

2019 Groundwater and Soil Vapour Monitoring Report McKenzie Trails Recreation Area NE and SE Portions of Section 28-037-27 W4M



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OCTOBER 2, 2020
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EXECUTIVE SUMMARY

The City of Red Deer (The City) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct the 2019 groundwater and vapour monitoring program at the former landfill located beneath the McKenzie Trails Recreation Area (McKenzie Trails), located within the NE and SE Section of 28-038-27 W4M in Red Deer, Alberta, hereafter referred to as “the site”. The objective of the monitoring program is to identify potential environmental concerns related to former operations at the site.

Tetra Tech’s scope of work for the 2019 monitoring and sampling program at the McKenzie Trails site included conducting quarterly events of groundwater and vapour monitoring, annual groundwater and vapour sampling, updating the hazard quotients, reviewing and updating previous recommendations for the site, and preparing an annual report.

The groundwater monitoring network at the site consists of six monitoring wells (MW-01 to MW-05 and MW-203). MW-03 (deep) and MW-04 (shallow) are a nested pair located in the northeast section of the site. Most of the wells are screened to the bottom of the well within the native sand and gravel. MW-05 is screened within the municipal solid waste (MSW) to bedrock. The vapour monitoring network consists of one vapour monitoring well (VW-01) near the southeast corner of the site.

Based upon the results of the groundwater and soil vapour monitoring and sampling conducted in 2019 and previous years, Tetra Tech has developed the following conclusions:

- The groundwater elevations in 2019 indicated that the inferred groundwater flow direction was overall northerly, which is consistent with the groundwater flow direction from 2013 and the flow direction in the Red Deer River. The average horizontal hydraulic gradient at the site in 2019 has been estimated as approximately 0.003 m/m. Groundwater elevations in 2019 were overall slightly lower than groundwater elevations measured in 2013.
- Routine groundwater chemistry parameters and dissolved metals that exceeded the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines) at one or more monitoring wells in 2019 included total dissolved solids (TDS), ammonia, arsenic, copper, iron, and manganese. The measured concentrations of one or more of these parameters suggest leachate has impacted the groundwater quality at MW-03, MW-04, and MW-203.
- Concentrations of benzene, toluene, ethylbenzene and xylenes (BTEX) and petroleum hydrocarbon (PHC) fractions F1 to F2, were less than the analytical detection limits at most locations in 2019. MW-203 had a detectable concentration of benzene (0.00053 mg/L), marginally greater than the detection limit (0.00050 mg/L). Concentrations of BTEX and PHC fractions F1 and F2 were less than the Tier 1 Guidelines at all locations.
- Concentrations of vinyl chloride were greater than the Tier 1 Guidelines in the groundwater samples collected from MW-04 and MW-203. Concentrations of vinyl chloride were historically less than the analytical detection limit at MW-04; no historical data was available for MW-203.
- Concentrations of BTEX, hydrocarbons, and volatile organic compounds (VOCs) in the soil vapour sample were less than the calculated soil vapour screening criteria.
- Concentrations of siloxanes were less than the analytical detections limits in the vapour sample collected.
- The estimated individual and cumulative risks and hazards associated with the soil vapour samples collected in December 2019 did not exceed the corresponding target risk and hazard levels.

Based upon the results of the groundwater monitoring program in 2019 and previous years, Tetra Tech has developed the following recommendations:

- Ongoing Monitoring:
 - Continue with a semi-annual groundwater monitoring program, with annual sampling at the hydraulically down-gradient monitoring wells (MW-03, MW-04, and MW-203) for another year to confirm trends. These wells should be sampled for routine chemistry, dissolved metals, and VOC parameters. As part of the monitoring program, well headspace monitoring should be included as described further below.
 - Survey the elevation of MW-203 to better establish the groundwater flow pattern within the north portion of the site.
 - If the measured concentrations are stable or decreasing, discontinue monitoring and sampling at the site. If the concentrations are confirmed and remain greater than the referenced guidelines, a qualitative evaluation of risks should be made to evaluate the potential concern, if any, these concentrations pose to the adjacent Red Deer River.
 - Based on the results of the soil vapour sample, there is little indication that this pathway will pose a hazard to receptors. The soil vapour concentrations were less than the levels of concern and groundwater concentrations of volatile chemicals were also less than established Tier 1 Guidelines, except for vinyl chloride in monitoring wells MW-04 and MW-203. Historical results have not identified vinyl chloride. If the concentrations of vinyl chloride exceed the referenced guidelines in the next monitoring events, a qualitative evaluation of risks, as stated above, should be conducted.
 - The north portion of the site is interpreted to have a low risk for vapour intrusion and installing additional soil vapour wells near monitoring wells MW-04 and MW-203 is not proposed. To support ongoing assessment of vapours, headspace monitoring of all wells (groundwater and vapour) for methane should be conducted in conjunction with the groundwater monitoring program, however further sampling of vapours in VW-01 is not considered warranted. Further to the well monitoring, it is Tetra Tech’s understanding that there are washroom buildings located near the centre of the site within the waste footprint. A walkthrough of the buildings should be conducted to evaluate the potential for accumulation of vapours; if the potential for accumulation is identified, indoor air monitoring could be undertaken in conjunction with the well headspace monitoring. Continue to monitor the riverbank during the semi-annual monitoring events for potential waste exposure and seepage due to bank erosion.
- Administrative Actions:
 - Utilize the revised generic mitigative measures when evaluating applications for development within the setback.
 - Ensure that the site is clearly identified within The City’s Land Use Bylaw and appropriate administrative requirements are met for the site in accordance with City policies.

Further to the above recommendations, as noted the site remains an historical landfill. It presently appears to be well maintained and capped. The City should review this status on an ongoing basis to ensure that the cover remains intact and drainage remains positive; repairs or maintenance should be undertaken as required to maintain the site. This evaluation should include regular inspection of the adjacent riverbank for evidence of erosion and potential exposed waste or leachate seepage.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of The City of Red Deer and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than The City of Red Deer, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in Appendix A or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

The City of Red Deer (The City) retained Tetra Tech Canada Inc. (Tetra Tech) to conduct the 2019 groundwater and vapour monitoring program at the former landfill located beneath the McKenzie Trails Recreation Area (McKenzie Trails), located within the NE and SE Sections of 28-038-27 W4M, hereafter referred to as “the site”. The objective of the monitoring program is to identify potential environmental concerns related to former operations at the site.

The project was completed under Tetra Tech’s Limitations on the Use of this Document for conducting environment work. A copy of these conditions is provided in Appendix A. Cross-sections that were prepared using the wells included in the monitoring program are included in Appendix B (from Tiamat Environmental Consultants Ltd. [Tiamat] 2014a).

1.1 Scope of Work

Tetra Tech’s scope of work for the 2019 monitoring and sampling program included the following activities:

- Conducting quarterly events of groundwater and vapour monitoring, including measuring headspace vapours and groundwater levels within each monitoring well and observing monitoring well integrity.
- Conducting groundwater sampling by:
 - Purging shallow groundwater monitoring wells and deep groundwater monitoring wells until practically dry or until a minimum of three well volumes had been removed and allowing the water levels in the wells to recover;
 - Measuring field parameters (pH, electrical conductivity [EC], and water temperature) at the time of sampling; and
 - Collecting groundwater samples from each well and submitting the samples for laboratory chemical analyses.
- Conducting vapour sampling by:
 - Collecting vapour samples into Summa canisters for analysis;
 - Collecting vapour samples for siloxanes analysis into thermal desorption (TD) tubes; and
 - Collecting one duplicate vapour sample for quality assurance/quality control (QA/QC) purposes.
- Conducting monitoring well repairs, as required.
- Updating the hazard quotients prepared during previous reporting using the 2019 monitoring and sampling results.
- Preparing an annual report summarizing the field activities undertaken for the year and interpreting the groundwater and soil vapour analytical results.

1.2 Pre-1972 Landfill Program

The scope of work for the monitoring program was based on the proposal submitted by Tetra Tech on January 11, 2019, to The City to conduct environmental monitoring services for the pre-1972 landfill sites.

The proposal was submitted in accordance with the Request for Proposal (RFP) No. 1090-2018-261 issued by The City on November 30, 2018, and Addendum 01 issued by The City on January 7, 2019. This report documents the scope and findings for the McKenzie Trails site.

The objective of the overall project for the pre-1972 Landfills was to:

- Confirm and implement the prior recommendations, as per the RFP;
- Consult with the regulator on amendments to the program, as required;
- Conduct environmental monitoring and sampling for each of the eight sites, as outlined in the RFP recommendations, while incorporating any approved recommendations;
- Update the hazard quotients for each site; and
- Prepare an environmental monitoring report for each of the eight sites.

The eight pre-1972 landfill sites include:

- Great West Adventure Park;
- Lindsay Thurber Comprehensive High School;
- McKenzie Trails;
- Montfort;
- Red Deer College;
- Red Deer Motors;
- Riverside Heavy Dry Waste Site; and
- Riverside Light Industrial Park.

Each site is summarized in a separate report. This report is focused on the McKenzie Trails site. It includes a description of the site geology and hydrogeology, the results of the 2019 monitoring activities at the site, and an interpretation and evaluation of the collected data.

2.0 BACKGROUND INFORMATION

2.1 General Information

The site is located within the NE and SE portions of 28-038-27 W4M, within Plan 4086EO and 3081MC. The site is zoned P1 – Parks and Recreation and is located within the McKenzie Trails Park. The site is located on the east bank of the Red Deer River, north of 67 Street and east of Riverside Drive. The Red Deer River is adjacent to the west boundary of the site and flows in a northeasterly direction. A general site plan is shown on Figure 1. The site has been redeveloped, and includes a picnic shelter, man-made pond, playground, paved walking trails, surface parking, and one year-round washroom facility. The Phase I ESA by Tiamat (2013) identified a non-potable water well as providing water for the public washroom facilities. Based on further discussions with the City, the water is reportedly a tank filled periodically with a water truck. The surrounding land use consists of Environmental Preservation District, Future Urban Development District, and Parks and Recreation District. A residential

subdivision is located on the east side of the park. Natural areas of the site consist of grasses, trees, and wetlands. Figure 2 shows the site location with surrounding land use.

2.2 Site History

Municipal records indicate that the waste disposal at the site occurred in two phases. Disposal in the southern portion occurred from 1930 to 1959 (approximately 29 years) and in the northern portion from 1960 to 1964 (approximately 4 years). The estimated age of the waste material post closure of the landfill is interpreted to be 55 to 60 years. Historical information indicates the waste as being municipal solid waste (MSW) including a mixture of plastics, cans, paper, scrap metals, wires, and glass. Bricks, wood, and ash were also encountered during the Phase II investigation (Tiamat 2014a).

Historical waste disposal was identified during the 2014 Phase II environmental site assessment (ESA) to be north of the man-made pond area. The waste area extends to the north end of the recreation area and to the west towards the Red Deer River. Estimated waste areas are identified on Figure 2. The Phase II ESA estimated the total area of buried waste at approximately 64,250 m². The status of the former landfill is inactive and closed.

Results of the 2014 Phase II ESA conducted by Tiamat indicate that surface material of sod and loam was overlying the buried MSW material. There were no indications of a formal barrier layer (e.g., clay) overlying the waste. The thickness of the layer of sod and loam varied between 8 cm and 15 cm. The MSW was mixed with fill consisting of sand, gravel, silt, and clay, located below the sod to a depth of approximately 5 m in the north-central area of the site. A portion of the waste material consists of burned garbage. The waste material was overlying silt (fill), sand and gravel (native), and siltstone (bedrock) in the northwest to southeast and the MSW was overlying silty sand (fill), sand and gravel (native), and siltstone and shale (bedrock) in the northeast to southwest with some clay (till) in the southwest. The base of the MSW material is similar to the level of the adjacent Red Deer River.

2.3 Historical Groundwater Monitoring and Investigation Summary

Alberta Environment¹ (AENV) installed monitoring wells in 1982, including seven groundwater monitoring wells within and beside the waste material boundary. In June 2013, the Red Deer River experienced flooding and the west side of the site was impacted. Groundwater monitoring wells located on the east riverbank were damaged or destroyed, with the exception of MW-203.

Previous reports prepared by Tiamat for the site include the following:

- Phase I ESA, Historic Waste Disposal Site, McKenzie Trail, The City of Red Deer. September 24, 2013 (Tiamat 2013).
- Phase II ESA, Historic Waste Disposal Site, McKenzie Trails Recreation Area, The City of Red Deer. February 12, 2014 (Tiamat 2014a).
- Environmental Risk Management Plan (RMP), Historic Waste Disposal Sites, McKenzie Trails Recreation Area, The City of Red Deer. November 26, 2014 (Tiamat 2014b).

Two testholes (TH-03 and TH-04) were advanced in June 2013 as part of the Phase II ESA; one vapour well (VW-01) and one monitoring well (MW-01) were installed.

The results of the Phase II ESA conducted by Tiamat in 2014 indicated the following:

¹ Currently Alberta Environment and Parks (AEP).

- There were no obvious activities that pose a high potential to adversely impact the site from activities on adjacent developments. The historical waste area is within the boundaries of the park.
- The waste area underlies the park space north of the man-made pond and extends to a set-back from the Red Deer River. The plan area of the waste was calculated to be approximately 64,520 m², calculated from aerial photography and site observations based on topography.
- Groundwater samples demonstrated a varying level of contamination for petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs), and chlorinated hydrocarbons.

A soil vapour sample indicated VOCs, aliphatic and aromatic hydrocarbons, and siloxanes. The concentrations were considered trace to low and not identified as an environmental concern to the residential developments southeast of the area.

The recommendations of the program were as follows:

- Monitor groundwater elevations and soil vapour data quarterly for one hydrogeological cycle.
- Determine if surface water sampling should be included along with additional groundwater monitoring locations to determine exposure from leachate contaminants.
- Collect an additional set of soil vapour and groundwater analytical data, groundwater elevations, and volatile headspace measurement during the winter months to determine seasonal changes in soil vapour concentrations.
- Develop a RMP to consider future land uses and address environmental concerns.
- Review all data to update the RMP with new information.

The results of the subsequent RMP conducted by Tiamat in 2014 indicated the following:

- Information in the preliminary quantitative risk assessment (PQRA) should be updated as new site information is obtained.
- A review of the RMP should be completed when the PQRA information is updated, if there are changes to the chemicals of potential concern (COPCs).
- The RMP should be reviewed and updated at five-year intervals.

2.4 Monitoring Well Network

The groundwater monitoring network at the site consists of six monitoring wells (MW-01 to MW-05 and MW-203). MW-03 (deep) and MW-04 (shallow) are a nested pair located in the northeast section of the site. Most of the wells are screened to the bottom of the well within the native sand and gravel. MW-05 is screened within the MSW to bedrock. Monitoring well completion details are summarized in Table 1. Most monitoring wells were reported to be in good condition in 2019. MW-03 and MW-04 were loose above the ground surface and repairs were made to the wells in September 2019. MW-203 was missing a cap in May 2019, and a cap and lock were added to the well in June 2019. The vapour monitoring network consists of one vapour monitoring well (VW-01) near the southeast corner of the site. The vapour well was reported to be in good condition during all events in 2019.

No survey data was available for MW-203, and the monitoring well should be surveyed to be properly incorporated into the monitoring well network.

Groundwater and vapour monitoring well locations are shown on Figure 2.

3.0 SITE SETTING

The following section presents an overview of the regional and local setting for the site.

3.1 Geology

The following sections summarize the regional and local geology.

3.1.1 Geological Setting and Stratigraphy

The following description of regional geological setting was obtained from Tiamat's 2013 Phase I report (Tiamat 2013):

“The City of Red Deer and area are located within the Red Deer River drainage basin in the western Alberta Plains. The Red Deer River valley is the principal drainage way. The fertile black soil in the region (Penhold Loam) is of alluvial lacustrine origin. The Penhold Loam is a well-drained fine sandy loam classified as Chernozemic. It is generally stone free and in natural areas, is typically 1.5 m thick, more or less.

The local topography is characterized with gentle slopes bordered on the east and west by uplands and incised at its lowest part by the valley of the Red Deer River. The Tertiary bedrock consists of sequences of alternating shales and sandstones of the Paskapoo Formation whereas the Quaternary deposits consist of drift deposits of clay, silt, gravel and sand. Published information indicates the banks of the Red Deer River comprise of dirty gravel with thickness ranging from 6 to 12 m, more or less. The Paskapoo Formation underlies the gravel sediments. This non-marine bedrock is composed of mudstone, siltstone and sandstone. The formation of the Rocky Mountains subjected the Paskapoo Formation to a regional stress-induced fracture pattern.

