg/kg	< 0.050	< 0.050	0.050	n/c	0	< 0.050	< 0.050	0.050	n/c	0	0.056	0.060	0.050	n/c	0.08
Tin	mg/kg	< 2.0	< 2.0	2.0	n/c	0	< 2.0	< 2.0	2.0	n/c	0	< 2.0	< 2.0	2.0	n/c	0
Uranium	mg/kg	0.501	0.325	0.050	43	n/c	0.286	0.288	0.050	1	n/c	0.311	0.343	0.050	10	n/c
Vanadium	mg/kg	44.6	37.2	0.20	18	n/c	49.3	51.1	0.20	4	n/c	33.6	37.0	0.20	10	n/c
Zinc	mg/kg	38.7	37.5	2.0	3	n/c	38.6	37.6	2.0	3	n/c	36.8	40.5	2.0	10	n/c

Notes:
Results are expressed in micrograms per kilogram (mg/kg), unless otherwise indicated.
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Method Reporting Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.
Relative Percent Difference (RPD) is calculated when the mean value is greater than five times the method reporting limit; Golder's internal QA/QC target is less than 35%.
Difference Factor (DF) is calculated when the mean value is less than five times the method reporting limit; Golder's internal QA/QC target is less than 2.
n/c = not calculated
BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

Sample Location																
Sample Name	**Units**	SH16-07 02044-05	SH16-07 02044-06	**RDL**	**RPD (%)**	**DF (unitless)**	SH16-05 03020-11	SH16-05 03020-12	**RDL**	**RPD (%)**	**DF (unitless)**	SH16-07 02053-11	SH16-07 02053-12	**RDL**	**RPD (%)**	**DF (unitless)**
Sample Collection Date		11/24/2016	11/24/2016				11/23/2016	11/23/2016				2/16/2017	2/16/2017			
Sample Depth		7 - 7.3 m	7 - 7.3 m				12.2 - 12.5 m	12.2 - 12.5 m				1.8 - 2.1 m	1.8 - 2.1 m			
PAH																
2-methylnaphthalene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Acenaphthene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Acenaphthylene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Anthracene	mg/kg	< 0.0040	< 0.0040	0.0040	n/c	0	< 0.0040	< 0.0040	0.0040	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo(a)anthracene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo(a)pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo(b)fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo(g,h,i)perylene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo(k)fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Benzo[b,j,k]fluoranthene	mg/kg	< 0.015	< 0.015	0.015	n/c	0	< 0.015	< 0.015	0.015	n/c	0	-	-	-	-	-
Chrysene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Dibenzo(a,h)anthracene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Fluorene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Naphthalene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Phenanthrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
Pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.050	< 0.050	0.050	n/c	0
EPH (C10-C19)	mg/kg	< 200	-	200	n/c	n/c	< 200	< 200	200	n/c	0	< 200	< 200	200	n/c	0
EPH (C19-C32)	mg/kg	< 200	-	200	n/c	n/c	< 200	< 200	200	n/c	0	< 200	< 200	200	n/c	0
LEPH (C10-C19) Less PAHs	mg/kg	< 200	-	200	n/c	n/c	< 200	< 200	200	n/c	0	< 200	< 200	200	n/c	0
HEPH (C19-C32) Less PAHs	mg/kg	< 200		200	n/c	n/c	< 200	< 200	200	n/c	0	< 200	< 200	200	n/c	0
Petroleum Hydrocarbons - F2 (C10-C1	mg/kg	< 30	< 30	30	n/c	0	< 30	< 30	30	n/c	0	< 30	< 30	30	n/c	0
Petroleum Hydrocarbons - F3 (C16-C3	mg/kg	< 50	< 50	50	n/c	0	< 50	< 50	50	n/c	0	< 50	< 50	50	n/c	0
Petroleum Hydrocarbons - F4 (C34-C5	mg/kg	< 50	< 50	50	n/c	0	< 50	< 50	50	n/c	0	< 50	< 50	50	n/c	0
Index of Additive Cancer Risk (IACR)	mg/kg	< 0.15	< 0.15	0.15	n/c	0	< 0.15	< 0.15	0.15	n/c	0	-	-	-	-	-
Soil Phenols																
2,4 dimethylphenol	mg/kg	-	< 0.020	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2-methylphenol (o-cresol)	mg/kg	-	< 0.020	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
3-methylphenol (m-cresol)	mg/kg	-	< 0.020	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
4-methylphenol (p-cresol)	mg/kg	-	< 0.080	0.080	n/c	n/c	< 0.090	-	0.090	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0
4-methylphenol (p-cresol)	mg/kg	-	-	-	-	-	-	< 0.10	0.10	n/c	n/c	-	-	-	-	-
Phenol	mg/kg	-	< 0.020	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
Chlorinated Phenols																
2,3,4,5-tetrachlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3,4,6-tetrachlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3,4-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3,5,6-tetrachlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3,5-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3,6-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,3-dichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,4 & 2,5-dichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,4,5-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,4,6-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2,6 dichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
2-chlorophenol (Ortho)	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
3,4 dichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
3,4,5-trichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
3,5 dichlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
3-chlorophenol (Meta)	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
4-chloro-3-methylphenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
4-chlorophenol (Para)	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0
Pentachlorophenol	mg/kg	< 0.020	-	0.020	n/c	n/c	< 0.020	< 0.020	0.020	n/c	0	< 0.020	< 0.020	0.020	n/c	0

Notes:

Results are expressed in micrograms per kilogram (mg/kg), unless otherwise indicated.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Method Reporting Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.

Relative Percent Difference (RPD) is calculated when the mean value is greater than five times the method reporting limit; Golder's internal QA/QC target is less than 35%.

Difference Factor (DF) is calculated when the mean value is less than five times the method reporting limit; Golder's internal QA/QC target is less than 2.

n/c = not calculated

BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

Table 12 - Results of Groundwater Analyses - Dissolved Metals
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			SH16-05S	SH16-05M	SH16-06S	SH16-06M	SH16-06M	SH16-07S	SH16-07M
Sample Name	*CSR Groundwater Quality Standards*	MCS	02333-07	02333-01	02333-02	02333-03	02333-04	02333-06	02333-05
Sample Date			08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016
Duplicate						FDA	FD		
Parameter									
Field and Physical									
Dissolved Oxygen (mg/L)			0.42	0.04	0.08	7.17	7.17	0.14	0.12
Conductivity (uS/cm)			678	1299	571	114	114	557.4	600
Oxidation Reduction Potential (mV)			-90.4	-61.4	-111.9	-102	-102	-125	-160
pH (pH units)			6.93	7.22	7.44	9.04	9.04	7.2	6.84
Temperature (°C)			13.5	10.8	12.7	12.9	12.9	12.4	12.1
Salinity (%)			0.024	0.060	0.021	0.016	0.016	0.021	0.026
Anions and Nutrients									
Bromide (Br)			121	640	166	113	119	< 50	< 250
Chloride (Cl)	*250000*	DW	24000	176000	38900	34900	35400	68100	25600
Fluoride (F)	*1500*	DW	238	350	386	57	59	249	120
Nitrate (as N)	*10000*	DW	< 5.0	< 25	< 5.0	7.5	8.4	< 5.0	< 25
Nitrite (as N)	*1000*	DW	< 1.0	< 5.0	< 1.0	19.1	19.7	< 1.0	< 5.0
Sulfate (SO4)	*500000*	DW	41900	118000	24200	41100	41500	8200	7700
Hardness, Calcium Carbonate			214	141	156	38.2	39.3	163	332
Dissolved Metals									
Aluminum	*9500*	DW	< 10	45	< 10	221	357	< 10	< 10
Antimony	*6*	AW-F	< 0.50	0.90	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	*10*	DW	3.9	4.9	3.8	1.0	< 1.0	4.0	6.9
Barium	*1000*	DW	86	80	50	23	24	61	107
Beryllium	*1.5*	DW	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Boron	*5000*	DW	< 100	< 100	< 100	< 100	< 100	< 100	120
Cadmium	*0.5*	DW	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium			55500	40600	44200	11200	11600	47100	91900
Chromium			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.97	< 0.50
Cobalt	*1*	DW	*1.72*	0.77	0.78	< 0.50	< 0.50	*1.22*	*2.37*
Copper	*20*	AW-F	< 1.0	< 1.0	< 1.0	1.4	1.4	< 1.0	< 1.0
Iron			8930	2520	1760	120	117	3050	18200
Lead	*10*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	*8*	DW	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Magnesium			18400	9600	11000	2490	2540	11000	24900
Manganese			1580	536	688	16	16	1140	2250
Mercury	*0.25*	AW-F	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	*250*	DW	5.0	29.0	6.1	3.0	3.0	4.9	3.6
Nickel	*80*	DW	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Potassium			6000	6600	5500	< 2000	< 2000	3400	8100
Selenium	*10*	DW	< 1.0	1.5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Silver	*0.5*	AW-F	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Sodium	*200000*	DW	80200	*215000*	73500	56700	59300	64200	84000
Thallium	*0.04*	DW	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Titanium	*1000*	AW-F	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Uranium	*20*	DW	2.30	14.6	1.36	1.70	1.71	0.58	1.85
Vanadium	*20*	DW	< 30	< 30	< 30	< 30	< 30	< 30	< 30
Zinc	*75*	AW-F	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	5.7

Notes:
Results are expressed in micrograms per litre (µg/L), unless otherwise noted.
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).
Land Use abbreviations: AW (Aquatic Life); M (Marine); F (Freshwater); and DW (Drinking Water).
- = not analyzed
< = less than laboratory reporting limit

Location			EW15-01	SH16-05S	SH16-05M	SH16-05M	SH16-06S	SH16-06M	SH16-06M	SH16-07S	SH16-07M
Sample Name	*CSR Groundwater Quality Standards*	MCS	00960-03	02333-07	02333-01	03810-01	02333-02	02333-03	02333-04	02333-06	02333-05
Sample Date			13/11/2015	08/12/2016	08/12/2016	04/08/2017	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016
Duplicate								FDA	FD		
Parameter											
Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	*60*	AW-F	0.295	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Acenaphthylene			0.239	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Acridine	*0.5*	AW-F	<0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Anthracene	*1*	AW-F	0.291	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(a)anthracene	*0.07*	DW	*0.15*	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(a)pyrene	*0.01*	DW	*0.137*	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Benzo(b)fluoranthene	*0.07*	DW	*0.129*	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(g,h,i)perylene			0.061	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo(k)fluoranthene			<0.080	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Chrysene	*1*	AW-F	0.144	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dibenzo(a,h)anthracene	*0.007*	DW	<0.050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Fluoranthene	*2*	AW-F	0.415	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluorene	*120*	AW-F	0.359	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Indeno(1,2,3-c,d)pyrene			0.062	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	*10*	AW-F	1.06	< 0.050	< 0.20	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	*3*	AW-F	1.22	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Pyrene	*0.2*	AW-F	*0.57*	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Quinoline	*0.05*	DW	<0.050	< 0.050	< 0.20	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Extractable Petroleum Hydrocarbons (C10-C19)	*5000*	AW-F	<250	< 250	1900	< 250	< 250	< 250	< 250	< 250	< 250
Light Extractable Petroleum Hydrocarbons (C10-C19) Less PAHs	*500*	AW-F	<250	< 250	*1900*	< 250	< 250	< 250	< 250	< 250	< 250
Extractable Petroleum Hydrocarbons (C19-C32)			520	< 250	310	< 250	< 250	< 250	< 250	< 250	< 250
Heavy Extractable Petroleum Hydrocarbons (C19-C32) Less PAHs			520	< 250	310	< 250	< 250	< 250	< 250	< 250	< 250

Notes:

Results are expressed in micrograms per litre (µg/L), unless otherwise noted.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).
Land Use abbreviations: AW (Aquatic Life); M (Marine); F (Freshwater); and DW (Drinking Water).

- = not analyzed

< = less than laboratory reporting limit

$EPHw_{10-19}$ = extractable petroleum hydrocarbons, carbon range 10-19

LEPHw = light extractable petroleum hydrocarbons

Where water use for the protection of aquatic life applies, the standards for $EPHw_{10-19}$ is equivalent to LEPHw, when no LEPHw analysis is undertaken.

VPHw = volatile petroleum hydrocarbons

VHw_{6-10} = volatile hydrocarbons, carbon range 6-10

Where water use for the protection of aquatic life applies, the standards for VHw_{6-10} equivalent to VPHw, when no VPHw analysis is undertaken.

Location			SH16-05S	SH16-05M	SH16-06S	SH16-06M	SH16-06M	SH16-07S	SH16-07M
Sample Name	*CSR Groundwater Quality Standards*	MCS	02333-07	02333-01	02333-02	02333-03	02333-04	02333-06	02333-05
Sample Date			08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016
Duplicate						FDA	FD		
Parameter									
Volatile Organic Compounds (VOCs)									
Bromodichloromethane (BDCM)	*100*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform (Tribromomethane)	*100*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Carbon Tetrachloride	*2*	DW	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chlorobenzene	*13*	AW-F	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	*20*	AW-F	2.3	16.5	1.7	*31.2*	*30.6*	2.5	7.9
Chloromethane			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dichloromethane (DCM) (Methylene Chloride)	*50*	DW	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Dibromochloromethane (DBCM)	*100*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-dichlorobenzene	*7*	AW-F	< 0.70	< 0.70	< 0.70	< 0.70	< 0.70	< 0.70	< 0.70
1,3-dichlorobenzene	*1500*	AW-F	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,4-dichlorobenzene	*5*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-dichloroethane	*30*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-dichloroethane	*5*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-dichloroethene	*14*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-dichloroethylene (cis) (1,2-dichloroethene) (cis)	*8*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-dichloroethylene (trans) (1,2-dichloroethene) (trans)	*80*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-dichloropropane (Propylene Dichloride)	*4.5*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-dichloropropene (cis)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-dichloropropene (trans)			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-dichloropropene, total	*1.5*	DW	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4
1,1,1,2-tetrachloroethane	*6*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2,2-tetrachloroethane	*0.8*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethylene (PCE/PERC)	*30*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1-trichloroethane	*8000*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-trichloroethane	*3*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)	*5*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane (Freon 11)	*1000*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trihalomethanes (Total)			2.3	16.5	< 2.0	31.2	30.6	2.5	7.9
Vinyl Chloride (Chloroethene)	*2*	DW	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene	*5*	DW	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Ethylbenzene	*140*	DW	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Toluene	*5*	AW-F	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Xylenes, Total	*90*	DW	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75
o-Xylene			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
m,p-Xylenes			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Methyl tert-Butyl Ether	*95*	DW	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Styrene	*720*	AW-F	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50

Notes:

Results are expressed in micrograms per litre (µg/L), unless otherwise noted.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).
Land Use abbreviations: AW (Aquatic Life); M (Marine); F (Freshwater); and DW (Drinking Water).

- = not analyzed

< = less than laboratory reporting limit

Supplementary Geo-Environmental Investigation
Table 15 - Results of Groundwater Analyses - Phenols PCBs
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Location			SH16-05S	SH16-05M	SH16-06S	SH16-06M	SH16-06M	SH16-07S	SH16-07M
Sample Name	*CSR Groundwater Quality Standards*	MCS	02333-07	02333-01	02333-02	02333-03	02333-04	02333-06	02333-05
Sample Date			08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016	08/12/2016
Duplicate						FDA	FD		
Parameter									
Non-chlorinated Phenols									
Phenol	*1000*	DW	< 1.0	< 5.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-methylphenol (o-cresol)	*200*	DW	< 0.50	< 2.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
3-methylphenol (m-cresol)	*200*	DW	< 0.50	< 2.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
4-methylphenol (p-cresol)	*400*	DW	0.68	< 2.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
2,4 dimethylphenol	*80*	DW	< 0.50	< 2.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Polychlorinated Biphenyls (PCBs)									
Total PCBs			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1016			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1221			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1232			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1242			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1248			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1254			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1260			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1262			< 1.0	-	< 1.0	-	-	-	-
Aroclor 1268			< 1.0	-	< 1.0	-	-	-	-

Notes:

Results are expressed in micrograms per litre (µg/L), unless otherwise noted.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).
Land Use abbreviations: AW (Aquatic Life); M (Marine); F (Freshwater); and DW (Drinking Water).