Generally, the fracture pattern resembles a series of vertical fractures that trend southwest to northeast, perpendicular to the Rocky Mountains. A report from the Alberta Energy and Utilities Board EUB/AGS Earth Sciences Report 2002-04, suggest the pattern of fractures may be complemented with sub-horizontal fractures resulting from conjugate fracture patterns, differential stress release or pressure release events. In the valley, lies preglacial Saskatchewan gravels and sand. Terrace gravels hydraulically connected to the Red Deer River are a known groundwater resource.

Surficial soils comprise largely of poorly to moderately sorted sand, silt and gravel with a varying amount of clay. The fluvial sediments generally have obscure bedding planes. Medium to coarse sized gravel with cross-bedded sand have been documented.”

3.1.2 Local Geology

Based on the findings from the 2014 Phase II ESA, McKenzie Trails Park consisted of 8 cm to 15 cm of sod and loam overlying municipal solid waste. The MSW is overlying a mix of silt (fill), sand and gravel (native) and siltstone and shale (bedrock). The maximum depth of waste encountered was approximately 6 m. There are no indications of a prepared landfill foundation (e.g. compacted clay liner) based on the drilling logs.”

Mapping by the Alberta Geological Survey (Andriashek 2018) indicates that a buried valley could be present approximately 300 m east of the site trending in a north-northeast direction, however the width of the valley is not defined.

3.2 Hydrogeology

The following sections summarize the regional and local hydrogeology.

3.2.1 Regional Hydrogeology

The following description is taken from regional hydrogeology information from Tiamat's 2013 Phase I report (Tiamat 2013):

“A significant buried valley and aquifer resource trending northeastward through the city has been partially mapped and lies in the SE 28-38-27 W4M (MacKenzie Trail and Riverside). This buried valley extends to a depth of 21 m, more or less and may extend to the south into north portions of 21-28-27 W4M.”

“The dominant type of near-surface groundwater in the Paskapoo Formation in the area of assessment is sodium bicarbonate. Notable concentrations of sodium sulfate type groundwater have also been reported. The quality of groundwater for potable use is generally suitable to depths of 300 m on the west side of Red Deer and decreases to 90 m, more or less in the east.

Areas of recharge (downward flow) in unsaturated heterogeneous sediments include most areas above the river and creek valleys, whereas; the river valleys will generally exhibit discharge. The distribution of groundwater in the area can also be influenced by the local geology, topographic relief, areas of artesian flow, springs and reasonable yielding water source wells.

Numerous permanent surface water features within The City of Red Deer and vicinity include Red Deer River, Waskasoo Creek, Gaetz Lakes, Hazlett Lake, Bower Ponds (result of formerly mining gravel resources), various sloughs in the fringe areas of the city and an assortment of other smaller creeks and springs. These water bodies can be relevant to the environmental sensitivity of the site assessment.”

There is a hydrologic relation between the gravel deposit and the Red Deer River. Depending on local sediments and flow dynamics, some sections of the Red Deer River may experience an influent flow pattern and river water may enter the gravel beds and remain as river bank storage. The bank storage is typically gradually released when the river becomes effluent, usually between July and August. These seasonal fluctuations of the river level have notable influences with the magnitude and direction of groundwater. Discharges generally occur at some point downstream from the point of entry.

The regional groundwater generally follows the bedrock topography. It should be noted that local topography, geology, land development and soil disturbances may influence the local movement and pattern of groundwater and in conjunction; groundwater levels may fluctuate seasonally and in response to climatic conditions. The shallow pattern of flow can also be influenced by the physical attributes of the fluvial sediments and the glacially formed Red Deer River Valley.”

3.2.2 Local Hydrogeology

The Red Deer River is located on the west and north sides of McKenzie Trails Park and flows in a northerly direction. Shallow groundwater is assumed to flow towards or parallel to the river. A man-made pond is located in the central portion of McKenzie Trails Park, south of the closed landfill, and collects some of the site drainage.

3.3 Groundwater Resource Usage

A search of the Alberta Water Well Database conducted in January 2020 for groundwater users within a 1 km radius of the McKenzie Trails area identified 65 groundwater wells; 24 of the wells are listed as domestic use, 2 are listed as domestic and stock use, 21 are listed as investigation, 2 are listed as injection use, 8 are listed as industrial use, 3 are listed as “other”, 1 as observation use, and 4 are listed as unknown use (AEP 2019a).

The nearest water well identified through the Water Well Database to site is located approximately 100 m west of site and the Red Deer River. The proposed well use was for investigation purposes. The water wells within a 1 km radius of site range from 2.4 m to 190 m deep. The status and use of the surrounding groundwater wells were not confirmed and they were not field verified.

Information for groundwater wells within 1 km of the site is provided in Appendix C.

4.0 CONCEPTUAL SITE MODEL

The selection of remediation guidelines is based on the conceptual site model (CSM) which outlines the rationale of the selection of applicable exposure pathways and indicates which soil and groundwater exposure-specific remediation guidelines should apply. This evaluation is based on guidance presented in the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines; AEP 2019a).

A CSM was developed for the site and includes the following items:

- Description of any identified environmental issues including a description of processes or activities undertaken at or near the site and a listing of COPCs identified in earlier investigations.
- Description of known and reported historical releases, including locations and status of any subsequent ESAs and remediation.
- Identification of applicable exposure pathways and receptors.

4.1 Chemicals of Potential Concern

Based on the information provided in historical reporting, and on typical COPCs in an MSW setting such as this, the COPCs for the groundwater component of the site include:

- Inorganic parameters and nutrients (e.g., ammonia, chloride, and total dissolved solids [TDS]);
- Metals;
- PHCs;
- VOCs; and
- Other indicator parameters, such as biological oxygen demand (BOD) and chemical oxygen demand (COD).

The COPCs for the soil vapour component of the site include:

- VOCs;
- Methane;
- BTEX and PHCs; and
- Siloxanes.

Amongst these COPCs, the soluble ones are expected to leach towards the groundwater table (e.g., BTEX, PHC fractions F1 and F2, chloride) while others will bind to the soil particles and are expected to migrate less (i.e., most metals).

4.2 Land Use

The Tier 1 Guidelines are subdivided by land use: natural area, agricultural, residential/parkland, and commercial/industrial. The site is currently zoned as P1- Parks and Recreation District. The site is surrounded by the Red Deer River to the west and north, residential and future urban development district to the east, and environmental preservation district to the south. The site is considered parkland land use.

4.3 Grain Size Designation

The Tier 1 Soil Guidelines have been developed for both coarse-grained and fine-grained soils. Fine-grained soils are defined as having a median grain size of less than or equal to 75 µm; coarse-grained soils have a median-grain size of greater than 75 µm. Where both fine- and coarse-grained strata are present, the dominant soil particle size is determined by the stratum governing horizontal and vertical migration to a receptor.

Particle size analyses was determined from the Phase II ESA completed by Tiamat. Samples were compared to coarse-grained criteria.

4.4 Exposure Pathways and Receptors for Soil and Groundwater

4.4.1 Human Receptors and Pathways

Human receptors assumed to be present on commercial and residential/parkland areas include adult workers, adult and child visitors, adult and child residents, and park users. The following human exposure pathways were considered when developing and implementing remediation guidelines:

- Direct soil contact.
- Groundwater ingestion (drinking water).
- Vapour inhalation.
- Off-site surface migration (wind or water erosion).

These pathways are briefly discussed individually below.

4.4.1.1 Direct Soil Contact – Human Pathway

The direct soil contact pathway is considered to be applicable to all land uses except in natural areas. Direct contact implies that humans can come in direct contact with contaminated soil via incidental ingestion, dermal contact, or inhalation of airborne soil particles. Since the land use for this site is considered parkland, this pathway is considered to be applicable.

4.4.1.2 Drinking Water (Groundwater Ingestion)

Water bearing units with a saturated hydraulic conductivity of greater than 1.0×10^{-6} m per second (m/sec) are considered to comprise a potential domestic use aquifer (DUA) (AEP 2019a). To eliminate this pathway, the presence of greater than 5 m of uncompacted, unfractured, saturated, fine-grained material with an assumed bulk (vertical) hydraulic conductivity of less than 1.0×10^{-7} m/sec must exist below the proven depth of contaminated material. This is required to ensure that the impacted material is isolated from potential underlying DUAs.

A search was conducted of the Alberta Water Well Database. One potable groundwater well was identified within 500 m of the site. Groundwater at the site is not presently used as drinking water; however, the presence of gravel layers beneath the site suggest that the DUA drinking water pathway cannot be excluded for the site.

4.4.1.3 Inhalation

The inhalation pathway considers the migration of volatile contaminants (e.g., BTEX, PHC fractions F1 to F2, and VOCs) released from the soil and/or groundwater into living or working spaces of buildings where humans may be exposed through inhalation. The inhalation pathway is applicable to all land uses except natural areas. Since the current land use is considered residential and/or parkland, there is a potential for the infiltration of vapours into buildings and subsequent inhalation by the inhabitants. Therefore, the inhalation pathway is applicable in this assessment.

4.4.1.4 Off-site Surface Migration by Wind or Water Erosion

The off-site surface migration pathway considers migration of contaminated soil from the site to an adjacent site of more sensitive land use via wind or water erosion. This pathway applies to commercial and industrial sites only and is not applicable to the site.

4.4.2 Ecological Receptors and Pathways

Ecological receptors at a typical contaminated site span a range of trophic levels, including soil-dependent organisms (e.g., plants and soil invertebrates) and higher-order consumers (e.g., terrestrial and avian wildlife and livestock). These pathways are applicable to the land use for this assessment.

4.4.2.1 Direct Soil Contact – Ecological Pathway

Plants and soil invertebrates may come into direct contact with contaminants in soil or shallow groundwater. This pathway is applicable to all land uses; therefore, it is considered for evaluation in this assessment.

4.4.2.2 Freshwater Aquatic Life

The freshwater aquatic life (FAL) pathway is applicable if a surface waterbody is present less than 300 m from the site. The nearest surface waterbody is the Red Deer River, located adjacent to the west and north of the site. The FAL pathway is applicable to the site.

4.4.2.3 Nutrient and Energy Cycling

The nutrient and energy cycling pathway consider the microbial functioning of the soil including carbon nitrogen cycling and is, therefore, applicable to all land uses.

4.4.3 Exposure Pathway Summary

To establish the appropriate guidelines for the site, the most sensitive land use was used. The receptors are a combination of the degree of potential exposure, the exposure pathway, and the contaminant of concern. Human receptor exposures applicable to the site include the direct soil contact, groundwater ingestion, and inhalation pathways. The ecological receptor exposures applicable to the site include direct soil contact, FAL, and nutrient and energy cycling.

4.5 Soil Vapour

As recommended by Alberta Environment and Parks the soil vapour results obtained during this investigation were compared to the Canadian Council of Minister of the Environment's document *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures Via Inhalation of Vapours* (CCME 2014). Generic soil vapour guidelines, that could indicate whether there are potential risks to indoor air from vapours in the soil, have been prepared using the default parameters outlined in the 2014 CCME protocol. The parameters used in the calculation of the generic soil vapour guidelines can be found in Table 6 to Table 9. The equations and model assumptions were taken directly from the CCME 2014 document. While the CCME does not publish soil vapour screening criteria, the approach used to calculate soil guidelines for the vapour inhalation pathway is used to derive the soil vapour screening criteria.

4.5.1 Indoor Air Risk Calculations

The Alberta Tier 2 Guidelines include human toxicity reference values (TRVs) for inhalation (Table A-7; AEP 2019c). For non-carcinogens, the inhalation TRV represents the concentration of the chemical of concern considered unlikely to cause adverse human health effects after a lifetime of continuous exposure, referred to as the inhalation tolerable concentration (ITC). For carcinogens, the inhalation TRV is referred to as the inhalation unit risk (IUR) and can be used to determine a risk-specific concentration (RSC). To ensure that the incremental lifetime cancer risk of an individual does not exceed 1 in 100,000 (1×10^{-5}) after a lifetime of continuous exposure, the RSC is calculated (as per Health Canada 2012, PQRA Guidance) as follows:

$$\text{RSC (mg/m}^3\text{)} = 1 \times 10^{-5}/\text{IUR}$$

Continuous exposure is expressed as an exposure term (ET), which is unitless. The ET for residential land use is 1 (AEP 2019c) based on 24 hours/day, 7 days/week, and 52 weeks/year. The ET is used to determine appropriate soil vapour screening levels. Soil vapour screening levels were calculated (as per Health Canada 2012, PQRA Guidance) using the equation below:

$$\text{Vapour Screening Level (mg/m}^3\text{)} = (\text{ITC or RSC})/\text{ET}$$

4.5.2 Methane and Explosive Risks

Landfill gas (LFG) can be generated from the degradation of wastes under anaerobic conditions. Methane gas can migrate through the ground and enter structures through porous concrete, joints, or fractures in foundations. When present, methane is considered a safety concern due to its explosive risk when it is in an atmosphere at concentrations between 5% and 15% by volume in air, in the presence of an ignition source. At concentrations less than 5% (the lower explosive limit [LEL]) and above 15% (the upper explosive limit), methane is not explosive. Methane on its own is not considered a health risk, although it can represent a concern if it is present at very high concentrations which could displace oxygen and present a risk of asphyxiation.

There are not guidelines for methane as part of the Alberta Tier 1 framework. However, for reference, the Standards for Landfills in Alberta identify maximum methane concentrations proximate to approved landfills, and Alberta Health Services have provided guidance for methane (in conjunction with well headspace pressures that would constitute a driving force); however, that document has not been issued in a final format.

4.6 Overall Guidelines

Groundwater concentrations at the site were compared to the Alberta Tier 1 Guidelines under residential and parkland land use for coarse-grained soils (AEP 2019a).

Soil vapour analytical results were compared to A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures Via Inhalation of Vapours under residential land use for both slab-on-grade and basement for coarse-grained soils (CCME 2014).

5.0 GROUNDWATER MONITORING AND SAMPLING PROGRAM

A discussion of the methods used for the fieldwork and laboratory testing is presented in the following sections. In 2019, Tetra Tech conducted groundwater monitoring on May 9 and 10, June 25, September 18, and December 4. Groundwater sampling was conducted on December 4 and 5, 2019.

5.1 Field Program

Groundwater monitoring consisted of measuring combustible vapour concentrations (CVCs) and VOCs in monitoring well headspace, and static groundwater levels in each monitoring well using an electronic water level indicator quarterly (May, June, September, and December).

The methodology for groundwater monitoring and sampling included the following:

- Observing the integrity of each well and noting drainage and site conditions near the well that may have an effect on monitoring results or groundwater quality.
- Measuring the VOC and CVC headspace concentrations in each well using an RKI Eagle II calibrated to methane elimination mode.
- Measuring liquid levels in each monitoring well with an interface probe and recording total depths confirming absence of non-aqueous phase liquids (NAPL).
- Recording of field data on standardized forms as documented in Tetra Tech standard operating practices.
- Purging each monitoring well requiring sampling using dedicated polyethylene bailers or Waterra tubing with inertial pump foot valves of at least three well volumes of water, or until the well was practically dry.

Following the completion of groundwater monitoring and purging, groundwater samples were collected from the required wells using the procedures identified below:

- Groundwater samples were collected from five monitoring wells (MW-01, MW-02, MW-03, MW-04, and MW-203). Monitoring well MW-05 contained insufficient water for field parameter measurements or sample collection. Samples were collected and placed into appropriate laboratory supplied, sterile glass and plastic vials and bottles for the required analytical package. Samples were filtered and/or preserved in the field, as required.

- Field measurements were taken for pH, EC, and temperature at the time of sampling.
- Samples were submitted in coolers with ice to ALS Laboratories (ALS) in Calgary, Alberta for laboratory analysis under a chain-of-custody (COC) documentation.

More information on the analytical program is provided in Section 5.2.

5.2 Analytical Program

The analytical program for the groundwater monitoring wells was developed based on the recommendations of previous reports and is summarized below:

- BTEX and PHC fractions F1 and F2;
- VOCs;
- Total Kjeldahl nitrogen (TKN);
- Routine water chemistry and dissolved metals;
- Dissolved organic carbon (DOC);
- Ammonia;
- Phosphorus;
- Adsorbable Organic Halides; and
- Volatile Fatty Acids.

6.0 VAPOUR MONITORING AND SAMPLING PROGRAM

A discussion of the methods used for the fieldwork and laboratory testing is presented in the following sections. In 2019, Tetra Tech conducted vapour monitoring on May 9 and 10, June 25, September 18, and December 3. Vapour sampling was conducted on December 3, 2019.

6.1 Field Program

Vapour monitoring consisted of measuring and recording soil gas pressure, composition (methane, carbon dioxide, oxygen, hydrogen sulphide, and balance) on a percent volumetric basis and groundwater elevation, quarterly (May, June, September, and December).

The soil vapour probe was inspected for visible signs of damage and the position of the sampling labcock was noted. Soil gas pressure was recorded using a digital manometer. Once the soil gas pressure measurement was recorded, the soil gas probe was purged of three well volumes of air, or until readings stabilized. The soil vapour well on site is a small diameter soil gas probe (1" well), which was purged directly with the GEM landfill gas analyzer.