- = not analyzed

< = less than laboratory reporting limit

Table 16 - Results of QAQC Groundwater Analyses - Dissolved Metals
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Sample Location	SH16-06M	SH16-06M	RDL	RPD (%)	DF (unitless)
Sample Name	02333-03	02333-04			
Sample Collection Date	12/08/2016	12/08/2016			
Anions and Nutrients					
Bromide (Br)	0.113	0.119	0.050	n/c	0.12
Chloride (Cl)	34.9	35.4	0.50	1	n/c
Fluoride (F)	0.057	0.059	0.020	n/c	0.1
Nitrate (as N)	0.0075	0.0084	0.0050	n/c	0.18
Nitrite (as N)	0.0191	0.0197	0.0010	3	n/c
Sulfate (SO4)	41.1	41.5	0.30	1	n/c
Hardness, Calcium Carbonate	38.2	39.3	0.50	3	n/c
Dissolved Metals					
Aluminum	0.221	0.357	0.010	27	n/c
Antimony	< 0.00050	< 0.00050	0.00050	n/c	0
Arsenic	0.0010	< 0.0010	0.0010	n/c	0
Barium	0.023	0.024	0.020	n/c	0.05
Beryllium	< 0.0050	< 0.0050	0.0050	n/c	0
Boron	< 0.10	< 0.10	0.10	n/c	0
Cadmium	< 0.000050	< 0.000050	0.000050	n/c	0
Calcium	11.2	11.6	0.10	4	n/c
Chromium	< 0.00050	< 0.00050	0.00050	n/c	0
Cobalt	< 0.00050	< 0.00050	0.00050	n/c	0
Copper	0.0014	0.0014	0.0010	n/c	0
Iron	0.120	0.117	0.030	n/c	0.1
Lead	< 0.0010	< 0.0010	0.0010	n/c	0
Lithium	< 0.050	< 0.050	0.050	n/c	0
Magnesium	2.49	2.54	0.10	2	n/c
Manganese	0.016	0.016	0.010	n/c	0
Mercury	< 0.00020	< 0.00020	0.00020	n/c	0
Molybdenum	0.0030	0.0030	0.0010	n/c	0
Nickel	< 0.0050	< 0.0050	0.0050	n/c	0
Potassium	< 2.0	< 2.0	2.0	n/c	0
Selenium	< 0.0010	< 0.0010	0.0010	n/c	0
Silver	< 0.000050	< 0.000050	0.000050	n/c	0
Sodium	56.7	59.3	2.0	4	n/c
Thallium	< 0.00020	< 0.00020	0.00020	n/c	0
Titanium	< 0.050	< 0.050	0.050	n/c	0
Uranium	0.00170	0.00171	0.00020	1	n/c
Vanadium	< 0.030	< 0.030	0.030	n/c	0
Zinc	< 0.0050	< 0.0050	0.0050	n/c	0
Non-chlorinated Phenols					
2,4 dimethylphenol	< 0.00050	< 0.00050	0.00050	n/c	0
2-methylphenol (o-cresol)	< 0.00050	< 0.00050	0.00050	n/c	0
3-methylphenol (m-cresol)	< 0.00050	< 0.00050	0.00050	n/c	0
4-methylphenol (p-cresol)	< 0.00050	< 0.00050	0.00050	n/c	0
Phenol	< 0.0010	< 0.0010	0.0010	n/c	0

Notes:

Results are expressed in micrograms per gram (µg/L), unless otherwise indicated.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Method Reporting Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.

Relative Percent Difference (RPD) is calculated when the mean value is greater than five times the method reporting limit; Golder's internal QA/QC target is less than 35%.

Difference Factor (DF) is calculated when the mean value is less than five times the method reporting limit; Golder's internal QA/QC target is less than 2.

n/c = not calculated

BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

Table 17 - Results of QAQC Groundwater Analyses - Hydrocarbons
AIWWTP Option 6 Outfall Alignment
Annacis Island, Delta, BC

Sample Location	SH16-06M	SH16-06M	RDL	RPD (%)	DF
Sample Name	02333-03	02333-04			(unitless)
Sample Collection Date	12/08/2016	12/08/2016			
PAHs					
Acenaphthene	< 0.000050	< 0.000050	0.000050	n/c	0
Acenaphthylene	< 0.000050	< 0.000050	0.000050	n/c	0
Acridine	< 0.000050	< 0.000050	0.000050	n/c	0
Anthracene	< 0.000050	< 0.000050	0.000050	n/c	0
Benzo(a)anthracene	< 0.000050	< 0.000050	0.000050	n/c	0
Benzo(a)pyrene	< 0.0000050	< 0.0000050	0.0000050	n/c	0
Benzo(b)fluoranthene	< 0.000050	< 0.000050	0.000050	n/c	0
Benzo(g,h,i)perylene	< 0.000050	< 0.000050	0.000050	n/c	0
Benzo(k)fluoranthene	< 0.000050	< 0.000050	0.000050	n/c	0
Chrysene	< 0.000050	< 0.000050	0.000050	n/c	0
Dibenzo(a,h)anthracene	< 0.0000050	< 0.0000050	0.0000050	n/c	0
Fluoranthene	< 0.000050	< 0.000050	0.000050	n/c	0
Fluorene	< 0.000050	< 0.000050	0.000050	n/c	0
Indeno(1,2,3-c,d)pyrene	< 0.000050	< 0.000050	0.000050	n/c	0
Naphthalene	< 0.000050	< 0.000050	0.000050	n/c	0
Phenanthrene	< 0.000050	< 0.000050	0.000050	n/c	0
Pyrene	< 0.000050	< 0.000050	0.000050	n/c	0
Quinoline	< 0.000050	< 0.000050	0.000050	n/c	0
Extractable Petroleum Hydrocarbons (C10-C19)	< 0.25	< 0.25	0.25	n/c	0
Extractable Petroleum Hydrocarbons (C19-C32)	< 0.25	< 0.25	0.25	n/c	0
Light Extractable Petroleum Hydrocarbons (C10-C19) Less PAHs	< 0.25	< 0.25	0.25	n/c	0
Heavy Extractable Petroleum Hydrocarbons (C19-C32) Less PAHs	< 0.25	< 0.25	0.25	n/c	0
VOCs					
1,1,1,2-tetrachloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,1,1-trichloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,1,2,2-tetrachloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,1,2-trichloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,1-dichloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,1-dichloroethene	< 0.0010	< 0.0010	0.0010	n/c	0
1,2-dichlorobenzene	< 0.00070	< 0.00070	0.00070	n/c	0
1,2-dichloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
1,2-dichloroethylene (cis) (1,2-dichloroethene) (cis)	< 0.0010	< 0.0010	0.0010	n/c	0
1,2-dichloroethylene (trans) (1,2-dichloroethene) (trans)	< 0.0010	< 0.0010	0.0010	n/c	0
1,2-dichloropropane (Propylene Dichloride)	< 0.0010	< 0.0010	0.0010	n/c	0
1,3-dichlorobenzene	< 0.0010	< 0.0010	0.0010	n/c	0
1,3-dichloropropene (cis)	< 0.0010	< 0.0010	0.0010	n/c	0
1,3-dichloropropene (trans)	< 0.0010	< 0.0010	0.0010	n/c	0
1,3-dichloropropene, total	< 0.0014	< 0.0014	0.0014	n/c	0
1,4-dichlorobenzene	< 0.0010	< 0.0010	0.0010	n/c	0
Benzene	< 0.00050	< 0.00050	0.00050	n/c	0
Bromodichloromethane (BDCM)	< 0.0010	< 0.0010	0.0010	n/c	0
Bromoform (Tribromomethane)	< 0.0010	< 0.0010	0.0010	n/c	0
Carbon Tetrachloride	< 0.00050	< 0.00050	0.00050	n/c	0
Chlorobenzene	< 0.0010	< 0.0010	0.0010	n/c	0
Chloroethane	< 0.0010	< 0.0010	0.0010	n/c	0
Chloroform	0.0312	0.0306	0.0010	2	n/c
Chloromethane	< 0.0050	< 0.0050	0.0050	n/c	0
Dibromochloromethane (DBCM)	< 0.0010	< 0.0010	0.0010	n/c	0
Dichloromethane (DCM) (Methylene Chloride)	< 0.0050	< 0.0050	0.0050	n/c	0
Ethylbenzene	< 0.00050	< 0.00050	0.00050	n/c	0
m,p-Xylenes	< 0.00050	< 0.00050	0.00050	n/c	0
Methyl tert-Butyl Ether	< 0.00050	< 0.00050	0.00050	n/c	0
o-Xylene	< 0.00050	< 0.00050	0.00050	n/c	0
Styrene	< 0.00050	< 0.00050	0.00050	n/c	0
Tetrachloroethylene (PCE/PERC)	< 0.0010	< 0.0010	0.0010	n/c	0
Toluene	< 0.00050	< 0.00050	0.00050	n/c	0
Trichloroethylene (TCE)	< 0.0010	< 0.0010	0.0010	n/c	0
Trichlorofluoromethane (Freon 11)	< 0.0010	< 0.0010	0.0010	n/c	0
Trihalomethanes (Total)	0.0312	0.0306	0.0020	2	n/c
Vinyl Chloride (Chloroethene)	< 0.0010	< 0.0010	0.0010	n/c	0
Xylenes, Total	< 0.00075	< 0.00075	0.00075	n/c	0

Notes:

Results are expressed in micrograms per gram (µg/L), unless otherwise indicated.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

Method Reporting Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.

Relative Percent Difference (RPD) is calculated when the mean value is greater than five times the method reporting limit; Golder's internal QA/QC target is less than 35%.

Difference Factor (DF) is calculated when the mean value is less than five times the method reporting limit; Golder's internal QA/QC target is less than 2.

n/c = not calculated

BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

Location Sample Name Sample Date QA/QC Parameter	*CSR Standards for Sediment*	MCS	**CCME Guidelines for Sediment ISQG**	MCS	**CCME Guidelines for Sediment PEL**	MCS	SDS-1 L1906730-1 28/03/2017	SDS-2 L1906730-2 28/03/2017	SDS-3 L1906730-3 28/03/2017 FDA	DUP-1 L1906730-9 28/03/2017 FD	SDS-4 L1906730-4 28/03/2017	SDS-5 L1906730-5 28/03/2017	SDS-6 L1906730-6 28/03/2017	SDS-7 L1906730-7 28/03/2017	SDS-8 L1907291-1 30/03/2017	SDS-9 L1907291-2 30/03/2017	SDS-10 L1907291-3 30/03/2017	SDS-11 L1907291-4 30/03/2017 FDA	DUP-3 L1907291-11 30/03/2017 FD	SDS-12 L1907291-5 30/03/2017	SDS-13 L1907291-6 30/03/2017	SDS-14 L1907291-7 30/03/2017	SDS-15 L1907291-8 30/03/2017	SDS-16 L1907291-9 30/03/2017	SDS-17 L1907291-10 30/03/2017
Physical Parameters																										
Moisture (%)							16.6	18.7	18.9	19.1	18.1	20.9	19.8	20.5	19.8	19.3	15.9	20.0	20.9	21.1	19.0	19.4	20.5	18.6	19.9
Saturation (%)							27.3	24.5	25.9	27.7	26.4	25.1	26.7	24.6	23.7	23.0	23.5	24.6	24.9	24.3	24.8	25.7	25.2	24.8	24.3
grain size 0.004 - 0.063 mm (Silt)							< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
grain size 0.063 - 2 mm (Sand)							98.8	98.3	99.4	98.9	96.8	99.0	99.5	98.3	99.5	99.2	98.4	98.9	98.3	99.2	99.5	98.9	98.1	99.7	99.7
Sieve - #10 (>2.00mm)							< 1.0	1.2	< 1.0	< 1.0	2.9	< 1.0	< 1.0	1.2	< 1.0	< 1.0	1.5	< 1.0	1.4	< 1.0	< 1.0	< 1.0	1.6	< 1.0	< 1.0
Clay Content (%)							< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Texture							Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Chemical Parameters																										
pH (pH units)							7.65	7.49	7.60	7.68	7.45	7.40	7.32	8.00	7.53	7.62	7.48	7.57	7.50	7.56	7.49	7.39	7.86	7.57	7.38
Total Organic Carbon (%)							0.272	0.200	0.137	0.075	< 0.050	0.115	0.136	< 0.050	0.099	< 0.050	0.063	0.059	< 0.050	0.051	0.055	0.058	0.071	0.116	< 0.050
Sodium							19.0|315	4.3|251	5.4|244	4.9|237	5.8|280	4.8|219	4.6|220	11.9|294	3.6	2.7	3.5	4.2	4.4	3.8	3.0	2.9	19.0	3.7	3.1
Chloride (Cl)							11.8	1.99	2.18	1.91	1.93	2.79	2.28	2.68	1.79	1.32	1.42	1.34	1.78	1.40	1.20	1.20	23.3	1.32	1.57
Metals																										
Aluminum							10200	11000	10300	9620	11100	9890	9590	9450	-	-	-	-	-	-	-	-	-	-	-
Antimony							0.21	0.20	0.18	0.19	0.22	0.18	0.19	0.18	0.16	0.16	0.16	0.16	0.38	0.18	0.19	0.18	0.17	0.17	0.18
Arsenic	11	F	**5.9**	F	**17**	F	3.52	3.70	3.25	3.33	4.00	3.32	3.14	3.39	3.16	3.02	2.96	3.17	3.55	3.18	3.24	3.43	3.31	3.33	3.12
Barium							47.3	46.3	46.2	42.2	54.0	42.0	41.0	46.0	41.5	40.3	35.8	42.8	40.2	49.2	46.3	47.5	38.3	62.6	49.1
Beryllium							0.19	0.21	0.21	0.19	0.22	0.19	0.19	0.18	0.16	0.17	0.16	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.18
Bismuth							< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	-	-	-	-	-	-	-	-	-	-	-
Boron							< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	-	-	-	-	-	-	-	-	-	-	-
Cadmium	2.2	F	**0.6**	F	**3.5**	F	0.113	0.119	0.113	0.107	0.124	0.107	0.107	0.105	0.093	0.112	0.112	0.104	0.109	0.103	0.107	0.103	0.101	0.107	0.097
Calcium							5570	6160	6210	5490	6370	5520	5330	4660	-	-	-	-	-	-	-	-	-	-	-
Chromium	56	F					31.9	28.8	25.3	26.6	31.3	26.3	21.3	18.5	14.5	17.8	18.0	14.4	18.3	19.7	25.5	19.3	20.6	21.5	22.5
Cobalt							8.69	8.85	7.88	7.14	9.13	7.77	7.60	7.38	6.14	6.59	6.72	6.19	6.89	6.73	6.81	7.26	6.81	6.80	7.10
Copper	67	F	**18.7**	M	**108**	M	15.6	15.3	14.4	12.9	14.9	13.5	14.2	13.2	11.2	11.6	12.5	12.3	12.4	11.7	12.4	12.4	11.8	12.4	13.1
Iron							21800	21300	19000	17200	21400	18700	17800	17500	-	-	-	-	-	-	-	-	-	-	-
Lead	57	F	**30.2**	M	**91.3**	F	2.29	2.46	2.17	2.19	2.40	2.08	2.03	2.03	1.87	1.88	1.94	1.87	2.10	1.95	1.89	2.01	2.04	2.06	1.96
Lithium							8.3	8.6	7.8	7.8	8.8	8.1	7.7	8.0	-	-	-	-	-	-	-	-	-	-	-
Magnesium							7590	7430	6960	6320	7950	6850	6460	6230	-	-	-	-	-	-	-	-	-	-	-
Manganese							437	471	415	411	485	413	410	430	-	-	-	-	-	-	-	-	-	-	-
Mercury	0.3	F	**0.13**	M	**0.486**	F	0.0196	0.0149	0.0170	0.0593	0.0134	0.0157	0.0162	0.0157	0.0178	0.0197	0.0168	0.0142	0.0143	0.0186	0.0197	0.0156	0.0164	0.0160	0.0231
Molybdenum							0.33	0.32	0.28	0.58	0.39	0.27	0.29	0.28	0.24	0.25	0.27	0.28	0.45	0.30	0.31	0.32	0.30	0.31	0.28
Nickel							35.6	32.6	29.3	28.5	37.8	29.5	27.0	25.8	21.3	23.0	23.8	22.4	24.7	26.0	27.3	25.7	26.3	26.9	27.2
Phosphorus							491	516	529	466	589	485	455	462	-	-	-	-	-	-	-	-	-	-	-
Potassium							500	490	470	490	520	450	430	450	-	-	-	-	-	-	-	-	-	-	-
Selenium							< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Silver							< 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	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Strontium							23.7	22.5	24.1	21.2	25.0	21.0	19.6	19.9	-	-	-	-	-	-	-	-	-	-	-
Thallium							< 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	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Tin							< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Titanium							850	988	878	792	938	815	855	773	-	-	-	-	-	-	-	-	-	-	-
Uranium							0.328	0.289	0.284	0.266	0.273	0.252	0.250	0.230	0.207	0.207	0.228	0.255	0.212	0.254	0.240	0.276	0.255	0.248	0.226
Vanadium							58.4	56.8	48.3	41.5	53.2	46.5	44.3	43.4	36.1	38.0	36.7	35.5	38.8	38.9	40.8	43.0	39.6	39.7	41.1
Zinc	170	M	**123**	F	**271**	M	41.5	41.1	38.9	36.5	42.1	37.6	37.0	37.4	32.3	34.3	34.2	32.9	35.6	34.3	33.4	35.8	33.7	34.4	35.7
Zirconium							5.1	5.6	5.3	4.9	5.7	5.0	5.3	4.7	-	-	-	-	-	-	-	-	-	-	-