After purging, gas composition measurements for methane, carbon dioxide, oxygen, balance gas, and hydrogen sulphide were recorded using the GEM analyzer. After recording soil gas concentrations, the probe/well depths and water levels were measured and recorded to confirm the water level within the probe was beneath the screen portion of the soil gas probe (i.e., the probe was not blinded).

A leak detection test was completed to ensure the vapour probe was sealed properly. The test was completed using helium gas a tracer to inspect the testing probe and apparatus for any leaks. If there was a leak beyond the acceptable range (2% of helium concentration), the connections were tightened, and the leak test was conducted again.

Sampling of soil vapour probe VW-01 was based on the methodology of the CCME sampling guidelines, which are summarized as follows:

- Prior to collecting the soil vapour probe samples, the well was purged of three well volumes, or until headspace readings stabilized.
- A 1.4 L Summa vacuum canister was used for sample collection at the soil vapour probe monitoring location.
- Sample data was recorded on the provided sample tag for each canister.
- Sample tubing that was used to connect the canister to the soil vapour probe was low in VOCs and only used once to prevent sample contamination.
- When beginning sample collection, the end cap was removed, and a 60-minute flow controller was attached to the canister. The start time was recorded on the sample tag.
- When sampling was complete, the valve was closed, and the flow controller was removed. The end time was recorded on the sample tag.
- The protective end cap was replaced back on the canister.
- Canisters, flow controllers, and pressure gauges were placed in the original shipping container and returned to the laboratory with a COC.
- The soil vapour probe sampling port was returned to the closed position and the well was securely locked.

The vapour sample was submitted to ALS for chemical analysis. Duplicate samples were collected during the vapour sampling event for QA/QC purposes. More information on the analytical program is provided in Section 6.2.

The vapour monitoring well location is shown on Figure 2.

6.2 Analytical Program

The analytical program for the vapour monitoring probe included:

- VOCs;
- Matrix gases including oxygen, carbon dioxide, methane, and nitrogen;
- BTEX and PHCs; and
- Siloxanes.

7.0 RESULTS AND DISCUSSION

This section presents the results of the fieldwork conducted in 2019 at the site and discussions of these results.

7.1 Groundwater Well Headspace Monitoring

Tetra Tech monitored six groundwater monitoring wells (MW-01, MW-02, MW-03, MW-04, MW-05, and MW-203) during each monitoring event for measurements of CVCs and VOCs in well headspace using an RKI Eagle Hydrocarbon Surveyor II. The results of well headspace monitoring at vapour-specific monitoring wells are provided in Section 7.5.

During the 2019 monitoring events, the CVCs in May and June were non-detect at all monitoring wells. In September, CVCs ranged from non-detect at monitoring wells MW-02 and MW-03 to 170 parts per million (ppm) at MW-05. During the December 2019 event, CVCs ranged from non-detect at several wells to 20 ppm at MW-02 and MW-203. CVCs at the upgradient wells MW-01 and MW-02 were low and consistent with the expected background concentrations.

VOCs in May 2019, June 2019, and September 2019 were non-detect at all monitoring wells. In December 2019, VOCs were 1 ppm at most monitoring wells, except for MW-01, which was non-detect.

The volatile and combustible headspace concentrations for 2019 are presented in Table 1.

7.2 Groundwater Elevations

The measured groundwater levels and calculated groundwater elevations for 2019 are presented in Table 1.

Figure 3 presents the groundwater elevation trends (hydrographs) for the groundwater monitoring wells. This figure shows the groundwater elevations in 2013 and 2019. Overall, groundwater elevations decreased at all monitoring wells from those measured in 2013. Seasonal fluctuations were observed at most wells in 2019, with the exception of MW-05 (screened within the waste), where groundwater levels remained fairly constant throughout 2019. An increase in water level was observed at MW-02 between September 2019 and December 2019. Water levels fluctuated the most at MW-02, MW-03, and MW-04, which are located closest to the river. Elevations were not calculated for MW-203, as there was no reference elevation for ground or top of casing available, however the measured depths to groundwater in 2019 followed a similar pattern to MW-02. The elevation of MW-203 should be surveyed to better establish the groundwater flow pattern within the north portion of the site.

In 2019, the average depth to groundwater in the monitoring wells was 2.43 m below grade (mbg) in May, 2.28 mbg in June, 2.58 mbg in September, and 2.15 mbg in December. The groundwater elevations and interpreted contours are shown on Figure 4 to Figure 7 for the four monitoring events, respectively. The interpreted contoured groundwater elevations for the monitoring wells suggest the groundwater flow was to the north-northeast during the four monitoring events. The differences in inferred groundwater flow direction may be due to the limited number of monitoring wells used to prepare the groundwater contours, or due to water level fluctuations in the nearby Red Deer River. In 2013, the groundwater flow was to the north-northwest. The Red Deer River, west and adjacent to the site, flows to the north. Based on the prepared groundwater contours, monitoring wells MW-03 and MW-04 are down-gradient and MW-02 is up-gradient. The contours do not include MW-203, as no survey data was available. MW-203 should be surveyed to be incorporated into future groundwater contours.

The average horizontal gradient in 2019 was 0.003 m/m. The horizontal gradient is consistent with historical results.

7.3 Groundwater Field Parameters

Field measurements for temperature, pH, and EC in December 2019 are shown in Table 2. Monitoring well MW-05 contained insufficient water for field parameter measurements or sample collection. A discussion of the results of the field tests is summarized in this section.

In 2019, groundwater temperatures ranged from 1.2°C (MW-203) to 5.4°C (MW-02).

In 2019, field pH values ranged from 7.25 (MW-04) to 8.53 (MW-01). Field pH was generally less than the laboratory pH except at MW-01 which marginally exceeded the Tier 1 Guidelines range. The difference between field recorded and laboratory pH values may be due to limitations of the field equipment and differences in sample temperature.

In 2019, field EC measurements ranged from 381 µS/cm (MW-02) to 1,017 µS/cm (MW-03). Field EC results were less than the laboratory measured EC results, which may be due to limitations of field equipment or temperature differences.

7.4 Groundwater Analytical Results

The groundwater analytical data for 2019 is summarized in Table 2. Monitoring well MW-05 was not sampled in 2019 due to insufficient water. The 2019 laboratory analytical reports are included in Appendix D. Historical data from the 2013 Phase II ESA is included in Appendix E.

Background Groundwater Quality

MW-01 and MW-02 are upgradient of the site and may represent background groundwater quality. Concentrations of TDS at MW-01 and MW-02 were 378 mg/L and 333 mg/L, respectively and concentrations of chloride were 17.0 mg/L and 7.67 mg/L, respectively. The concentration of ammonia (0.477 mg-N/L) was consistent with the concentration measured at MW-01 in 2013.

MW-01 contained concentrations of dissolved arsenic, dissolved iron, and dissolved lead greater than the Tier 1 Guidelines. Concentrations of dissolved arsenic, manganese, and iron may be naturally occurring as described below and not necessarily related to former landfill operations. MW-02 contained concentrations of dissolved manganese and dissolved copper greater than the Tier 1 Guidelines. The concentration of dissolved copper was marginally greater than the Tier 1 Guidelines (0.007 mg/L) at monitoring well MW-02 (0.00719 mg/L). Historically in 2013 all dissolved copper concentrations were less than the Tier 1 Guidelines.

Concentrations of BTEX, PHC fractions F1 and F2, and VOCs were less than the analytical detection limits at MW-01 and MW-02.

Routine Water Chemistry Parameters

In 2019, TDS concentrations ranged from 333 mg/L (MW-02) to 1,090 mg/L (MW-03). TDS concentrations at monitoring wells MW-03, MW-04, and MW-203 were greater than the Tier 1 Guidelines (500 mg/L) in 2019. Historical TDS concentrations were not available for the site. Elevated TDS concentrations often occur in groundwater as a result of the dissolution of naturally occurring salts and minerals, and do not necessarily indicate groundwater quality impact related to the former landfill. However, monitoring wells MW-03, MW-04 and MW-203 exhibit the highest hardness (calcium and magnesium combined) and alkalinity, which is often observed when the groundwater quality is affected by leachate.

In 2019, concentrations of chloride at the site range from 7.67 mg/L at MW-02 (up-gradient) to 49.6 mg/L at MW-03 (down-gradient). The concentrations at all wells were less than the Tier 1 Guidelines (120 mg/L). Concentrations of chloride in 2019 were consistent with concentrations measured in 2013; the maximum chloride concentration measured in 2013 was measured at MW-03 (70 mg/L).

Ammonia concentrations at the site in 2019 ranged from less than the analytical detection limit at MW-02 to 13.3 mg-N/L at MW-203 in December. MW-203 is the closest monitoring well to the Red Deer River. Concentrations of ammonia exceeded Tier 1 Guidelines at MW-01, MW-03, MW-04, and MW-203, and the concentrations at MW-03 (7.0 mg-N/L), MW-04 (10.4 mg-N/L), and MW-203 (13.3 mg-N/L) are clearly elevated and suggest groundwater quality impact by MSW landfill leachate. Concentrations of ammonia in 2013 were greater than the referenced guideline at MW-03 and MW-05 (MW-203 was not sampled in 2013). Concentrations of nitrate and nitrite were less than the analytical detection limits at all monitoring wells, except for nitrate at MW-04 (0.17 mg-N/L), which is less than the Tier 1 Guidelines.

Dissolved Metals

Concentrations of dissolved arsenic were greater than the Tier 1 Guidelines (0.005 mg/L) at MW-01 and MW-203. For MSW, arsenic can be a chemical of concern related to landfill leachate; however, arsenic is also strongly absorbed into iron(hydr)oxides, which are naturally occurring in most Alberta soils. If these iron precipitates dissolve under anoxic conditions, arsenic is mobilized. The results for the five monitoring wells show a clear correlation between dissolved iron and dissolved arsenic concentrations. The two arsenic exceedances are also near the Tier 1 Guideline and may be predominantly a result of iron(hydr)oxide dissolution rather than originating from MSW leachate.

Boron is often a useful parameter to determine impacts related to MSW leachate. The dissolved boron concentrations did not exceed the Tier 1 Guidelines in December 2019; however, the measured concentrations at MW-03, MW-04, and MW-203 were approximately one order of magnitude greater than at MW-01 and MW-02.

Iron and manganese are redox-sensitive parameters that also naturally occur in groundwater under anaerobic conditions and can help determine whether the groundwater quality is affected by biodegradation reactions, for instance related to landfill leachate. The dissolved manganese concentrations were greater than the Tier 1 Guidelines (0.05 mg/L) at all monitoring wells during the sampling event in 2019. The dissolved iron concentrations were greater than the Tier 1 Guidelines at most monitoring wells in 2019, with the exception of MW-02 and MW-03.

Organic Parameters

Concentrations of BTEX and PHC fractions F1 to F2, were less than the analytical detection limits at most locations in 2019. MW-203 had a detectable concentration of benzene (0.00053 mg/L), marginally greater than the detection limit (0.00050 mg/L). The concentration was less than the Tier 1 Guidelines (0.005 mg/L).

Concentrations of adsorbable organic halides and volatile fatty/carboxylic acids were less than the analytical detection limits at all locations in December 2019.

In 2019, VOC concentrations were less than the analytical detection limits for all parameters, except for 1,2-dichloroethene (cis) and vinyl chloride at MW-03, MW-04, and MW-203. Concentrations of VOCs were less than the Tier 1 Guidelines with the exception of vinyl chloride at MW-04 (0.00643 mg/L) and MW-203 (0.00289 mg/L), which were greater than the Tier 1 Guidelines but within the same order of magnitude (0.0011 mg/L). Historically, vinyl chloride concentrations were less than the analytical detection limits at MW-03 and MW-04. No historical data is available for MW-203.

Cis 1,2-dichloroethene is a known breakdown product of dry-cleaning liquids (i.e. tetrachloroethene; TCE) and has no established Tier 1 Guidelines value. It typically further degrades to form vinyl chloride (VC). TCE was not detected in 2019; however, in 2013 a TCE concentration of 0.0033 mg/L was measured at MW-05. MW-05 also contained a trace concentration (0.0007 mg/L) vinyl chloride in 2013. As stated above, the well is completed within an area with MSW and contained insufficient water to collect samples in 2019.

7.5 Soil Vapour Monitoring Results

The soil vapour monitoring results are presented in Table 3.

Pressures at vapour well VW-01 were negligible during all four monitoring events in 2019. Concentrations of methane and carbon monoxide were less than the instrument detection limits in 2019. Concentrations of carbon dioxide, oxygen, and the balance gas were consistent during the four monitoring events. The vapour well was consistently dry in 2019 indicating the well was not blinded. The site only contains one vapour well (VW-01), which is located between the waste footprint and the building to the southeast. It is Tetra Tech's understanding that there are washroom buildings located near the centre of the site within the waste footprint. A walkthrough of the buildings should be conducted to evaluate the potential for accumulation of vapours and the requirement for vapour monitoring. Further, monitoring of groundwater monitoring well headspaces for methane is suggested as a useful screening tool in the absence of vapour wells in other areas of the site.

7.6 Vapour Analytical Results

Table 4 summarizes the soil vapour chemical results collected for 2019 and compares them to the soil vapour screening criteria protective of vapour intrusion into indoor air. The 2019 laboratory analytical reports are included in Appendix C.

BTEX and PHC fractions F1 and F2 (parameters with a TRV for inhalation) were compared against the screening criteria for residential land use for coarse-grained soil. BTEX and/or PHC aliphatic and aromatic fractions that comprise F1 and F2 were detected at concentrations greater than the analytical detection limits in sample VW-01. However, soil vapour concentrations were between 855 and 46,500 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

Siloxanes do not have TRVs for inhalation and were, therefore, not compared against the vapour screening criteria. Concentrations of siloxanes in sample VW-01 were less than the analytical detection limits.

Naphthalene was not detected at concentrations greater than the analytical detection limit.

VOCs (parameters with a TRV for inhalation) were compared against the screening criteria for residential land use, coarse-grained soil. Acetone and dichlorodifluoromethane (a freon compound) were detected at concentrations greater than the analytical detection limits in sample VW-01. Acetone was not analyzed in 2013 but soil vapour concentrations for acetone in 2019 were 262,500 times less than the soil vapour screening criteria, . The concentration of dichlorodifluoromethane was greater than in 2013 but the 2019 value was 1,490 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

Concentrations of VOC parameters in 2019 were less than concentrations measured in 2013, and concentrations of several compounds detected in 2013 were less than the analytical detection limit in 2019. The concentration of dichlorodifluoromethane increased since 2013.

7.7 Quality Assurance/Quality Control

7.7.1 Methods

Tetra Tech's groundwater QA/QC procedures include reviewing the data collected for precision and accuracy and following the appropriate field protocols.

The field procedures for QA/QC involved:

- Changing nitrile gloves between sample collections;
- Using sample containers provided by the laboratory;
- Cleaning monitoring and sampling tools between sample locations;
- Filling sample containers for PHC analysis with no headspace (air) when the containers were closed;
- Conducting leak testing at vapour wells prior to the collection of vapour samples;
- Collecting a duplicate vapour sample during the vapour sampling event; and
- Documenting field procedures and sampling activities.

7.7.2 Results

The QA/QC results are included in Table 5. The duplicate samples were submitted for analysis of the same parameters as the original samples.

Leak testing was conducted at vapour wells prior to collected vapour samples for analysis. For leak testing, test sample was collected into tedlar bag while tubing was set up in shroud filled with helium. If resulting test samples included concentrations of helium less than 2% of concentration within the shroud, the test was considered successful. Leak testing results for the wells were successful and contained non-detect concentrations for helium.

The duplicate analysis is compared by relative percent difference (RPD). The RPD is calculated using the following equation:

$$RPD = \frac{(V_1 - V_2)}{\frac{(V_1 + V_2)}{2}} * 100\%$$

Where:

V_1 = Parent Sample

V_2 = Duplicate Sample

Chemical parameters were considered as having passed the QA/QC reproducibility procedure if the RPD was less than or equal to 20%, indicating a close correlation between the sample-duplicate pair.

RPD values were not calculated if one or both of the sample-duplicate concentrations were between the reportable detection limit (RDL) and five times the RDL. In these cases, chemical parameters were still considered as having passed the QA/QC reproducibility procedure if the sample duplicate concentration difference was less than one RDL value.

Duplicate RPDs were less than 20% for all the reportable concentrations. Based on the QA/QC results, the sample methods and results are considered acceptable.

8.0 HAZARD QUOTIENT CALCULATIONS

Using the soil vapour screening levels described above and the soil vapour sampling results, estimated cancer risks (for carcinogens) and estimated hazard quotients (for non-carcinogens) were calculated for the site.