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).

Canadian Council of Ministers of the Environment (CCME) Sediment Guidelines for the Protection of Aquatic Life in Marine/Estuarine and Freshwater.

Accessed May 2016. Available online at: http://st-ts.ccme.ca/en/index.html?chems=all&chapters=3.

The most conservative guideline between freshwater and marine/estuarine guidelines was selected where both were available.

< = below laboratory detection limit or less than; "-" = not measured; FD = field duplicate; FDA = field duplicate available; FS = freshwater; I = interim guideline; ISQG = interim sediment quality guideline; M/ES = marine and/or estuarine water; QA/QC = quality assurance/quality control;

Sensitive site means a sediment site with sensitive aquatic habitat and for which sensitive sediment management objectives apply.

Typical site means a sediment site which is not a sensitive sediment site.

Location Sample Name Sample Date QA/QC Parameter	*CSR Standards for Sediment*	MCS	CCME Guidelines for Sediment ISQG	MCS	CCME Guidelines for Sediment PEL	MCS	SDS-1 L1906730-1 28/03/2017	SDS-2 L1906730-2 28/03/2017	SDS-3 L1906730-3 28/03/2017 FDA	DUP-1 L1906730-9 28/03/2017 FD	SDS-4 L1906730-4 28/03/2017	SDS-5 L1906730-5 28/03/2017	SDS-6 L1906730-6 28/03/2017	SDS-7 L1906730-7 28/03/2017	SDS-8 L1907291-1 30/03/2017	SDS-9 L1907291-2 30/03/2017	SDS-10 L1907291-3 30/03/2017	SDS-11 L1907291-4 30/03/2017 FDA	DUP-3 L1907291-11 30/03/2017 FD	SDS-12 L1907291-5 30/03/2017	SDS-13 L1907291-6 30/03/2017	SDS-14 L1907291-7 30/03/2017	SDS-15 L1907291-8 30/03/2017	SDS-16 L1907291-9 30/03/2017	SDS-17 L1907291-10 30/03/2017
PAH																									
Acenaphthene	0.055	F	**0.00671**	F, M	**0.0889**	F, M	< 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	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Acenaphthylene	0.079	M	**0.00587**	F, M	**0.128**	F, M	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	**0.0076**	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Anthracene	0.15	F	**0.0469**	F, M	**0.245**	F, M	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	0.0059	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040	< 0.0040
Benzo(a)anthracene	0.24	F	**0.0317**	F	**0.385**	F	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	**0.034**	0.018	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(a)pyrene	0.47	M	**0.0319**	F	**0.763**	M	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	**0.031**	0.019	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(b)fluoranthene							< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.043	0.022	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(g,h,i)perylene							< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.013	0.013	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(k)fluoranthene							< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.019	0.013	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chrysene	0.52	M	**0.0571**	F	**0.846**	M	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.044	0.022	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenzo(a,h)anthracene	0.084	F	**0.00622**	F, M	**0.135**	F, M	< 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	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050
Fluoranthene	0.93	M	**0.111**	F	**1.494**	M	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.023	0.018	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo(a)pyrene Total Potency Equivalence (TPE)							< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.045	0.028	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Benzo(b,j,k)fluoranthene							< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	0.062	0.036	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Fluorene	0.089	F	**0.0212**	F, M	**0.144**	F, M	< 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	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)pyrene							< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.015	0.013	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Index of Additive Cancer Risk (IACR)							< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	0.61	0.36	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15
Naphthalene	0.24	F	**0.0346**	F, M	**0.391**	F, M	< 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	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	0.32	F	**0.0419**	F	**0.515**	F	< 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	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Pyrene	0.54	F	**0.053**	F	**0.875**	F	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.028	0.020	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
2-methylnaphthalene	0.12	F	**0.0202**	F, M	**0.201**	F, M	< 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	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
EPH (C10-C19)							-	< 200	-	< 200	-	-	< 200	-	-	< 200	< 200	-	-	-	-	-	-	-	-
LEPH (C10-C19) Less PAHs							-	< 200	-	< 200	-	-	< 200	-	-	< 200	< 200	-	-	-	-	-	-	-	-
EPH (C19-C32)							-	< 200	-	< 200	-	-	< 200	-	-	< 200	< 200	-	-	-	-	-	-	-	-
HEPH (C19-C32) Less PAHs							-	< 200	-	< 200	-	-	< 200	-	-	< 200	< 200	-	-	-	-	-	-	-	-
BC_SUM_13PAH							0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).

Canadian Council of Ministers of the Environment (CCME) Sediment Guidelines for the Protection of Aquatic Life in Marine/Estuarine and Freshwater.

Accessed May 2016. Available online at: http://st-ts.ccme.ca/en/index.html?chems=all&chapters=3.

The most conservative guideline between freshwater and marine/estuarine guidelines was selected where both were available.

< = below laboratory detection limit or less than; "-" = not measured; FD = field duplicate; FDA = field duplicate available; FS = freshwater; I = interim guideline; ISQG = interim sediment quality guideline; M/ES = marine and/or estuarine water; QA/QC = quality assurance/quality control;

Sensitive site means a sediment site with sensitive aquatic habitat and for which sensitive sediment management objectives apply.

Typical site means a sediment site which is not a sensitive sediment site.

Location Sample Name Sample Date QA/QC Parameter	*CSR Omnibus Standards for Sediment*	MCS	CCME Guidelines for Sediment ISQG	MCS	CCME Guidelines for Sediment PEL	MCS	SDS-2 L1906730-2 28/03/2017	SDS-6 L1906730-6 28/03/2017	SDS-9 L1907291-2 30/03/2017	SDS-10 L1907291-3 30/03/2017
Chlorinated Phenols										
2-chlorophenol (Ortho)							< 0.020	< 0.020	< 0.020	< 0.020
3-chlorophenol (Meta)							< 0.020	< 0.020	< 0.020	< 0.020
4-chlorophenol (Para)							< 0.020	< 0.020	< 0.020	< 0.020
4-chloro-3-methylphenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3-dichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,4 & 2,5-dichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,6 dichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
3,4 dichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
3,5 dichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,4-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,5-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,6-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,4,5-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,4,6-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
3,4,5-trichlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,4,5-tetrachlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,4,6-tetrachlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
2,3,5,6-tetrachlorophenol							< 0.020	< 0.020	< 0.020	< 0.020
Pentachlorophenol	0.36	M					< 0.020	< 0.020	< 0.020	< 0.020
Soil Pesticides										
Dibutyltin							< 1.0	< 1.0	< 1.0	< 1.0
Dioctyltin							< 1.0	< 1.0	< 1.0	< 1.0
Diphenyltin							< 1.0	< 1.0	< 1.0	< 1.0
Monobutyltin							< 1.0	< 1.0	< 1.0	< 1.0
Monooctyltin							< 1.0	< 1.0	< 1.0	< 1.0
Monophenyltin							< 1.0	< 1.0	< 1.0	< 1.0
Tetrabutyltin							< 1.0	< 1.0	< 1.0	< 1.0
Tricyclohexyltin							< 1.0	< 1.0	< 1.0	< 1.0
Triphenyltin							< 1.0	< 1.0	< 1.0	< 1.0
Tributyltin							< 1.0	< 1.0	< 1.0	< 1.0

Notes:

Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.