Estimated risks were calculated by dividing the soil vapour concentration by the corresponding soil vapour screening level for carcinogenic effects and multiplying the ratio by the target risk level of 1×10^{-5} . Similarly, the estimated hazard quotients (HQ) represent the soil vapour concentration divided by the corresponding soil vapour screening level for non-carcinogenic effects.

Risk estimates for non-carcinogenic COPCs are defined as HQ. Hazard quotients are calculated based on a ratio of the estimated exposure and the toxicity reference values identified as the tolerable daily intake (TDI) or tolerable concentration (TC) according to the following equation:

$$\text{Hazard Quotient} = \frac{\text{Estimated Daily Dose (mg/kg-day or mg/m}^3\text{)}}{\text{Tolerable Daily Intake (mg/kg-day) or Tolerable Concentration (mg/m}^3\text{)}}$$

Non-carcinogenic risk characterization in the assessment was completed for all COPCs.

When the HQ is greater than the target risk value, the scenario poses a potential concern and requires further evaluation or risk management. It is important to note that HQs greater than the target risk value do not necessarily indicate that adverse health effects will occur. This is because of the conservative assumptions used in estimating concentrations and in setting the target values. HQ that are less than the target risk value indicate that exposure is within acceptable levels and no further risk management is necessary. HQ greater than the target risk value suggest that further investigation or risk management (e.g., remediation) may be warranted.

For non-carcinogens, the cumulative target risk value used was 1.0. This target risk value accounts for additional exposure to the chemicals of concern from sources other than the site. Therefore, the cumulative target risk value of 1.0 represents an allocation of 20% of a person's daily exposure from site sources and the remaining 80% would come from other sources. Other sources of exposure include ambient air, household products, and soil and water contact from locations other than the site.

For carcinogens, the risk of cancer is assumed to be proportional to dose with the assumption that any exposure results in a nonzero probability of risk. Carcinogenic risk probabilities were calculated by multiplying the estimated exposure level by the route-specific cancer slope factor (SF) or unit risk factor (URF) for each carcinogen:

$$R = E \times SF \text{ (or URF)}$$

Where:

- R = Estimated individual excess lifetime cancer risk;
- E = Exposure level for each chemical of potential concern (mg/kg/day or mg/m³); and
- SF = Route- and chemical-specific SF (mg/kg/day)⁻¹ or URF ((mg/m³)⁻¹).

Risk probabilities determined for each carcinogen were also considered to be additive over all exposure pathways so that an overall risk of cancer was estimated for each group of potentially exposed receptors.

When assessing risks posed by exposure to carcinogenic substances, Health Canada and other regulatory agencies assume that any level of exposure is associated with some hypothetical cancer risk. As a result, it is necessary for regulatory agencies to specify an acceptable risk level. Per Health Canada guidance (2010a, 2010b),

cancer risks are deemed essentially negligible where the estimated cumulative incremental lifetime cancer risk is less than or equal to 1 in 100,000 (1×10^{-5}).

For this evaluation, target risk and hazard levels were determined in accordance with Alberta Tier 2 Guidelines. For carcinogens, the cumulative target risk level is 1×10^{-5} , as this value is considered by Health Canada to represent a negligible risk. For non-carcinogens a cumulative target hazard level of 1 is used as potential exposures that result in hazard indices equal to or less than 1 signify negligible potential for adverse health effects. Each sampling location was screened individually for every chemical detected.

A cumulative risk level for carcinogens was not calculated as none of the carcinogenic parameters were detected greater than the laboratory detection limits. A cumulative hazard level identified in the sample and its duplicate collected for the non-carcinogens ranged between 0.001 to 0.003. Table 6 summarizes the properties of the compounds being assessed. Table 7 summarizes the soil properties used for the calculations. Table 8 summarizes the building properties used for the calculations, and Table 9 presents the generic soil vapour criteria calculated. Table 10 presents the estimated risk and hazard for the volatile compounds that were detected in soil vapour.

As shown in Table 10, the estimated cumulative risks and hazards associated with the soil vapour samples collected in December 2019 did not exceed the corresponding target risk and hazard levels.

9.0 EVALUATION OF SITE CONDITIONS

9.1 Summary of Site Conditions

Based on the 2019 and historical data for the site, there is no evidence that there are significant concerns related to the former landfill operations at McKenzie Trails. However, there is evidence of residual impacts by leachate and the site does contain buried landfill waste, therefore some risk management measures are required. Further, there are several elements of the site assessment data requiring further confirmation as detailed below.

The groundwater quality appears to be affected by leachate at several monitoring wells. Most obvious are elevated ammonia concentrations at MW-03, MW-04 and MW-203. Chloride and boron, which are often elevated in MSW leachate, did not exceed the referenced guidelines at the monitoring wells that were sampled. Two chlorinated VOCs were detected in 2019 at the downgradient monitoring wells. One VOC compound (vinyl chloride) exceeded the referenced Tier 1 Guidelines at MW-04 and MW-203.

The proximity of the Red Deer River warrants further assessment of the groundwater flow pattern and trends in groundwater quality and a qualitative evaluation of risks to the adjacent Red Deer River. The site only contains one vapour well (VW-01), which is located between the waste footprint and the building to the southeast. It is Tetra Tech's understanding that there are washroom buildings located near the centre of the site within the waste footprint, A walkthrough of the buildings should be conducted to evaluate the potential for accumulation of vapours and the requirement for vapour monitoring. In addition, as part of the ongoing groundwater monitoring program, well headspace monitoring of all wells (i.e. groundwater and vapour) for methane should be conducted to verify the methane concentrations at the site.

9.2 Review of Mitigative Measures from Risk Management Plan

The 2014 RMP presented a proposed site-specific environmental risk management plan as a tool to assist with the review of future subdivision applications on lands lying within the regulated setback distance from the site (300 m). The focus was on potential ingress of soil gas for COPCs with a HQ greater than 1.0. Residential land use was considered most sensitive, and exposure ratings for other land uses (e.g. school, public institutions, commercial complexes) were considered to not be greater than residential; however, unique exceptions would have to be reviewed and addressed on a site-specific basis (Tiamat, 2014). Further, underground utility workers and subsurface utility infrastructure were considered relevant to potential exposure.

The RMP applied a 10x factor of safety to the hazard quotients to address uncertainties. Hazard quotients from the RMP ranged up to 566 (including the 10x factor of safety). Based on these, the RMP then provided recommended generic mitigative measures based on the calculated HQs, ranging from passive to active measures, recognizing that the ultimate approach would require a design professional for the proposed development.

Following the 2014 RMP, CCME released the document “*A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures Via Inhalation of Vapours*” (CCME 2014), designed to provide guidance for developing site-appropriate soil vapour quality guidelines. The guidelines developed using the methods outlined in the CCME document were used for this current study and are included with the vapour sampling results in Table 4. Hazard quotients were calculated using estimated dose (based on concentrations measured at the site) and divided by tolerable daily intake. Soil vapour concentrations from the Phase II ESA conducted in 2013 were not compared to soil vapour quality guidelines, however spot checks of five target compounds with the highest HQs in the 2013 work (benzene, tetrachloroethylene, chloromethane, 1,2,4-trimethylbenzene and styrene) identified that none of the 2013 concentrations would have unacceptable HQs using the updated CCME methodology.

The 2014 RMP was prepared concurrent to RMPs at several other former City landfills, and a common set of mitigative measures was applied based on the HQs. Subsequent to the 2014 RMP and to the release of the CCME Protocol document, The City undertook additional assessment at another former City Landfill (Montfort); as part of that work, their consultant XCG Consulting Limited (XCG) revised the 2014 RMP criteria ranges for each generic mitigative measure category to include a Cancer Risk range to allow comparison of the 2014 RMP ranges with the HQ and Cancer Risks calculated by XCG². From that work, XCG identified the following generic mitigative measures for developments within a 300 m setback of these landfills (based on Tiamat, 2014), and these have been adopted for this site:

Passive Measures

1. Passive Measures – Level A: for Cancer Risk of $> 1E^{-5}$ and $< 5E^{-5}$ and/or HQ > 0.2 and < 1 .

Compacted clay liner with a minimum thickness of 1m and confirmed maximum hydraulic conductivity of 10^{-8} m/sec.

2. Passive Measures – Level B: for Cancer Risk of $> 5E^{-5}$ and $< 5E^{-4}$ and/or HQ > 1 and < 5 .

Synthetic liner with type of material, thickness and installation details dependent on the design professional.

3. Passive Measures – Level C: for Cancer Risk of $> 5E^{-4}$ and $< 1E^{-3}$ and/or HQ > 5 and < 50 .

² XCG Consulting Limited, 2018. Vapour Intrusion Assessment and Environmental Monitoring Report, prepared for the City of Red Deer's Montfort Landfill.

Passive sub-slab depressurization (SSD) system with a minimum depressurization of 4 to 10 Pa. In some instances (such as a pervious subgrade), the actual depressurization necessary may require an active SSD or alternative active ventilation system.

Active Measures

Field verify the presence of the identified chemicals of concern and other potential chemicals in the soil gas state at the development site. If confirmed, determine the most appropriate manner to prevent soil vapour intrusion.

1. Active Measures – Level D: for Cancer Risk of $> 1E^{-3}$ and $< 2E^{-3}$ and/or HQ values >50 and <100 .

Active SSD must be configured to compensate for depressurization of the building and have adequate negative pressure gradients across the entire footprint of the foundation.

2. Active Measures - Level E: for Cancer Risk of $>2E^{-3}$ and/or HQ values >100 .

Installation of geomembrane and active soil vapour extraction with system fault notification alarm.

For consistency with XCG's approach from 2017, we compared individual hazard quotients with the individual target hazard level (0.2). Based on the 2019 program, the greatest hazard quotient calculated for the site was 0.001 (vs target individual hazard level of 0.2) and the estimated cancer risk was not calculated as no carcinogenic parameters were detected above the detection limits. The greatest cumulative hazard quotient calculated for the site was 0.003 (vs target cumulative hazard level of 1.0). While development at the site is not currently proposed, for illustrative purposes, based on these hazard quotients calculated from the 2019 vapour data no passive or active measures would be required for the site. It is noted that even if the 10x factor of safety is applied, mitigative measures would still not be required. It should also be noted that assumptions made in the calculations of hazard quotients and cancer risk above are inherently conservative and therefore applying a factor of safety is not needed.

Future applications for development within the setback are subject to review by The City. The developer's team would be responsible for reviewing and verifying the available data relative to their proposed development. The mitigative measures presented above are generic and can be used as a general guide for expectations by The City; ultimately, the developer's design engineer would be responsible for developing measures specific to the intended development based on the above or an appropriate equivalent. Protection of workers (e.g. construction and utility) should form part of any development plan.

10.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the groundwater and soil vapour monitoring and sampling conducted in 2019 and previous years, Tetra Tech has developed the following conclusions:

- The groundwater elevations in 2019 indicated that the inferred groundwater flow direction was overall northerly, which is consistent with the groundwater flow direction from 2013 and the flow direction in the Red Deer River. The average horizontal hydraulic gradient at the site in 2019 has been estimated as approximately 0.003 m/m. Groundwater elevations in 2019 were overall slightly lower than groundwater elevations measured in 2013.
- Routine groundwater chemistry parameters and dissolved metals that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2019 included TDS, ammonia, arsenic, copper, iron, and manganese. The measured concentrations of one or more of these parameters suggest leachate has impacted the groundwater quality at MW-03, MW-04, and MW-203, each hydraulically downgradient of the waste disposal area.

- Concentrations of dissolved BTEX and PHC fractions F1 to F2, were less than the analytical detection limits at most locations in 2019. MW-203 had a detectable concentration of benzene (0.00053 mg/L), marginally greater than the detection limit (0.00050 mg/L). Concentrations of BTEX and PHC fractions F1 and F2 were less than the Tier 1 Guidelines at all locations.
- Concentrations of vinyl chloride were greater than the Tier 1 Guidelines in the groundwater samples collected from MW-04 and MW-203. Concentrations of vinyl chloride in 2013 were less than the analytical detection limit at MW-04; no historical data was available for MW-203.
- Concentrations of BTEX, hydrocarbons, and VOCs in the soil vapour sample were less than the calculated soil vapour screening criteria.
- Concentrations of siloxanes were less than the analytical detections limits in the vapour sample collected.
- As indicated in Table 10, the estimated individual and cumulative risks and hazards associated with the soil vapour samples collected in December 2019 did not exceed the corresponding target risk and hazard levels.

Based upon the results of the groundwater monitoring program in 2019 and previous years, there appear to be residual impacts in the groundwater and buried waste remains beneath the site, therefore ongoing risk management is required. Risk management is recommended to include ongoing monitoring; and administrative actions. The following recommendations are made according to these risk management elements:

- Ongoing Monitoring:
 - Continue with a semi-annual groundwater monitoring program, with annual sampling at the hydraulically down-gradient monitoring wells (MW-03, MW-04, and MW-203) for another year to confirm trends. These wells should be sampled for routine chemistry, dissolved metals, and VOC parameters. As part of the monitoring program, well headspace monitoring should be included as described further below.
 - Survey the elevation of MW-203 to better establish the groundwater flow pattern within the north portion of the site.
 - If the measured concentrations are stable or decreasing, discontinue monitoring and sampling at the site. If the concentrations are confirmed and remain greater than the referenced guidelines, a qualitative evaluation of risks should be made to evaluate the potential concern, if any, these concentrations pose to the adjacent Red Deer River.
 - Based on the results of the soil vapour sample, there is little indication that this pathway will pose a hazard to receptors. The soil vapour concentrations were less than the levels of concern and groundwater concentrations of volatile chemicals were also less than established Tier 1 Guidelines, except for vinyl chloride in monitoring wells MW-04 and MW-203. Historical results have not identified vinyl chloride. If the concentrations of vinyl chloride exceed the referenced guidelines in the next monitoring events, a qualitative evaluation of risks, as stated above, should be conducted.
 - The north portion of the site is interpreted to have a low risk for vapour intrusion and installing additional soil vapour wells near monitoring wells MW-04 and MW-203 is not proposed. To support ongoing assessment of vapours, headspace monitoring of all wells (groundwater and vapour) for methane should be conducted in conjunction with the groundwater monitoring program, however further sampling of vapours in VW-01 is not considered warranted. Further to the well monitoring, it is Tetra Tech's understanding that there are washroom buildings located near the centre of the site within the waste footprint. A walkthrough of the buildings should be conducted to evaluate the potential for accumulation of vapours; if the potential for accumulation is identified, indoor air monitoring could be undertaken in conjunction with the well headspace monitoring. Continue to monitor the riverbank during the semi-annual monitoring events for potential waste exposure and seepage due to bank erosion.

▪ **Administrative Actions:**

- Utilize the revised generic mitigative measures when evaluating applications for development within the setback.
- Ensure that the site is clearly identified within The City’s Land Use Bylaw and appropriate administrative requirements are met for the site in accordance with City policies.

Further to the above recommendations, as noted the site remains an historical landfill. It presently appears to be well maintained and capped. The City should review this status on an ongoing basis to ensure that the cover remains intact and drainage remains positive; repairs or maintenance should be undertaken as required to maintain the site. This evaluation should include regular inspection of the adjacent riverbank for evidence of erosion and potential exposed waste or leachate seepage.

11.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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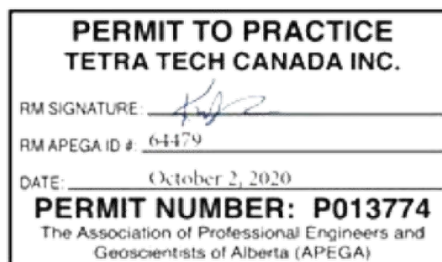
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Table 1: Groundwater Elevations

Monitoring Well		MW-01	MW-02	MW-03	MW-04	MW-05	MW-203
Total Drilled Depth (m)		5.5	10.6	9.1	3.8	6.1	5.3
Top of Screened Interval (mbg)		0.9	6.9	-	-	3.1	-
Bottom of Screened Interval (mbg)		5.5	10.6	9.1	3.8	6.1	-
Stick up (m)		0.79	0.92	0.87	0.77	0.86	0.51
Ground Elevation (m)		848.29	849.75	847.47	847.48	849.38	-
TPC Elevation (m)		849.09	850.67	848.34	848.25	850.24	-
Depth to Groundwater (mBTPC)	Aug-13	1.71	3.10	1.56	1.55	3.69	4.12
	May-19	2.59	4.18	2.55	2.46	4.10	3.46
	Jun-19	2.63	4.01	2.40	2.29	4.11	2.96
	Sep-19	2.89	4.27	2.72	2.67	4.12	3.52
	Dec-19	2.75	3.35	2.50	2.38	4.12	2.52
Groundwater Elevation (m)	Aug-13	847.38	847.57	846.78	846.70	846.55	-
	May-19	846.50	846.49	845.79	845.79	846.15	-
	Jun-19	846.46	846.66	845.94	845.96	846.14	-
	Sep-19	846.19	846.40	845.62	845.58	846.13	-
	Dec-19	846.34	847.32	845.84	845.87	846.12	-
Combustible Vapour Concentrations* (CVCs) (ppm)	May-19	0	0	0	0	0	0
	Jun-19	0	0	0	0	0	0
	Sep-19	35	15	0	0	170	100
	Dec-19	0	20	0	0	5	20
Volatile Organic Compounds* (VOCs) (ppm)	May-19	0	0	0	0	0	0
	Jun-19	0	0	0	0	0	0
	Sep-19	0	0	0	0	0	0
	Dec-19	0	1	1	1	1	1

Notes:

mbg - Metres below grade.

mBTPC - Metres below top of plastic pipe casing.

ppm - Parts per million.