Standards shown from the *Contaminated Sites Regulation* ("CSR"; BC Reg. 375/96, including amendments up to 1 November 2017).

Canadian Council of Ministers of the Environment (CCME) Sediment Guidelines for the Protection of Aquatic Life in Marine/Estuarine and Freshwater.

Accessed May 2016. Available online at: http://st-ts.ccme.ca/en/index.html?chems=all&chapters=3.

The most conservative guideline between freshwater and marine/estuarine guidelines was selected where both were available.

< = below laboratory detection limit or less than; "-" = not measured; FD = field duplicate; FDA = field duplicate available; FS = freshwater; I = interim guideline; ISQG = interim sediment quality guideline; M/ES = marine and/or estuarine water; QA/QC = quality assurance/quality control;

Sensitive site means a sediment site with sensitive aquatic habitat and for which sensitive sediment management objectives apply.

Typical site means a sediment site which is not a sensitive sediment site.

Sample Location Sample Name Sample Collection Date	Units	DUP-3 3/30/2017	SDS-11 3/30/2017	RDL	RPD (%)	DF (unitless)	DUP-2 3/28/2017	NF-3 3/28/2017	RDL	RPD (%)	DF (unitless)	DUP-1 3/28/2017	SDS-3 3/28/2017	RDL	RPD (%)	DF (unitless)
Physical Parameters																
pH	pH units	7.50	7.57	0.10	1	n/c	7.82	7.79	0.10	0	n/c	7.68	7.60	0.10	1	n/c
Total Organic Carbon	%	< 0.050	0.059	0.050	n/c	0.18	0.608	0.631	0.050	4	n/c	-	0.137	0.075	n/c	n/c
Metals																
Aluminum	mg/kg						12800	12600	50	2	n/c	9620	10300	50	7	n/c
Antimony	mg/kg	0.38	0.16	0.10	n/c	**2.20**	0.47	0.46	0.10	n/c	0.1	0.19	0.18	0.10	n/c	0.1
Arsenic	mg/kg	3.55	3.17	0.10	11	n/c	5.75	5.80	0.10	1	n/c	3.33	3.25	0.10	2	n/c
Barium	mg/kg	40.2	42.8	0.50	6	n/c	92.9	90.9	0.50	2	n/c	42.2	46.2	0.50	9	n/c
Beryllium	mg/kg	0.17	0.17	0.10	n/c	0	0.30	0.31	0.10	n/c	0.1	0.19	0.21	0.10	n/c	0.2
Bismuth	mg/kg	-	-	-	-	-	< 0.20	< 0.20	0.20	n/c	0	< 0.20	< 0.20	0.20	n/c	0
Boron	mg/kg	-	-	-	-	-	< 5.0	< 5.0	5.0	n/c	0	< 5.0	< 5.0	5.0	n/c	0
Cadmium	mg/kg	0.109	0.104	0.050	n/c	0.1	0.186	0.178	0.020	4	n/c	0.107	0.113	0.020	5	n/c
Calcium	mg/kg						7550	7540	50	0	n/c	5490	6210	50	12	n/c
Chromium	mg/kg	18.3	14.4	0.50	24	n/c	44.0	43.0	0.50	2	n/c	26.6	25.3	0.50	5	n/c
Cobalt	mg/kg	6.89	6.19	0.10	11	n/c	12.6	12.5	0.10	1	n/c	7.14	7.88	0.10	10	n/c
Copper	mg/kg	12.4	12.3	0.50	1	n/c	27.3	26.4	0.50	3	n/c	12.9	14.4	0.50	11	n/c
Iron	mg/kg	-	-	-	-	-	31400	30500	50	3	n/c	17200	19000	50	10	n/c
Lead	mg/kg	2.10	1.87	0.50	n/c	0.46	5.38	5.36	0.50	0	n/c	2.19	2.17	0.50	n/c	0.04
Lithium	mg/kg	-	-	-	-	-	13.0	13.2	2.0	2	n/c	7.8	7.8	2.0	n/c	0
Magnesium	mg/kg	-	-	-	-	-	9720	9620	20	1	n/c	6320	6960	20	10	n/c
Manganese	mg/kg	-	-	-	-	-	481	484	1.0	1	n/c	411	415	1.0	1	n/c
Mercury	mg/kg	0.0143	0.0142	0.0050	n/c	0.02	0.0363	0.100	0.0050	**93**	n/c	0.0593	0.0170	0.0050	**111**	n/c
Molybdenum	mg/kg	0.45	0.28	0.10	n/c	1.7	0.74	0.75	0.10	1	n/c	0.58	0.28	0.10	**70**	n/c
Nickel	mg/kg	24.7	22.4	0.50	10	n/c	44.5	43.8	0.50	2	n/c	28.5	29.3	0.50	3	n/c
Phosphorus	mg/kg	-	-	-	-	-	781	722	50	8	n/c	466	529	50	13	n/c
Potassium	mg/kg	-	-	-	-	-	960	950	100	1	n/c	490	470	100	n/c	0.2
Selenium	mg/kg	< 0.20	< 0.20	0.20	n/c	0	0.30	0.28	0.20	n/c	0.1	< 0.20	< 0.20	0.20	n/c	0
Silver	mg/kg	< 0.10	< 0.10	0.10	n/c	0	< 0.10	< 0.10	0.10	n/c	0	< 0.10	< 0.10	0.10	n/c	0
Sodium	mg/kg	4.4	4.2	1.0	n/c	0.2	354	344	50	3	n/c	237	244	50	n/c	0.14
Sodium	mg/kg	-	-	-	-	-	-	-	-	-	-	4.9	5.4	1.0	10	n/c
Strontium	mg/kg	-	-	-	-	-	43.8	43.4	0.50	1	n/c	21.2	24.1	0.50	13	n/c
Thallium	mg/kg	< 0.050	< 0.050	0.050	n/c	0	0.072	0.076	0.050	n/c	0.08	< 0.050	< 0.050	0.050	n/c	0
Tin	mg/kg	< 2.0	< 2.0	2.0	n/c	0	< 2.0	< 2.0	2.0	n/c	0	< 2.0	< 2.0	2.0	n/c	0
Titanium	mg/kg						1040	1020	1.0	2	n/c	792	878	1.0	10	n/c
Uranium	mg/kg	0.212	0.255	0.050	18	n/c	0.689	0.683	0.050	1	n/c	0.266	0.284	0.050	7	n/c
Vanadium	mg/kg	38.8	35.5	0.20	9	n/c	66.4	64.5	0.20	3	n/c	41.5	48.3	0.20	15	n/c
Zinc	mg/kg	35.6	32.9	2.0	8	n/c	68.2	65.2	2.0	4	n/c	36.5	38.9	2.0	6	n/c
Zirconium	mg/kg	-	-	-	-	-	5.3	5.6	1.0	6	n/c	4.9	5.3	1.0	8	n/c
PAH																
2-methylnaphthalene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0
Acenaphthene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	0.0081	0.0070	0.0050	n/c	0.22	< 0.0050	< 0.0050	0.0050	n/c	0
Acenaphthylene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0
Anthracene	mg/kg	< 0.0040	< 0.0040	0.0040	n/c	0	0.0073	0.0053	0.0040	n/c	0.5	< 0.0040	< 0.0040	0.0040	n/c	0
Benzo(a)anthracene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.020	0.011	0.010	n/c	0.9	< 0.010	< 0.010	0.010	n/c	0
Benzo(a)pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.013	< 0.010	0.010	n/c	0.3	< 0.010	< 0.010	0.010	n/c	0
Benzo(b)fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.032	0.025	0.010	n/c	0.7	< 0.010	< 0.010	0.010	n/c	0
Benzo(b,j,k)fluoranthene	mg/kg	< 0.015	< 0.015	0.015	n/c	0	0.044	0.037	0.015	n/c	0.466667	< 0.015	< 0.015	0.015	n/c	0
Benzo(g,h,i)perylene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0
Benzo(k)fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.013	0.012	0.010	n/c	0.1	< 0.010	< 0.010	0.010	n/c	0
Chrysene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.020	< 0.020	0.020	n/c	0	< 0.010	< 0.010	0.010	n/c	0
Dibenzo(a,h)anthracene	mg/kg	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0	< 0.0050	< 0.0050	0.0050	n/c	0
Fluoranthene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.060	0.050	0.010	18	n/c	< 0.010	< 0.010	0.010	n/c	0
Fluorene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.012	< 0.010	0.010	n/c	0.2	< 0.010	< 0.010	0.010	n/c	0
Indeno(1,2,3-c,d)pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0	< 0.010	< 0.010	0.010	n/c	0
Naphthalene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.013	< 0.010	0.010	n/c	0.3	< 0.010	< 0.010	0.010	n/c	0
Phenanthrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.038	0.037	0.010	n/c	0.1	< 0.010	< 0.010	0.010	n/c	0
Pyrene	mg/kg	< 0.010	< 0.010	0.010	n/c	0	0.046	0.043	0.010	n/c	0.3	< 0.010	< 0.010	0.010	n/c	0
Index of Additive Cancer Risk (IACR)	mg/kg	< 0.15	< 0.15	0.15	n/c	0	0.39	0.29	0.15	n/c	0.666667	< 0.15	< 0.15	0.15	n/c	0