- Unavailable.

* Measured using an RKI Eagle Hydrocarbon Surveyor II operated in methane elimination mode.

Table 2: Groundwater Analytical Results

Parameter	Unit	Tier 1 Guideline ^{1,2}	Location Code	MW-01	MW-02	MW-03	MW-04	MW-203
			Sample Date	4-Dec-2019	4-Dec-2019	4-Dec-2019	4-Dec-2019	5-Dec-2019
			Lab Report Number	L2393410	L2393410	L2393410	L2393410	L2393410
			Laboratory ID	L2393410-1	L2393410-2	L2393410-3	L2393410-4	L2393410-5
Field								
Field Temperature	°C	-	2.90	5.42	2.64	2.67	1.15	
Field Electric Conductivity	µS/cm	-	434	381	1,017	973	510	
Field pH	pH Units	6.5 to 8.5	8.53	7.98	7.48	7.25	7.64	
Routine								
pH	pH Units	6.5 to 8.5	8.13	8.22	7.77	7.53	8.03	
Electrical Conductivity (EC)	µS/cm	-	617	559	1,680	1,660	1,030	
Total Dissolved Solids (TDS)	mg/L	500	378	333	1,090	1,010	633	
Hardness as CaCO ₃	mg/L	-	289	269	646	664	437	
Alkalinity (total as CaCO ₃)	mg/L	-	337	255	934	872	510	
Bicarbonate	mg/L	-	411	311	1,140	1,060	622	
Carbonate	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	
Hydroxide	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	
Calcium	mg/L	-	71.7	72.2	168	168	119	
Magnesium	mg/L	-	26.8	21.6	55.0	59.3	33.9	
Potassium	mg/L	-	4.27	2.70	9.68	20.7	13.8	
Sodium	mg/L	200	40.1	16.4	174	96.6	47.1	
Chloride	mg/L	120	17.0	7.67	49.6	42.9	19.5	
Fluoride	mg/L	1.5	0.094	0.086	<0.10	<0.10	<0.10	
Phosphorus - Total	mg/L	-	0.412	0.0202	0.273	0.568	0.35	
Sulphate	mg/L	429 ³	16.0	59.6	69.5	94.7	93.2	
Ionic Balance	N/A	-	102	94.0	98.6	91.1	95.2	
Nutrients								
Ammonia as N	mg/L	0.374 to 9.71 ⁶	0.477	<0.050	7.0	10.4	13.3	
Nitrate (as NO ₃ -N)	mg/L	3	<0.020	<0.020	<0.10	0.17	<0.10	
Nitrite (as NO ₂ -N)	mg/L	0.08 to 0.20 ⁴	<0.010	<0.010	<0.050	<0.050	<0.050	
Nitrate and Nitrite (as N)	mg/L	-	<0.022	<0.022	<0.11	0.17	<0.11	
Total Kjeldahl Nitrogen (TKN)	mg/L	-	1.29	0.23	8.2	13.3	15	
Carbon								
Dissolved Organic Carbon (DOC)	mg/L	-	5.4	4.6	11.4	20.7	9.5	
Dissolved Metals								
Aluminum	mg/L	0.050 ⁵	0.0033	0.0074	<0.0050	0.0348	0.0035	
Antimony	mg/L	0.006	0.00014	0.00013	<0.00050	<0.00050	<0.00010	
Arsenic	mg/L	0.005	0.00828	0.00029	0.00137	0.00440	0.00796	
Barium	mg/L	1	0.421	0.152	0.309	0.253	0.188	
Boron	mg/L	1.5	0.024	0.016	0.875	0.977	0.494	
Cadmium	mg/L	0.00036 to 0.00037 ³	<0.000050	0.000148	<0.00025	0.0000830	0.0000408	
Chromium	mg/L	0.05	<0.00010	<0.00010	<0.00050	<0.00050	0.00015	
Copper	mg/L	0.007	<0.00020	0.00719	0.0052	<0.0010	<0.00020	
Iron	mg/L	0.3	3.09	0.041	0.123	3.85	2.23	
Lead	mg/L	0.0070 ³	<0.000050	0.000219	<0.00025	<0.00025	<0.000050	
Manganese	mg/L	0.05	0.861	0.0843	1.02	1.16	0.303	
Mercury	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
Nickel	mg/L	0.120 to 0.259 ³	0.00192	0.00099	0.0171	0.0093	0.00054	
Selenium	mg/L	0.002	0.000104	0.000132	<0.00025	<0.00025	0.000242	
Silver	mg/L	0.0001	<0.000010	<0.000010	<0.000050	<0.000050	<0.000010	
Uranium	mg/L	0.015	0.000733	0.000851	0.00242	0.00297	0.00059	
Zinc	mg/L	0.03	<0.0010	0.0058	0.0247	0.0097	0.0011	
Organics								
AOX	mg/L	-	ND	ND	ND	ND	ND	
Hydrocarbons								
Benzene	mg/L	0.005	<0.00050	<0.00050	<0.00050	<0.00050	0.00053	
Toluene	mg/L	0.021	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Ethylbenzene	mg/L	0.0016	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Xylenes (m & p)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Xylene (o)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
Xylenes Total	mg/L	0.02	<0.00071	<0.00071	<0.00071	<0.00071	<0.00071	
Styrene	mg/L	0.072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	
F1 (C ₆ -C ₁₀)	mg/L	-	<0.10	<0.10	<0.10	<0.10	<0.10	
F1 (C ₆ -C ₁₀) - BTEX	mg/L	0.81	<0.10	<0.10	<0.10	<0.10	<0.10	
F2 (C ₁₀ -C ₁₆)	mg/L	1.1	<0.10	<0.10	<0.10	<0.10	<0.10	
Volatile Fatty/Carboxylic Acids								
Acetic Acid	mg/L	-	<10	<10	<10	<10	<10	
Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	
Formic Acid	mg/L	-	<50	<50	<50	<50	<50	
Hexanoic Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	
iso-Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	
Isovaleric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	
Propanoic Acid	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	
Valeric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	

Notes:

¹ Alberta Environment and Parks (AEP). 2019. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Policy and Planning Division. 198 pp. Referenced guidelines are for coarse-textured soils under Residential/Parkland land use.

² Alberta Environment and Parks (AEP). Environmental Quality Guidelines for Alberta Surface Waters. March 2018. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (FAL). Most conservative values applied (chronic or acute).

³ Guideline varies with hardness. Values shown based on site hardness range of 269 mg/L to 664 mg/L.

⁴ Guideline varies with chloride. Values shown based on site chloride range of 7.70 mg/L to 49.6 mg/L.

⁵ Guideline varies with pH. Values shown based on site pH range of 7.25 to 8.53.

⁶ Guideline varies with pH and temperature. Values shown based on pH range of 7.25 to 8.53 and temperature range of 1.15 to 5.42°C.

"-" No applicable guideline.

"ND" Non-detected.

BOLD - Greater than Tier 1 Guideline.

N/A - Not applicable.

Table 2: Groundwater Analytical Results

		Location Code	MW-01	MW-02	MW-03	MW-04	MW-203
		Sample Date	4-Dec-2019	4-Dec-2019	4-Dec-2019	4-Dec-2019	5-Dec-2019
		Lab Report Number	L2393410	L2393410	L2393410	L2393410	L2393410
		Laboratory ID	L2393410-1	L2393410-2	L2393410-3	L2393410-4	L2393410-5
Parameter	Unit	Tier 1 Guideline ^{1,2}					
Volatile Organic Compounds (VOCs)							
Bromobenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromochloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromodichloromethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromoform	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromomethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
n-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
sec-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
tert-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Carbon tetrachloride	mg/L	0.00057	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.0013	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloroethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.018	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
2-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
4-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dibromochloromethane	mg/L	0.19	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dibromo-3-chloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dibromoethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dibromomethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichlorobenzene	mg/L	0.0007	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichlorobenzene	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,4-Dichlorobenzene	mg/L	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1-Dichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichloroethane	mg/L	0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethene	mg/L	0.014	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichloroethene (cis)	mg/L	-	<0.0010	<0.0010	0.0036	0.0083	0.0083
1,2-Dichloroethene (trans)	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dichlorodifluoromethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
2,2-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloropropene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene [cis]	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichloropropene [trans]	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Hexachlorobutadiene	mg/L	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
p-Isopropyltoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Methylene Chloride	mg/L	0.05	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
iso-Propylbenzene (cumene)	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
n-Propylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,1,2-Tetrachloroethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Tetrachloroethene	mg/L	0.01	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2,3-Trichlorobenzene	mg/L	0.008	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2,4-Trichlorobenzene	mg/L	0.015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,1-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,2-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Trichloroethene	mg/L	0.005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Trichlorofluoromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2,3-Trichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2,4-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3,5-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl chloride	mg/L	0.0011	<0.00050	<0.00050	0.00070	0.00643	0.00289

Notes:

¹ Alberta Environment and Parks (AEP). 2019. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Policy and Planning Division. 198 pp. Referenced guidelines are for coarse-textured soils under Residential/Parkland land use.

² Alberta Environment and Parks (AEP). Environmental Quality Guidelines for Alberta Surface Waters. March 2018. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (FAL). Most conservative values applied (chronic or acute).

³ Guideline varies with hardness. Values shown based on site hardness range of 269 mg/L to 664 mg/L.

⁴ Guideline varies with chloride. Values shown based on site chloride range of 7.70 mg/L to 49.6 mg/L.

⁵ Guideline varies with pH. Values shown based on site pH range of 7.25 to 8.53.

⁶ Guideline varies with pH and temperature. Values shown based on pH range of 7.25 to 8.53 and temperature range of 1.15 to 5.42°C.

"-" No applicable guideline.

"ND" Non-detected.

BOLD - Greater than Tier 1 Guideline.

N/A - Not applicable.

Table 3: 2019 Soil Vapour Monitoring Results

Parameter	Gas Well				
	VW-01				
	Aug-13	May-19	Jun-19	Sep-19	Dec-19
Pressure (kPa) ¹		0.0	0.0	0.0	0.0
CH ₄ (%)	0.0	0.0	0.0	0.0	0.0
CO (ppm) ²		0.0	0.0	0.0	0.0
CO ₂ (%)	9.5	1.3	2.0	5.4	2.2
O ₂ (%)	5.8	18.8	18.2	17.4	19.3
Balance (% v/v)	84.7	79.9	79.8	77.2	78.5
Static Water Level (mbtoc) ³		Dry	Dry	Dry	Dry
Depth to Bottom (m)	5.50	2.56	2.56	2.56	2.67
Stick up (m)		0.77	0.77	0.87	0.87

Notes:

¹ kPa - Kilopascal.

² ppm - Parts per million.

³ mbtoc - Meters below top of casing.

N/A - Not applicable - well can not be accessed to obtain measurement.

Table 4: Soil Vapour Analytical Results

Location Code Field ID Sample Date Lab Report Number Laboratory ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m ³) ¹	VW-01		
		VW-01	19DUP01	
		3-Dec-2019	3-Dec-2019	
		L2393598	L2393598	
		L2393598-1 / L2393598-3	L2393598-2	
Parameter	Unit	µg/m ³		
Field Tests				
Air Volume	L		0.06	-
Initial Pressure	in Hg		-9.2	-9.2
Aliphatic/Aromatic PHC Sub-Fractionation				
Aliphatics (C ₆ -C ₈)	µg/m ³	740,737	17	29
Aliphatics (>C ₈ -C ₁₀)	µg/m ³	40,257	<15	41
Aliphatics (>C ₁₀ -C ₁₂)	µg/m ³	40,257	<15	<15
Aliphatics (>C ₁₂ -C ₁₆)	µg/m ³	40,257	<30	<30
Aromatics (>C ₈ -C ₁₀)	µg/m ³	805	<15	<15
Aromatics (>C ₁₀ -C ₁₂)	µg/m ³	8,051	<15	<15
Aromatics (>C ₁₂ -C ₁₆)	µg/m ³	8,051	<30	<30
Linear and Cyclic Methyl Siloxanes				
Hexamethylcyclotrisiloxane, D3(CVMS)	µg/m ³	NG	<170	-
Octamethylcyclotetrasiloxane, D4(CVMS)	µg/m ³	NG	<170	-
Decamethylcyclopentasiloxane, D5(CVMS)	µg/m ³	NG	<170	-
Dodecamethylcyclohexasiloxane, D6(CVMS)	µg/m ³	NG	<170	-
Hexamethyldisiloxane, MM(LVMS)	µg/m ³	NG	<170	-
Octamethyltrisiloxane, MDM(LVMS)	µg/m ³	NG	<170	-
Decamethyltetrasiloxane, MD2M(LVMS)	µg/m ³	NG	<170	-
Dodecamethylpentasiloxane, MD3M(LVMS)	µg/m ³	NG	<170	-
Hydrocarbons				
Benzene	µg/m ³	195	<0.64	<0.64
Toluene	µg/m ³	124,220	<0.75	2.67
Ethylbenzene	µg/m ³	34,330	<0.87	<0.87
Xylenes (m & p)	µg/m ³	NG	<1.7	6.0
Xylene (o)	µg/m ³	NG	<0.87	1.38
Xylenes Total	µg/m ³	6,330	<2.0	7.4
Styrene	µg/m ³	3,220	<0.85	<0.85
F1 (C ₆ -C ₁₀)	µg/m ³	867,383	16	62
F2 (C ₁₀ -C ₁₆)	µg/m ³	52,495	<15	<15
Alcohols				
Isopropanol	µg/m ³	6,219	<2.5	<2.5
High Level Fixed Gases				
Nitrogen	%	NG	74.7	75.8
Oxygen	%	NG	19.5	20.1
Carbon Dioxide	%	NG	1.76	1.73
Carbon Monoxide	%	NG	<0.050	<0.050
Methane	%	NG	<0.050	<0.050
Hydrocarbon Gases (C₁-C₅)				
Methane	%	NG	0.00017	0.00013
Ethane	%	NG	<0.00020	<0.00020
Ethene	%	NG	<0.00020	<0.00020
Propane	%	NG	<0.00020	<0.00020
Propene	%	NG	<0.00020	<0.00020
Butane	%	NG	<0.00020	<0.00020
Pentane	%	NG	<0.00020	<0.00020
Polycyclic Aromatic Hydrocarbons (PAHs)				
Naphthalene	µg/m ³	112	<2.6	<2.6

Notes:

¹ Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours. Refer to Tables 6 to 9 for further information.

NG - No applicable criteria.

BOLD - Greater than criteria.

Table 4: Soil Vapour Analytical Results

Location Code Field ID Sample Date Lab Report Number Laboratory ID	Generic Soil Vapour Criteria - Residential Coarse-Grained (µg/m ³) ¹	VW-01		
		VW-01	19DUP01	
		3-Dec-2019	3-Dec-2019	
		L2393598	L2393598	
		L2393598-1 / L2393598-3	L2393598-2	
Parameter	Unit	µg/m ³		
Volatile Organic Compounds (VOCs)				
1,1,1-Trichloroethane	µg/m ³	1,693,510	<1.1	<1.1
1,1,1,2-Tetrachloroethane	µg/m ³	11	<1.4	<1.4
1,1,2-Trichloroethane	µg/m ³	7	<1.1	<1.1
1,1-Dichloroethane	µg/m ³	430	<0.81	<0.81
1,1-Dichloroethene	µg/m ³	6,470	<0.79	<0.79
1,2,4-Trichlorobenzene	µg/m ³	365	<1.5	<1.5
1,2,4-Trimethylbenzene	µg/m ³	2,235	<0.98	<0.98
1,2-Dibromoethane	µg/m ³	590	<1.5	<1.5
1,2-Dichlorobenzene	µg/m ³	7,072	<1.2	<1.2
1,2-Dichloroethane	µg/m ³	24	<0.81	<0.81
1,2-Dichloroethene (cis)	µg/m ³	242	<0.79	<0.79
1,2-Dichloroethene (trans)	µg/m ³	245	<0.79	<0.79
1,2-Dichloropropane	µg/m ³	135	<0.92	<0.92
1,2-Dichlorotetrafluoroethane	µg/m ³	566,335	<1.4	<1.4
1,3,5-Trimethylbenzene	µg/m ³	2,235	<0.98	<0.98
1,3-Butadiene	µg/m ³	17	<0.44	<0.44
1,3-Dichlorobenzene	µg/m ³	64	<1.2	<1.2
1,3-Dichloropropene [cis]	µg/m ³	163	<0.91	<0.91
1,3-Dichloropropene [trans]	µg/m ³	149	<0.91	<0.91
1,4-Dichlorobenzene	µg/m ³	64	<1.2	<1.2
1,4-Dioxane	µg/m ³	105	<0.72	<0.72
1-Methyl-4 ethyl benzene	µg/m ³	14,461	<0.98	<0.98
2-Butanone (MEK)	µg/m ³	167,364	<0.59	<0.59
2-Hexanone (MBK)	µg/m ³	1,053	<4.1	<4.1
4-Methyl-2-pentanone (MIBK)	µg/m ³	103	<0.82	<0.82
Acetone	µg/m ³	918,788	2.3	3.5
Allyl chloride	µg/m ³	32	<0.63	<0.63
Benzyl chloride	µg/m ³	34	<1.0	<1.0
Bromodichloromethane	µg/m ³	28	<1.3	<1.3
Bromoform	µg/m ³	1,494	<2.1	<2.1
Bromomethane	µg/m ³	173	<0.78	<0.78
Carbon disulfide	µg/m ³	21,713	<0.62	<0.62
Carbon tetrachloride	µg/m ³	113	<1.3	<1.3
Chlorobenzene	µg/m ³	347	<0.92	<0.92
Chloroethane	µg/m ³	31,019	<0.53	<0.53
Chloroform	µg/m ³	27	<0.98	<0.98
Chloromethane	µg/m ³	2,657	<0.41	<0.41
Cyclohexane	µg/m ³	201,510	<0.69	<0.69
Dibromochloromethane	µg/m ³	4,750	<1.7	<1.7
Dichlorodifluoromethane	µg/m ³	3,584	1.89	2.40
Ethyl acetate	µg/m ³	2,509	<0.72	<0.72
Freon 113	µg/m ³	230,627	<1.5	<1.5
Heptane	µg/m ³	14,461	<0.82	<0.82
Hexachlorobutadiene	µg/m ³	51	<2.1	<2.1
Hexane	µg/m ³	18,839	<0.70	<0.70
Isooctane	µg/m ³	14,917	<0.93	<0.93
iso-Propylbenzene (cumene)	µg/m ³	14,461	<0.98	<0.98
Methyl t-Butyl Ether (MTBE)	µg/m ³	1,153	<0.72	<0.72
Methylene Chloride	µg/m ³	18,764	<0.69	<0.69
Propylene	µg/m ³	91,723	<0.34	<0.34
Tetrachloroethene	µg/m ³	2,679	<1.4	<1.4
Tetrahydrofuran	µg/m ³	62,828	<0.59	<0.59
Trichloroethene	µg/m ³	153	<1.1	<1.1
Trichlorofluoromethane	µg/m ³	34,325	<1.1	<1.1
Vinyl acetate	µg/m ³	6,586	<1.8	<1.8
Vinyl bromide (bromoethene)	µg/m ³	94	<0.87	<0.87
Vinyl chloride	µg/m ³	140	<0.51	<0.51

Notes:

¹ Canadian Council of Ministers of the Environment (CCME). 2014. A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours. Refer to Tables 6 to 9 for further information.

NG - No applicable criteria.

BOLD - Greater than criteria.

Table 5: Soil Vapour Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	Field ID		RPD (%)
			Sample Date	VW-01	
			Lab Report Number	19DUP01	
			Laboratory ID	3-Dec-2019	
			L2393598	3-Dec-2019	
			L2393598-1 / L2393598-3	L2393598-2	
Field Tests					
Air Volume	L	0.01	0.06	-	-
Initial Pressure	in Hg	-30	-9.2	-9.2	0
Aliphatic/Aromatic PHC Sub-Fractionation					
Aliphatics (C ₆ -C ₈)	µg/m ³	15	17	29	-
Aliphatics (>C ₈ -C ₁₀)	µg/m ³	15	<15	41	-
Aliphatics (>C ₁₀ -C ₁₂)	µg/m ³	15	<15	<15	-
Aliphatics (>C ₁₂ -C ₁₆)	µg/m ³	30	<30	<30	-
Aromatics (>C ₈ -C ₁₀)	µg/m ³	15	<15	<15	-
Aromatics (>C ₁₀ -C ₁₂)	µg/m ³	15	<15	<15	-
Aromatics (>C ₁₂ -C ₁₆)	µg/m ³	30	<30	<30	-
Linear and Cyclic Methyl Siloxanes					
Hexamethylcyclotrisiloxane, D3(CVMS)	µg/m ³	170	<170	-	-
Octamethylcyclotetrasiloxane, D4(CVMS)	µg/m ³	170	<170	-	-
Decamethylcyclopentasiloxane, D5(CVMS)	µg/m ³	170	<170	-	-
Dodecamethylcyclohexasiloxane, D6(CVMS)	µg/m ³	170	<170	-	-
Hexamethyldisiloxane, MM(LVMS)	µg/m ³	170	<170	-	-
Octamethyltrisiloxane, MDM(LVMS)	µg/m ³	170	<170	-	-
Decamethyltetrasiloxane, MD2M(LVMS)	µg/m ³	170	<170	-	-
Dodecamethylpentasiloxane, MD3M(LVMS)	µg/m ³	170	<170	-	-
Hydrocarbons					
Benzene	µg/m ³	0.64	<0.64	<0.64	-
Toluene	µg/m ³	0.75	<0.75	2.67	-
Ethylbenzene	µg/m ³	0.87	<0.87	<0.87	-
Xylenes (m & p)	µg/m ³	1.7	<1.7	6.0	-
Xylene (o)	µg/m ³	0.87	<0.87	1.38	-
Xylenes Total	µg/m ³	2	<2.0	7.4	-
Styrene	µg/m ³	0.85	<0.85	<0.85	-
F1 (C ₈ -C ₁₀)	µg/m ³	15	16	62	-
F2 (C ₁₀ -C ₁₆)	µg/m ³	15	<15	<15	-
Alcohols					
Isopropanol	µg/m ³	2.5	<2.5	<2.5	-
High Level Fixed Gases					
Nitrogen	%	1	74.7	75.8	1
Oxygen	%	0.1	19.5	20.1	3
Carbon Dioxide	%	0.05	1.76	1.73	2
Carbon Monoxide	%	0.05	<0.050	<0.050	-
Methane	%	0.0001	<0.050	<0.050	-
Hydrocarbon Gases (C₁-C₅)					
Methane	%	0.0001	0.00017	0.00013	-
Ethane	%	0.0002	<0.00020	<0.00020	-
Ethene	%	0.0002	<0.00020	<0.00020	-
Propane	%	0.0002	<0.00020	<0.00020	-
Propene	%	0.0002	<0.00020	<0.00020	-
Butane	%	0.0002	<0.00020	<0.00020	-
Pentane	%	0.0002	<0.00020	<0.00020	-
Polycyclic Aromatic Hydrocarbons (PAHs)					
Naphthalene	µg/m ³	2.6	<2.6	<2.6	-
Volatile Organic Compounds (VOCs)					
1,1,1-Trichloroethane	µg/m ³	1.1	<1.1	<1.1	-
1,1,2,2-Tetrachloroethane	µg/m ³	1.4	<1.4	<1.4	-
1,1,2-Trichloroethane	µg/m ³	1.1	<1.1	<1.1	-
1,1-Dichloroethane	µg/m ³	0.81	<0.81	<0.81	-
1,1-Dichloroethene	µg/m ³	0.79	<0.79	<0.79	-
1,2,4-Trichlorobenzene	µg/m ³	1.5	<1.5	<1.5	-
1,2,4-Trimethylbenzene	µg/m ³	0.98	<0.98	<0.98	-
1,2-Dibromoethane	µg/m ³	1.5	<1.5	<1.5	-
1,2-Dichlorobenzene	µg/m ³	1.2	<1.2	<1.2	-
1,2-Dichloroethane	µg/m ³	0.81	<0.81	<0.81	-
1,2-Dichloroethene (cis)	µg/m ³	0.79	<0.79	<0.79	-
1,2-Dichloroethene (trans)	µg/m ³	0.79	<0.79	<0.79	-
1,2-Dichloropropane	µg/m ³	0.92	<0.92	<0.92	-
1,2-Dichlorotetrafluoroethane	µg/m ³	1.4	<1.4	<1.4	-
1,3,5-Trimethylbenzene	µg/m ³	0.98	<0.98	<0.98	-
1,3-Butadiene	µg/m ³	0.44	<0.44	<0.44	-
1,3-Dichlorobenzene	µg/m ³	1.2	<1.2	<1.2	-
1,3-Dichloropropene [cis]	µg/m ³	0.91	<0.91	<0.91	-
1,3-Dichloropropene [trans]	µg/m ³	0.91	<0.91	<0.91	-
1,4-Dichlorobenzene	µg/m ³	1.2	<1.2	<1.2	-
1,4-Dioxane	µg/m ³	0.72	<0.72	<0.72	-
1-Methyl-4 ethyl benzene	µg/m ³	0.98	<0.98	<0.98	-
2-Butanone (MEK)	µg/m ³	0.59	<0.59	<0.59	-
2-Hexanone (MBK)	µg/m ³	4.1	<4.1	<4.1	-
4-Methyl-2-pentanone (MIBK)	µg/m ³	0.82	<0.82	<0.82	-
Acetone	µg/m ³	1.2	2.3	3.5	-
Allyl chloride	µg/m ³	0.63	<0.63	<0.63	-
Benzyl chloride	µg/m ³	1	<1.0	<1.0	-
Bromodichloromethane	µg/m ³	1.3	<1.3	<1.3	-
Bromoform	µg/m ³	2.1	<2.1	<2.1	-
Bromomethane	µg/m ³	0.78	<0.78	<0.78	-
Carbon disulfide	µg/m ³	0.62	<0.62	<0.62	-
Carbon tetrachloride	µg/m ³	1.3	<1.3	<1.3	-
Chlorobenzene	µg/m ³	0.92	<0.92	<0.92	-
Chloroethane	µg/m ³	0.53	<0.53	<0.53	-
Chloroform	µg/m ³	0.98	<0.98	<0.98	-
Chloromethane	µg/m ³	0.41	<0.41	<0.41	-
Cyclohexane	µg/m ³	0.69	<0.69	<0.69	-
Dibromochloromethane	µg/m ³	1.7	<1.7	<1.7	-
Dichlorodifluoromethane	µg/m ³	0.99	1.89	2.4	-
Ethyl acetate	µg/m ³	0.72	<0.72	<0.72	-
Freon 113	µg/m ³	1.5	<1.5	<1.5	-

Notes:

- Not analyzed or RPD not calculated.
- < Concentration is less than the laboratory detection limit indicated.
- RDL Laboratory Reportable Detection Limit.
- RPD RPD is Relative Percentage Difference calculated as $RPD(\%) = \frac{|V1-V2|}{[(V1+V2)/2]} \times 100$ where V1,V2 = concentrations of parent and duplicate sample, respectively.
- RPDs have only been calculated where a concentration is greater than 5 times the RDL

Table 5: Soil Vapour Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	Field ID	VW-01	19DUP01	RPD (%)
			Sample Date	3-Dec-2019	3-Dec-2019	
			Lab Report Number	L2393598	L2393598	
			Laboratory ID	L2393598-1 / L2393598-3	L2393598-2	
Volatile Organic Compounds (VOCs)						
Heptane	µg/m ³	0.82	<0.82	<0.82	-	
Hexachlorobutadiene	µg/m ³	2.1	<2.1	<2.1	-	
Hexane	µg/m ³	0.7	<0.70	<0.70	-	
Isooctane	µg/m ³	0.93	<0.93	<0.93	-	
iso-Propylbenzene (cumene)	µg/m ³	0.98	<0.98	<0.98	-	
Methyl t-Butyl Ether (MTBE)	µg/m ³	0.72	<0.72	<0.72	-	
Methylene Chloride	µg/m ³	0.69	<0.69	<0.69	-	
Propylene	µg/m ³	0.34	<0.34	<0.34	-	
Tetrachloroethene	µg/m ³	1.4	<1.4	<1.4	-	
Tetrahydrofuran	µg/m ³	0.59	<0.59	<0.59	-	
Trichloroethene	µg/m ³	1.1	<1.1	<1.1	-	
Trichlorofluoromethane	µg/m ³	1.1	<1.1	<1.1	-	
Vinyl acetate	µg/m ³	1.8	<1.8	<1.8	-	
Vinyl bromide (bromoethene)	µg/m ³	0.87	<0.87	<0.87	-	
Vinyl chloride	µg/m ³	0.51	<0.51	<0.51	-	

Notes:

- Not analyzed or RPD not calculated.
- < Concentration is less than the laboratory detection limit indicated.
- RDL Laboratory Reportable Detection Limit.
- RPD RPD is Relative Percentage Difference calculated as $RPD(\%) = \frac{|V1-V2|}{[(V1+V2)/2]} * 100$ where V1, V2 = concentrations of parent and duplicate sample, respectively.
- RPDs have only been calculated where a concentration is greater than 5 times the RDL