Notes:

Results are expressed in miligrams per kilogram (mg/kg), unless otherwise indicated.

FDA = field duplicate available

FD = field duplicate

QA/QC = quality assurance/quality control

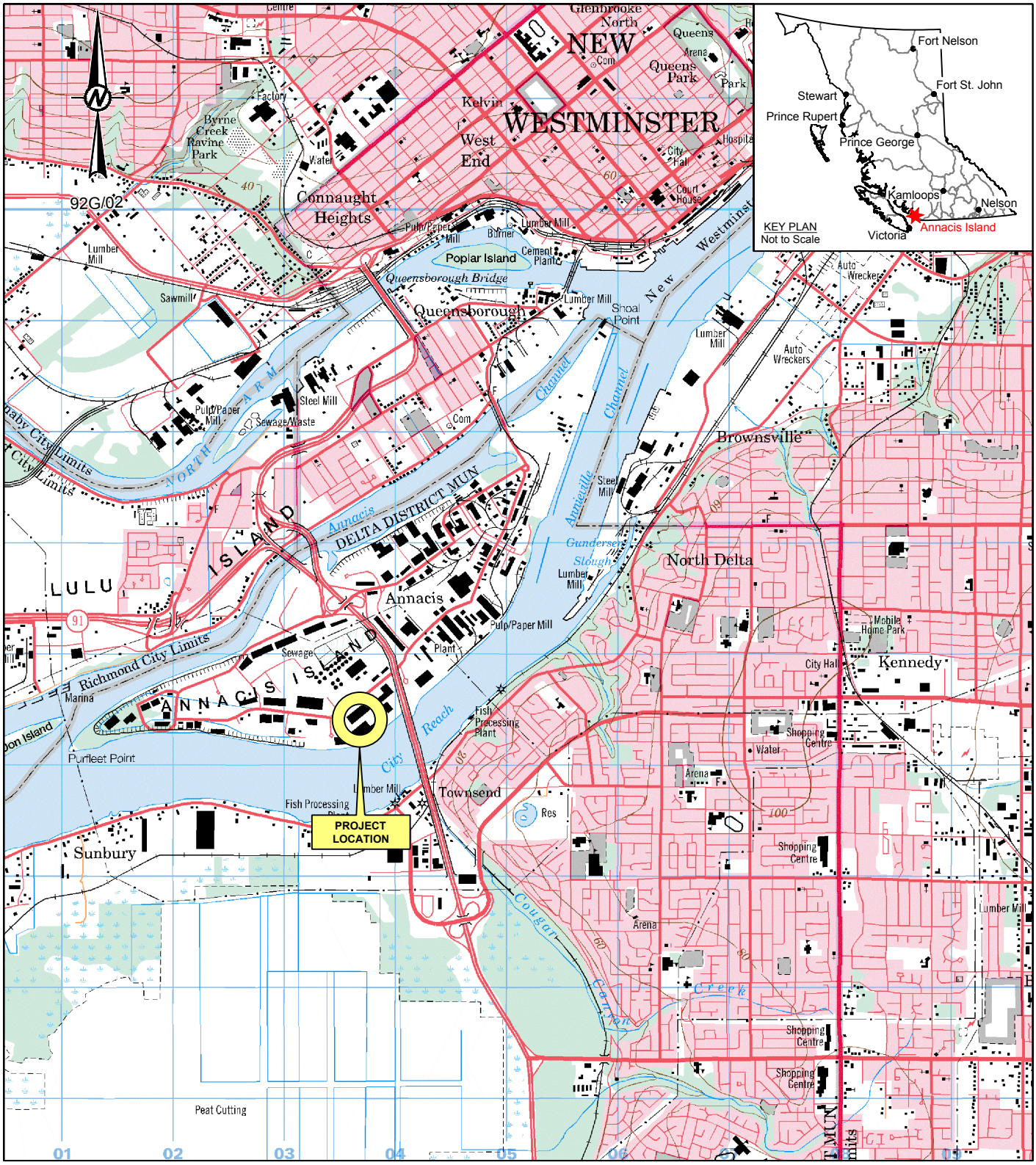
Method Reporting Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.

Relative Percent Difference (RPD) is calculated when the mean value is greater than five times the method reporting limit; Golder's internal QA/QC target is less than 35%.

Difference Factor (DF) is calculated when the mean value is less than five times the method reporting limit; Golder's internal QA/QC target is less than 2.

n/c = not calculated

BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.



REFERENCE

BASE MAPPING FROM CANMATRIX 1: 50000 NTS - 92G/02
CANVEC DATA OBTAINED FROM GEOGRATIS, CENTRE FOR TOPOGRAPHIC INFORMATION (NRCAN, ESS) DEPARTMENT OF NATURAL RESOURCES, CANADA.
DATUM: NAD83, PROJECTION: UTM ZONE 10

0 1,000 2,000
1:50,000 METRES

CLIENT
CDM SMITH

PROJECT
AIWWTP TRANSIENT MITIGATION AND OUTFALL, DELTA, BC
SUPPLEMENTARY GEO-ENVIRONMENTAL ASSESSMENT

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-06-14
PREPARED	RTJ
DESIGN	AGH
REVIEW	AGH
APPROVED	AGH

TITLE
KEY PLAN

PROJECT No.	PHASE	Rev.	FIGURE
1525010	3000/3300	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

0 25 mm

Path: \\golder.gds\gal\Fort St John\CAD-GIS\CDM Smith\Annacis Island\99_PROJECTS\1525010_Enviro\02_PRODUCTION\1525010_3300_3300.6\DWG\ | File Name: 1525010_3300_3300.6_01 - Key Plan.dwg

LEGEND

- SONIC HOLE LOCATION
- BOREHOLE LOCATION
- AUGERHOLE LOCATION
- SEDIMENT SAMPLE LOCATION
- INSTALLED MONITORING WELL

REFERENCE(S)

1. BACKGROUND IMAGE SUPPLIED BY AND SOURCED UNDER LICENSE FROM GOOGLE EARTH PRO. ON JUNE 7, 2017 IMAGE DATE: AUG 17, 2016 IMAGE GEOREFERENCED BY GOLDER AND INTENDED FOR INDICATIVE PURPOSES ONLY
2. BASE DRAWING PROVIDED BY BLACK & VEATCH FILE: C000A_XXXXX-1.DWG
3. 2016 CCG BATHYMETRY SURVEY AND OPTION 6 ALIGNMENT PROVIDED BY CDM SMITH CANADA ULC ON MAY 19, 2016 FILE: C201072016.DWG
4. DATUM: NAD83, PROJECTION: UTM ZONE 10