Table 6: Chemical, Physical, and Toxicological Properties

Parameter	TC	RsC	H'	D _{air}	D _{water}	BAF	MF			
	Tolerable Concentration	Risk-specific concentration	Unitless Henry's Law Constant	Pure component molecular diffusivity in air	Pure component molecular diffusivity in water	Bioattenuation Factor	Mass Fraction in Soil (Coarse and Fine)	Mass Fraction in Soil Vapour - Coarse Soil	Mass Fraction in Soil Vapour - Fine Soil	
Units	mg/m ³	mg/m ³	unitless	cm ² /s	cm ² /s	unitless	unitless	unitless	unitless	
Benzene	--	0.003	0.225	0.088	1.00E-05	10	--	--	--	
Toluene	3.8	--	0.274	0.087	9.20E-06	10	--	--	--	
Ethylbenzene	1	--	0.358	0.075	8.50E-06	10	--	--	--	
Xylenes	0.18	--	0.252	0.078	9.90E-06	10	--	--	--	
Naphthalene	0.003	--	0.017	0.059	7.50E-06	10	--	--	--	
F1	Aliphatic C>6-C8	18.4	--	50	0.05	0.00001	10	0.55	0.854	0.842
	Aliphatic C>8-C10	1	--	80	0.05	0.00001	10	0.36	0.141	0.153
	Aromatic C>8-C10	0.2	--	0.48	0.05	0.00001	10	0.09	0.005	0.005
F2	Aliphatic C>10-C12	1	--	120	0.05	0.00001	10	0.36	0.767	0.766
	Aliphatic C>12-C16	1	--	520	0.05	0.00001	10	0.44	0.205	0.206
	Aromatic C>10-C12	0.2	--	0.14	0.05	0.00001	10	0.09	0.023	0.023
	Aromatic C>12-C16	0.2	--	0.053	0.05	0.00001	10	0.11	0.005	0.005
1,1,1-Trichloroethane	5	--	0.688	0.078	0.000009	10	--	--	--	
1,1,2,2-Tetrachloroethane	--	0.000172	0.019	0.071	0.000008	10	--	--	--	
1,1,2-Trichloroethane	0.0002	0.000625	0.038	0.078	0.000009	10	--	--	--	
1,1-Dichloroethane	--	0.006250	0.240	0.074	0.000011	10	--	--	--	
1,1-Dichloroethene	0.2	--	0.942	0.090	0.000010	10	--	--	--	
1,2,4-Trichlorobenzene	0.007	--	0.112	0.030	0.000008	10	--	--	--	
1,2,4-Trimethylbenzene	0.06	--	0.230	0.061	0.000008	10	--	--	--	
1,2-Dibromoethane	0.0093	0.016700	0.027	0.022	0.000012	10	--	--	--	
1,2-Dichlorobenzene	0.2	--	0.072	0.069	0.000008	10	--	--	--	
1,2-Dichloroethane	0.007	0.000385	0.049	0.104	0.000010	10	--	--	--	
1,2-Dichloropropane	0.004	0.002703	0.110	0.078	0.000009	10	--	--	--	
1,3,5-Trimethylbenzene	0.06	--	0.359	0.060	0.000008	10	--	--	--	
1,3-Butadiene	0.002	0.000333	3.009	0.249	0.000011	10	--	--	--	
1,3-Dichlorobenzene	0.095	0.000909	0.128	0.069	0.000008	10	--	--	--	
1,4-Dichlorobenzene	0.095	0.000909	0.098	0.069	0.000008	10	--	--	--	
1,4-Dioxane	0.03	0.002000	0.000	0.229	0.000010	10	--	--	--	
2-Hexanone	0.03	--	0.004	0.070	0.000008	10	--	--	--	
Acetone	31	--	0.002	0.124	0.000011	10	--	--	--	
Allyl chloride	0.001	--	0.450	0.094	0.000011	10	--	--	--	
Benzyl chloride	0.001	--	0.017	0.075	0.000008	10	--	--	--	
Bromodichloromethane	--	0.000270	0.098	0.030	0.000011	10	--	--	--	
Bromoform	--	0.009091	0.024	0.015	0.000010	10	--	--	--	
Bromomethane	0.005	--	0.255	0.073	0.000012	10	--	--	--	
Carbon Disulfide	0.7	--	0.705	0.104	0.000010	10	--	--	--	
Carbon Tetrachloride	0.1	0.001667	1.183	0.078	0.000009	10	--	--	--	
Chlorobenzene	0.01	--	0.148	0.073	0.000009	10	--	--	--	
Chloroethane	1	--	0.073	0.271	0.000012	10	--	--	--	
Chloroform	0.098	0.000435	0.154	0.104	0.000010	10	--	--	--	
Chloromethane	0.09	--	0.388	0.126	0.000007	10	--	--	--	
cis-1,2-Dichloroethene	0.007	--	0.302	0.074	0.000011	10	--	--	--	
cis-1,3-Dichloropropene	0.02	0.002500	0.053	0.087	0.000010	10	--	--	--	
Cyclohexane	6	--	7.618	0.080	0.000009	10	--	--	--	
Dibromochloromethane	0.07	--	0.040	0.020	0.000011	10	--	--	--	
Dichlorodifluoromethane	0.1	--	16.475	0.067	0.000010	10	--	--	--	
4-Ethyltoluene	0.40	--	0.205	0.065	0.000007	10	--	--	--	
Ethyl acetate	0.07	--	0.006	0.067	0.000010	10	--	--	--	
Freon 113	5	--	21.500	0.038	0.000009	10	--	--	--	
Freon 114	17	--	115.000	0.082	0.000009	10	--	--	--	
Heptane	0.4	--	83.709	0.065	0.000007	10	--	--	--	
Hexachlorobutadiene	--	0.000455	0.421	0.027	0.000007	10	--	--	--	
Isooctane	0.4	--	30.500	0.060	0.000007	10	--	--	--	
Isopropyl alcohol	0.2	--	0.000331	0.103	0.000011	10	--	--	--	
Isopropylbenzene	0.4	--	0.591	0.065	0.000007	10	--	--	--	
Methyl ethyl ketone	5	--	0.001	0.081	0.000010	10	--	--	--	
Methyl isobutyl ketone	0.003	--	0.006	0.075	0.000008	10	--	--	--	
Methylene chloride	0.6	1	0.151	0.101	0.000012	10	--	--	--	
MTBE	0.037	--	0.028	0.102	0.000011	10	--	--	--	
n-Hexane	0.7	--	73.916	0.200	0.000008	10	--	--	--	
Propylene	3	--	8.013	0.110	0.000011	10	--	--	--	
Styrene	0.092	--	0.130	0.071	0.000008	10	--	--	--	
Tetrachloroethylene	0.36	0.038462	1.077	0.072	0.000008	10	--	--	--	
Tetrahydrofuran	2	--	0.003	0.099	0.000011	10	--	--	--	
trans-1,2-Dichloroethene	--	--	0.277	0.071	0.000012	10	--	--	--	
trans-1,3-Dichloropropene	0.02	0.002500	0.053	0.087	0.000010	10	--	--	--	
Trichloroethylene	0.04	0.002439	0.477	0.079	0.000009	10	--	--	--	
Trichlorofluoromethane	1.05	--	5.200	0.087	0.000010	10	--	--	--	
Vinyl acetate	0.2	--	0.024	0.085	0.000009	10	--	--	--	
Vinyl bromide	0.003	--	0.260	0.100	0.000012	10	--	--	--	
Vinyl chloride	0.1	0.002273	3.236	0.106	0.000012	10	--	--	--	
Hydrogen Sulfide	0.002	--	0.350	0.188	0.000022	10	--	--	--	

Notes:

cm²/s Square centimetres per second

F1 Fraction 1 (C6-C10)

F2 Fraction 2 (C>10-C16)

mg/m³ Milligrams per cubic metre

PHC Petroleum hydrocarbon

-- not applicable

Refer Canadian Council of Ministers of the Environment (CCME). 2014. *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours*.

Table 7: Soil Properties for Evaluation of Vapour Transport

Parameter		Units	Coarse-Grained Soil	Fine-Grained Soil
θ_a	Vapour-filled porosity	unitless	0.31	0.303
ρ_b	Dry bulk density	g/cm ³	1.7	1.4
n	Total soil porosity	unitless	0.36	0.47
θ_w	Moisture-filled porosity	unitless	0.05	0.167
Q_{soil}	Soil gas flow rate	cm ³ /s	167	16.7

Notes:

Values from CCME (2014).

- cm Centimetre
- cm² Square centimetre
- g/cm³ Grams per cubic centimetre
- PHC Petroleum hydrocarbon

References: Canadian Council of Ministers of the Environment (CCME). 2014. *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours*.

Table 8: Building Properties for Evaluation of Vapour Transport

Parameter		Units	Residential Land Use
			Basement
L _B	Building length	cm	1,225
W _B	Building width	cm	1,225
A _B	Building area exposed to soil, including basement wall area	cm ²	2.7E+06
H _B	Building height	cm	360
L _{crack}	Thickness of the foundation	cm	11.25
A _{crack}	Area of cracks through which contaminant vapours enter the building	cm ²	994.5
ACH	Air exchanges per hour	h ⁻¹	0.5

Notes:

Values taken from CCME (2014).

cm Centimetre

cm² Square centimetre

h⁻¹ Per hour

References: Canadian Council of Ministers of the Environment (CCME). 2014. *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours*.

Table 9: Generic Soil Vapour Criteria

Parameter	Units	Residential Land Use		
		Basement and Slab-on-Grade		
		Coarse Grained	Units	Coarse Grained
Benzene		0.195		195
Toluene		124		124,220
Ethylbenzene		34		34,330
Xylenes		6		6,330
PHC F1		867		867,380
PHC F2		53		52,500
Naphthalene		0.112		112
Isopropanol		6.22		6,219
1,1,1-Trichloroethane		1,694		1,693,510
1,1,2,2-Tetrachloroethane		0.01		11
1,1,2-Trichloroethane		0.01		7
1,1-Dichloroethane		0.43		430
1,1-Dichloroethene		6.47		6,470
1,2,4-Trichlorobenzene		0.36		365
1,2,4-Trimethylbenzene		2.23		2,235
1,2-Dibromoethane		0.59		590
1,2-Dichlorobenzene		7.07		7,072
1,2-Dichloroethane		0.02		24
1,2-Dichloroethene (cis)		0.24		242
1,2-Dichloroethene (trans)		NG		NG
1,2-Dichloropropane		0.14		135
1,3,5-Trimethylbenzene		2.23		2,235
1,3-Butadiene		0.02		17
1,3-Dichlorobenzene		0.06		64
1,3-Dichloropropene [cis]		0.16		163
1,3-Dichloropropene [trans]		0.15		149
1,4-Dichlorobenzene		0.06		64
1,4-Dioxane		0.11		105
1-Methyl-4 ethyl benzene		14.46		14,461
2-Butanone (MEK)		167		167,364
2-Hexanone (MBK)		1.05		1,053
4-Methyl-2-pentanone (MIBK)		0.1		103
Acetone	mg/m ³	919	µg/m ³	918,788
Allyl chloride		0.03		32
Benzyl chloride		0.03		34
Bromodichloromethane		0.03		28
Bromoform		1.49		1,494
Bromomethane		0.17		173
Carbon disulfide		21.71		21,713
Carbon tetrachloride		0.11		113
Chlorobenzene		0.35		347
Chloroethane		31		31,019
Chloroform		0.03		27
Chloromethane		2.66		2,657
Cyclohexane		202		201,510
Dibromochloromethane		4.75		4,750
Dichlorodifluoromethane		3.58		3,584
Ethyl acetate		2.51		2,509
Freon 113		231		230,627
Freon 114		566.00		566,335
Heptane		14.46		14,461
Hexachlorobutadiene		0.05		51
Hexane		18.84		18,839
Isooctane		14.92		14,917
iso-Propylbenzene (cumene)		14.46		14,461
Methyl t-Butyl Ether (MTBE)		1.15		1,153
Methylene Chloride		18.76		18,764
Propylene		92		91,723
Styrene		3.22		3,220
Tetrachloroethene		2.68		2,679
Tetrahydrofuran		62.83		62,828
Trichloroethene		0.15		153
Trichlorofluoromethane		34.32		34,325
Vinyl acetate		6.59		6,586
Vinyl bromide (bromoethene)		0.09		94
Vinyl chloride		0.14		140

Notes:

mg/m³ milligrams per cubic metre
 µg/m³ micrograms per cubic metre

Table 10: Soil Vapour Risk Evaluation

Parameter	Unit	Soil Vapour Screening Criteria ^a	Soil Vapour Results ($\mu\text{g}/\text{m}^3$)		Comparisons of Soil Vapour Measurements to Soil Vapour Criteria			
					Estimated Cancer Risk ^b		Estimated Hazard Quotients ^c	
			VW-01	19DUP01	VW-01	19DUP01	VW-01	19DUP01
Toluene	$\mu\text{g}/\text{m}^3$	124,220	<0.75	2.67	-	-	ND	2.15E-05
Xylenes, Total	$\mu\text{g}/\text{m}^3$	6,330	<2.0	7.4	-	-	ND	1.17E-03
Aliphatic >C6-C8	$\mu\text{g}/\text{m}^3$	740,737	17	29	-	-	2.30E-05	3.92E-05
Aliphatic >C8-C10	$\mu\text{g}/\text{m}^3$	40,257	<15	41	-	-	ND	1.02E-03
F1 (C6-C10)	$\mu\text{g}/\text{m}^3$	867,383	465	85.4	-	-	5.36E-04	9.85E-05
Acetone	$\mu\text{g}/\text{m}^3$	918,788	2.3	3.5	-	-	2.50E-06	3.81E-06
Dichlorodifluoromethane	$\mu\text{g}/\text{m}^3$	3,584	1.89	2.40	-	-	5.27E-04	6.70E-04
Cumulative Risk and Hazard Index ^d					0.0E+00	0.0E+00	0.001	0.003
Target Risk and Hazard Levels					1.0 x 10⁻⁵		1.00	

Notes:

< – not detected. Listed value is the corresponding detection limit.

- = screening criteria not calculated as appropriate toxicity data not available.

Bold = identifies estimated risks and hazards that exceeded the target risk level of 1×10^{-5} or target hazard level of 1.

^a Listed soil vapour screening criteria derived in accordance with CCME, 2014.

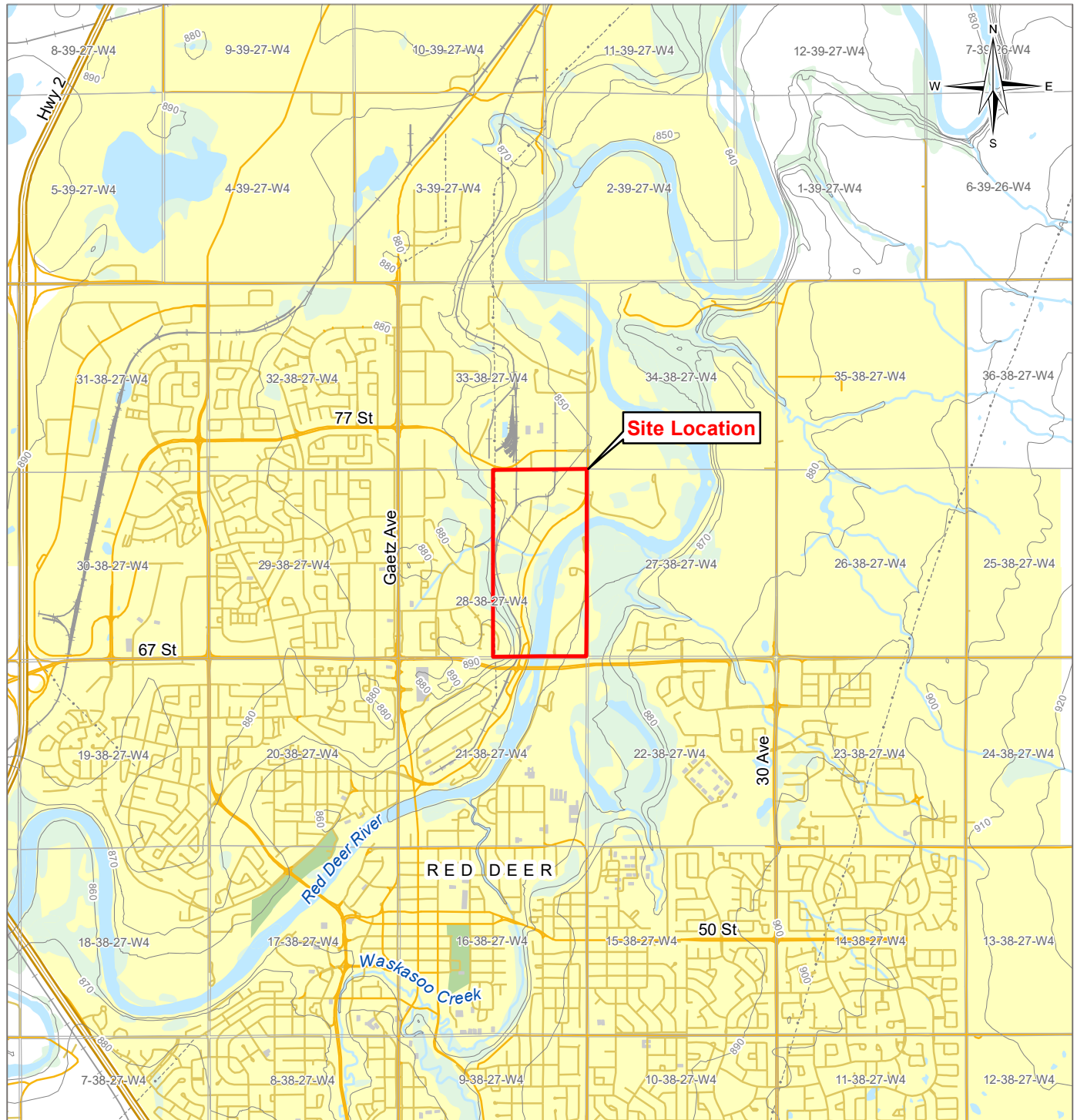
^b Estimated cancer risk = (soil vapour concentration/cancer soil vapour screening level) x 10^{-5} .

^c Estimated hazard quotient = (soil vapour concentration/non-cancer soil vapour screening level).

^d Cumulative risk and hazard index represent the sum of chemical-specific cancer risks and hazard quotients.

FIGURES

Figure 1	Site Location Plan
Figure 2	Site Plan and Surrounding Land Use
Figure 3	Historical Groundwater Elevations (Groundwater Monitoring Wells)
Figure 4	Groundwater Elevation Contours – May 2019
Figure 5	Groundwater Elevation Contours – June 2019
Figure 6	Groundwater Elevation Contours – September 2019
Figure 7	Groundwater Elevation Contours – December 2019



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LEGEND

- Site Boundary
- Highway
- Main Road
- Local Road
- Resource/Recreational Road
- Railway
- Power Line
- Building
- Park
- Residential Area
- Contour (10 m)
- Watercourse
- Waterbody
- Wooded Area
- Urban Area

NOTES
Base data source: CanVec 1:50,000.