0 100 200
1:4,000 METRES

CLIENT
CDM SMITH

PROJECT
AIWWTP TRANSIENT MITIGATION AND OUTFALL, DELTA, BC
SUPPLEMENTARY GEO-ENVIRONMENTAL ASSESSMENT

TITLE
SITE AND SAMPLING LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-06-14
PREPARED	RTJ
DESIGN	AGH
REVIEW	AGH
APPROVED	AGH

PROJECT No.	PHASE	Rev.	FIGURE
1525010	3000/3300	A	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25 mm

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501000 502500 504000 505500

5448000 5449500

PROPOSED OPTION 6
OUTFALL ALIGNMENT

0 500 1,000
1:20,000 METRES

LEGEND

SAa — LANDFILL INCLUDING SAND, GRAVEL, TILL, CRUSHED STONE, AND REFUSE

SAb-e — BOG, SWAMP, AND SHALLOW LAKE DEPOSITS: SAb, LOWLAND PEAT UP TO 14 m THICK, IN PART OVERLYING Fb, c; SAc, LOWLAND PEAT UP TO 1 m THICK UNDER Fb (UP TO 2 m THICK); SAd, LOWLAND ORGANIC SANDY LOAM TO CLAY LOAM 15 TO 45 cm THICK OVERLYING SAg AND Fd; SAe, UPLAND PEAT UP TO 8 m OR MORE THICK

FRASER RIVER SEDIMENTS

Fa-d — DELTAIC AND DISTRIBUTARY CHANNEL FILL SEDIMENTS OVERLYING AND CUTTING ESTUARINE SEDIMENTS AND OVERLAIN IN PART OF THE AREA BY OVERBANK SEDIMENTS: Fa, CHANNEL DEPOSITS, FINE TO MEDIUM SAND AND MINOR SILT OCCURRING ALONG PRESENT DAY RIVER CHANNELS; Fb, OVERBANK SANDY TO SILT LOAM UP TO 2 m THICK OVERLYING 15 m OR MORE OF Fd; Fc, OVERBANK SILTY TO SILT CLAY LOAM NORMALLY UP TO 2 m THICK OVERLYING 15 m OR MORE OF Fd; Fd*, DELTAIC AND DISTRIBUTARY CHANNEL FILL (INCLUDES TIDAL FLAT DEPOSITS) SANDY TO SILT LOAM, 10 TO 40 m THICK INTERBEDDED FINE TO MEDIUM SAND AND MINOR SILT BEDS; MAY ALSO CONTAIN ORGANIC AND FOSSILIFEROUS MATERIAL

Ca-e — CAPILANO SEDIMENTS (CHRONOLOGICALLY EQUIVALENT TO SUMAS DRIFT AND FORT LANGLEY FORMATION, SEE LITHOLOGIC UNITS AND ENVIRONMENTS OF DEPOSITION) RAISED MARINE, DELTAIC, AND FLUVIAL DEPOSITS: Ca, RAISED MARINE BEACH, SPIT, BAR, AND LAG VENEER, POORLY SORTED SAND TO GRAVEL (EXCEPT IN BAR DEPOSITS) NORMALLY LESS THAN 1 m THICK BUT UP TO 8 m THICK, MANTLING OLDER SEDIMENTS AND CONTAINING FOSSIL MARINE SHELL CASTS UP TO 175 m ABOVE SEA LEVEL; Cb, RAISED BEACH MEDIUM TO COARSE SAND 1 TO 5 m THICK CONTAINING FOSSIL MARINE SHELL CASTS; Cc, RAISED DELTAIC AND CHANNEL FILL MEDIUM SAND TO COBBLE GRAVEL UP TO 15 m THICK DEPOSITED BY PROGLACIAL STREAMS AND COMMONLY UNDERLAIN BY SILTY TO SILTY CLAY LOAM; Cd, MARINE AND GLACIOMARINE STONY (INCLUDING TILL-LIKE DEPOSITS) TO STONELESS SILT LOAM TO CLAY LOAM 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. Ce, MAINLY MARINE SILT LOAM TO CLAY LOAM WITH MINOR SAND, SILT, AND STONY GLACIOMARINE MATERIAL (SEE Cd), UP TO 60+m THICK. IN MANY OF THE UPLAND AREAS SEDIMENTS MAPPED AS Cc AND Cd ARE MANTLED BY A THIN VENEER (LESS THAN 1 m) OF Ca

VASHON DRIFT AND CAPILANO SEDIMENTS

VC — GLACIAL DRIFT INCLUDING: LODGMENT AND MINOR FLOW TILL, LENSE AND INTERBEDS OF SUBSTRATIFIED GLACIOFLUVIAL SAND TO GRAVEL, SAND LENSES AND INTERBEDS OF GLACIOLACUSTRINE LAMINATED STONY SILT; UP TO 25 m THICK BUT IN MOST PLACES LESS THAN 8 m THICK (CORRELATES WITH Va, b); OVERLAIN BY GLACIOMARINE AND MARINE DEPOSITS SIMILAR TO Cd 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 TILL IS MANTLED BY BOULDERY GRAVEL THAT MAY BE IN PART ABLATION TILL, IN PART COLLUVIUM, AND IN PART MARINE SHORE IN ORIGIN

VASHON DRIFT

Va,b — TILL, GLACIOFLUVIAL, GLACIOLACUSTRINE, AND ICE-CONTACT DEPOSITS: Va, LODGMENT TILL (WITH SANDY LOAM MATRIX) AND MINOR FLOW TILL CONTAINING LENSES AND INTERBEDS OF GLACIOLACUSTRINE LAMINATED STONY SILT; Vb, GLACIOGLUVIAL SANDY GRAVEL AND GRAVELLY SAND OUTWASH AND ICE-CONTACT DEPOSITS

PRE-VASHON DEPOSIT

PVa-h — GLACIAL, NONGLACIAL, AND GLACIOMARINE SEDIMENTS: PVa, QUADRA FLUVIAL CHANNEL FILL AND FLOODPLAIN DEPOSITS, CROSSBEDDED SAND CONTAINING MINOR SILT AND GRAVEL LENSES AND INTERBEDS; PVb, QUADRA (?) GLACIOFLUVIAL DEPOSITS, DELTAIC, AND CROSSBEDDED SAND TO GRAVEL (MAY BE IN PART Vb); PVc, QUADRA MARINE INTERBEDDED FINE SAND TO CLAYEY SILT BELIEVED TO BE OFF SHORE EQUIVALENTS OF PVa; PVd, COQUITLAM TILL, GLACIOMARINE (?), SAND GLACIOLACUSTRINE DEPOSITS; PVe, COWICHAN HEAD FLUVIAL, ORGANIC COLLUVIAL, AND BOG AND SWAMP SEDIMENTS; PVf, SEMIAHMOO TILL, GLACIOFLUVIAL, GLACIOMARINE, AND GLACIOLACUSTRINE DEPOSITS; PVg*, HIGHBURY FLUVIAL AND BOG AND SWAMP DEPOSITS; PVh*, WESTLYNN GLACIOFLUVIAL SANDY GRAVEL

RS — AREA OF RECORDED LANDSLIDES.

PROPOSED OPTION 6 OUTFALL ALIGNMENT

LEGEND

1. SURFICIAL GEOLOGY MAP OBTAINED FROM GEOLOGICAL SURVEY OF CANADA MAP 1484 A (NEW WESTMINSTER), 1980.

CLIENT
CDM SMITH

PROJECT
AIWWTP TRANSIENT MITIGATION AND OUTFALL, DELTA, BC
SUPPLEMENTARY GEO-ENVIRONMENTAL ASSESSMENT

TITLE
SURFICIAL GEOLOGY

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-06-14
PREPARED	RTJ
DESIGN	AGH
REVIEW	AGH
APPROVED	AGH

PROJECT No.	PHASE	Rev.	FIGURE
1525010	3000/3300	A	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm 0

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CDM Smith

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