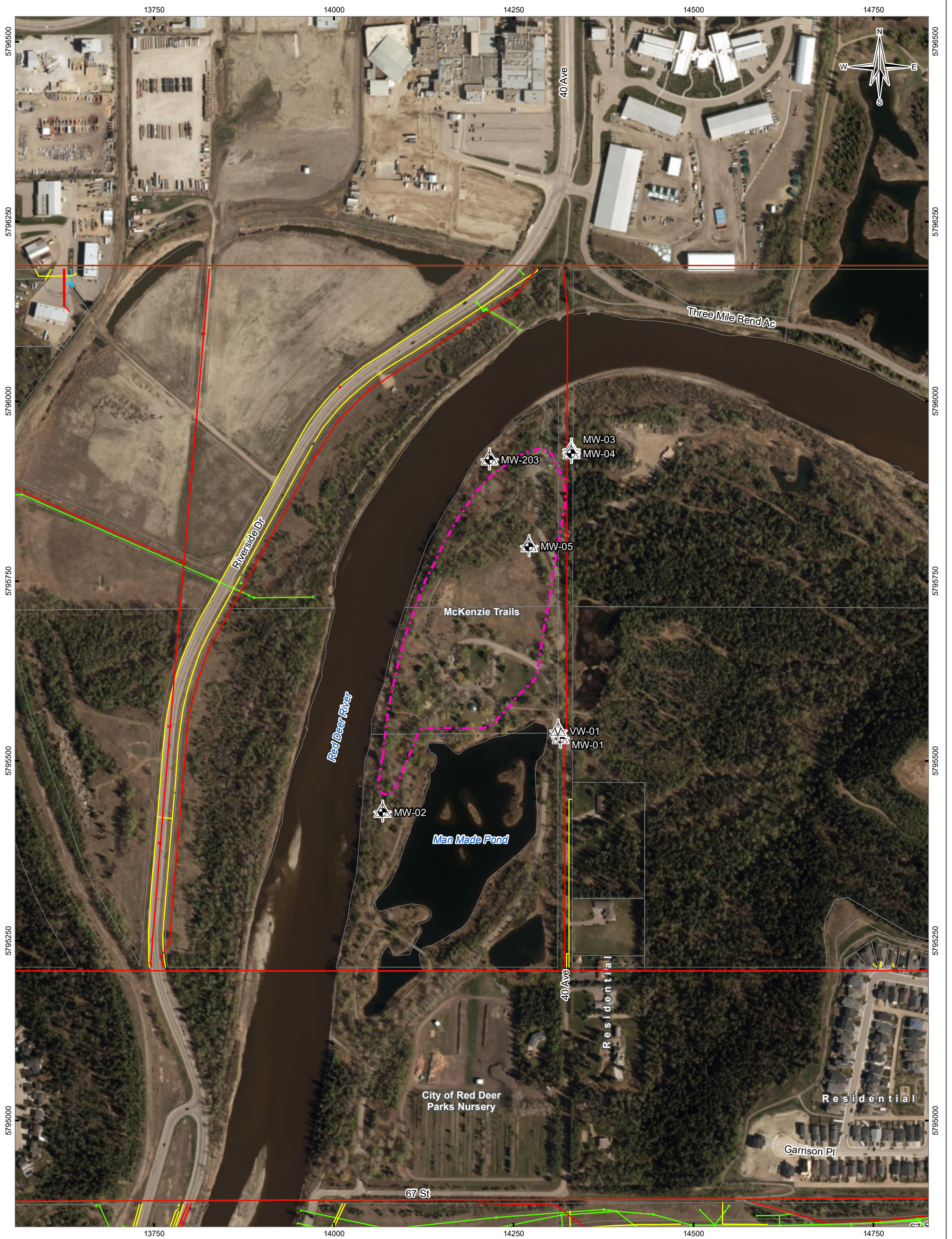
STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT MCKENZIE TRAILS RECREATION AREA

Site Location Plan

PROJECTION 3TM 114		DATUM NAD83		CLIENT THE CITY OF Red Deer	
Scale: 1:50,000					
FILE NO. SWOP04071-01_Figure1_SiteLocation.mxd					
OFFICE Tl-EDM	DWN MRV	CKD SL	APVD MR	REV 0	TETRA TECH
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.003				

Figure 1



LEGEND

- Monitoring Well
- Vapour Well
- Historic Waste Disposal (Provided by Tiamat, 2014)
- Lot Boundary
- Utilities**
- Electrical
- Sanitary
- Storm
- Water

NOTES
 Base data source: Imagery provided by ESRI; Red Deer County (2018)
 Roads from City of Red Deer Open Data, 2018
 Utilities provided by City of Red Deer.
 Locations have not been field verified, and should not be used for construction or other intrusive field activities.

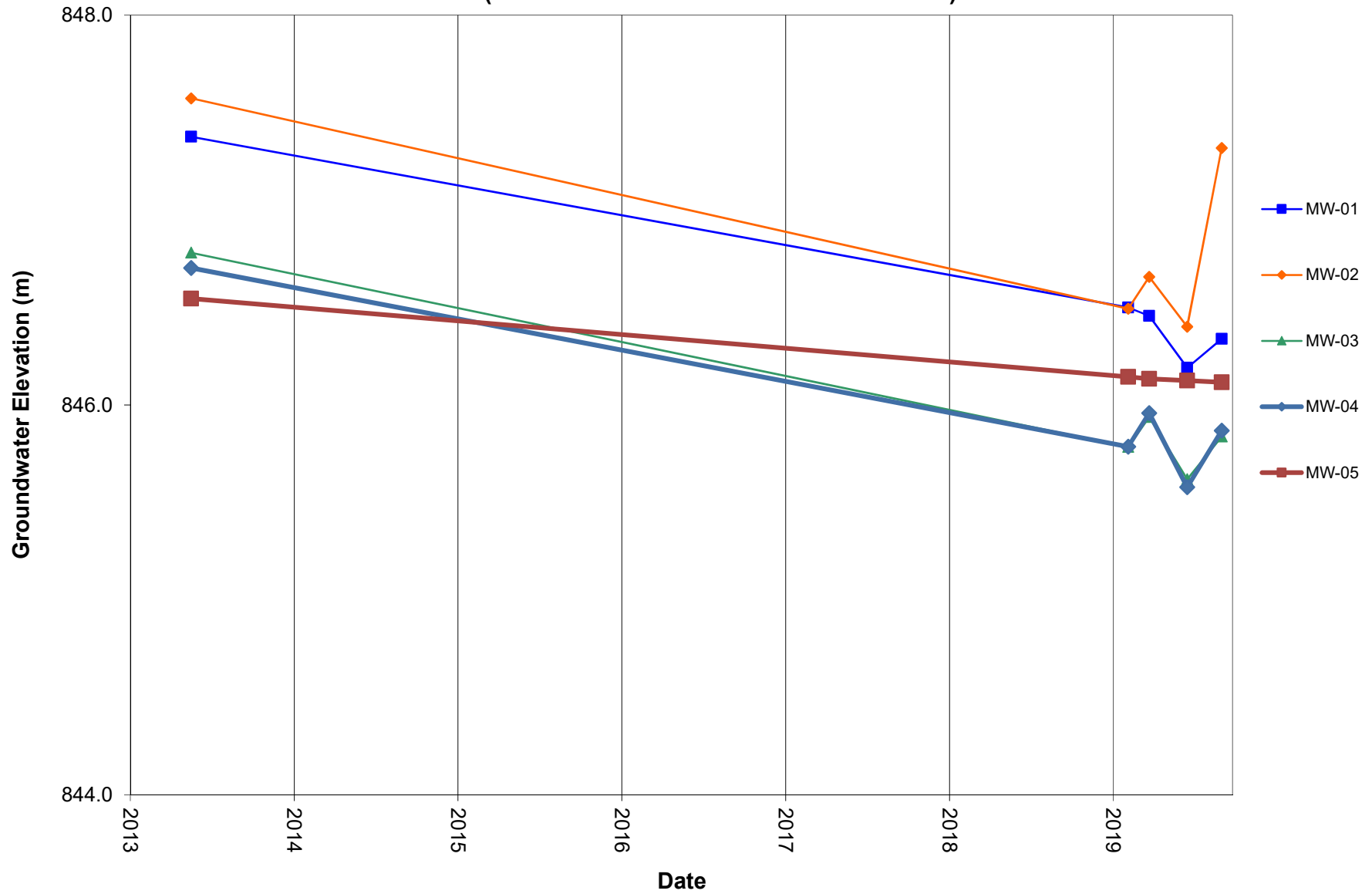
STATUS
 ISSUED FOR USE

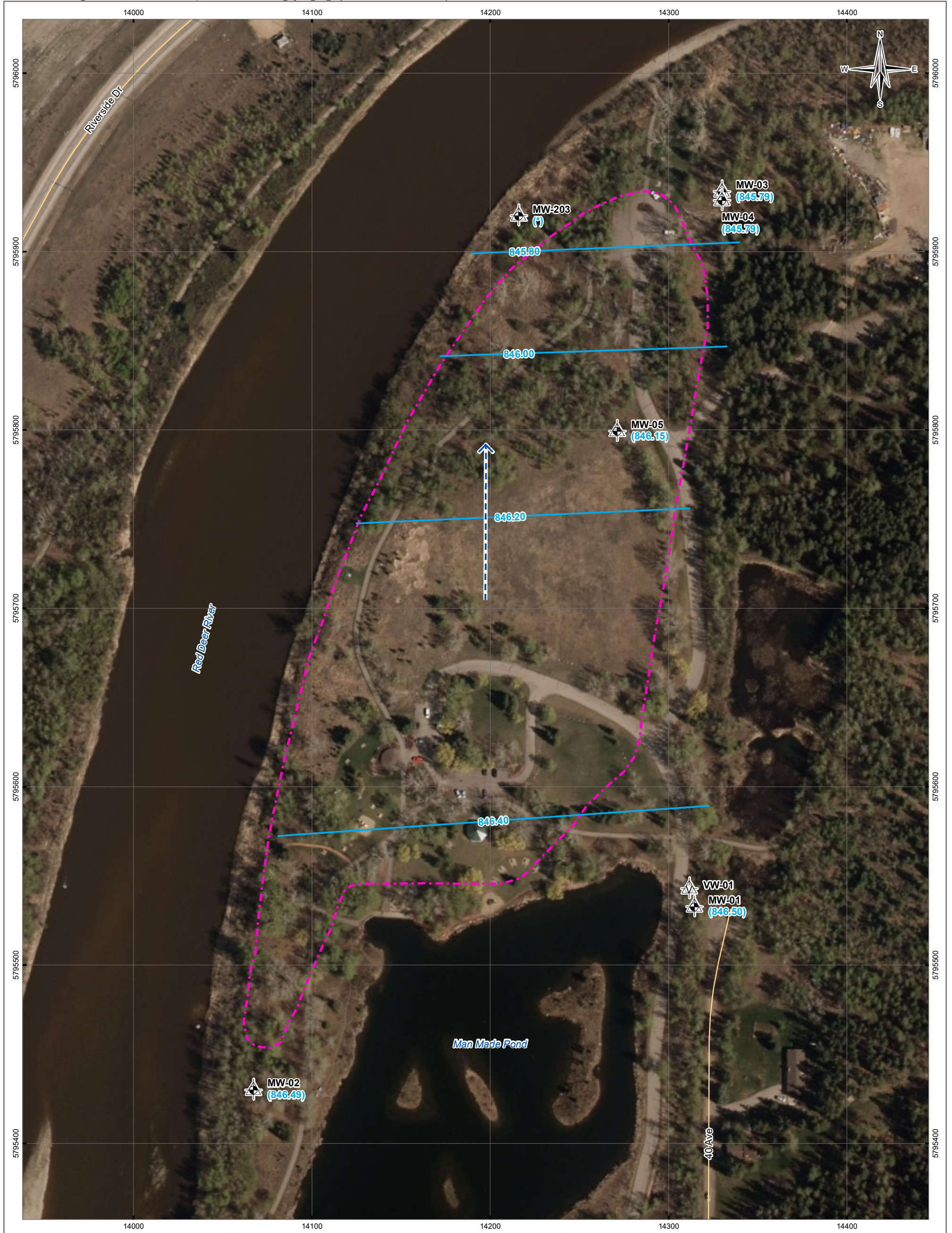
**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 MCKENZIE TRAILS RECREATION AREA**

Site Plan and Surrounding Land Use







PROJECTION 3TM 114	DATUM NAD83	CLIENT
Scale: 1:5,000 100 50 0 100 Metres		
FILE NO. SWOP04071-01_Figure2_LandUse.mxd		
OFFICE Tt-EDM	DWN MRV	CKD SL
DATE October 1, 2020	APVD MR	REV 0
PROJECT NO. SWM.SWOP04071-01.003		Figure 2

FIGURE 3
HISTORICAL GROUNDWATER ELEVATIONS
(GROUNDWATER MONITORING WELLS)







LEGEND

-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
- (84X.XX)** Groundwater Elevation (masl)
-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Road

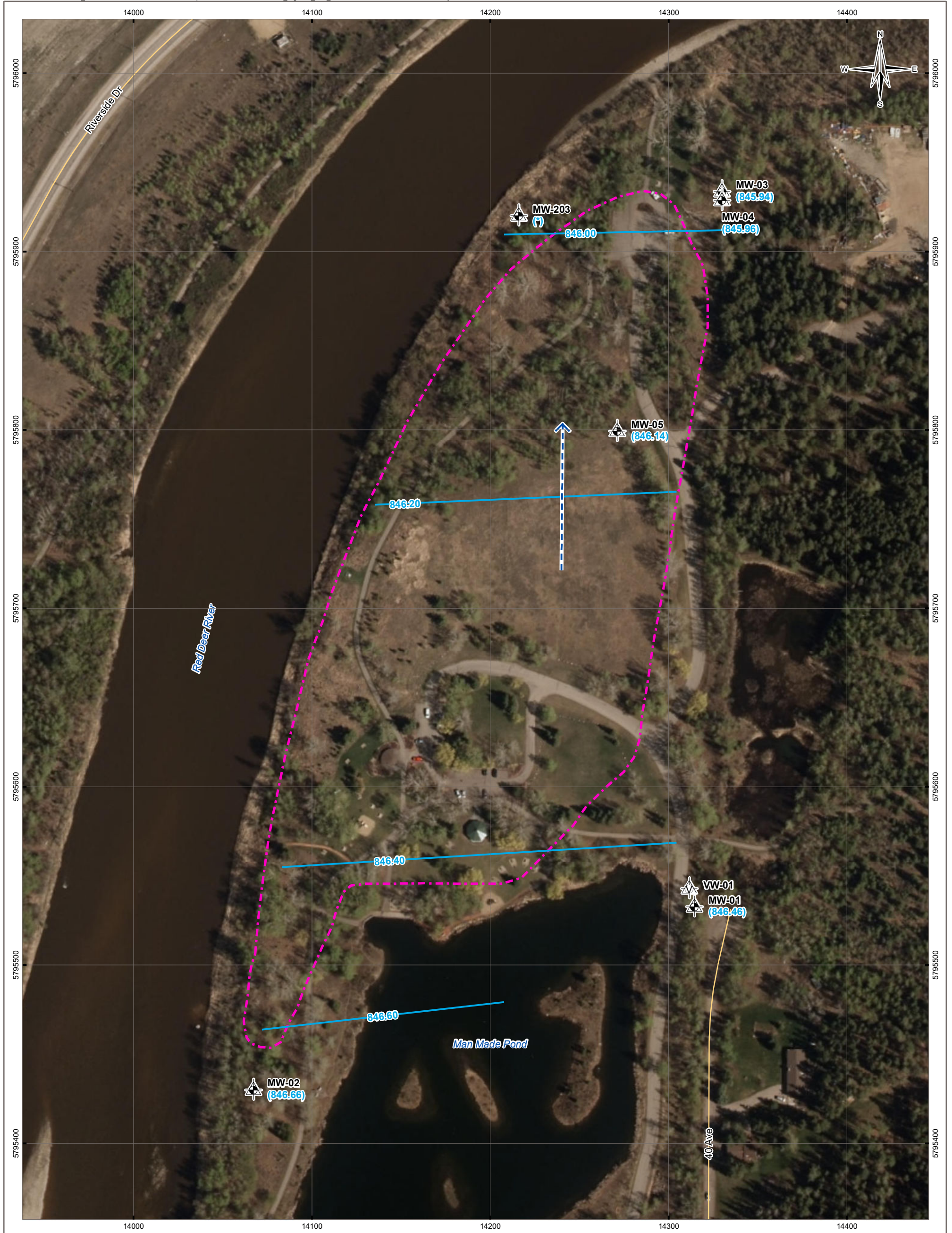
NOTES
 Base data source: Imagery provided by ESRI; Red Deer County (2018)
 Roads from City of Red Deer Open Data, 2018
 masl - metres above sea level
 * - not measured

**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 MCKENZIE TRAILS RECREATION AREA**








**Groundwater Elevation Contours
 May 2019**

PROJECTION 3TM 114	DATUM NAD83	CLIENT 
Scale: 1:2,000		
		
FILE NO. SWOP04071-01_Figure4_GW_May2019.mxd		
OFFICE Tl-EDM	DWN MRV	CKD SL
DATE October 1, 2020	APVD MR	REV 0
PROJECT NO. SWM.SWOP04071-01.003		Figure 4

STATUS
ISSUED FOR USE



LEGEND

-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (84X.XX) Groundwater Elevation (masl)
-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Road

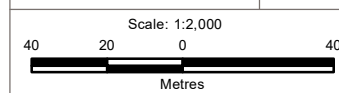
NOTES
 Base data source: Imagery provided by ESRI; Red Deer County (2018)
 Roads from City of Red Deer Open Data, 2018
 masl - metres above sea level
 * - not measured

STATUS
 ISSUED FOR USE

**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 MCKENZIE TRAILS RECREATION AREA**

**Groundwater Elevation Contours
 June 2019**

PROJECTION: 3TM 114
 DATUM: NAD83

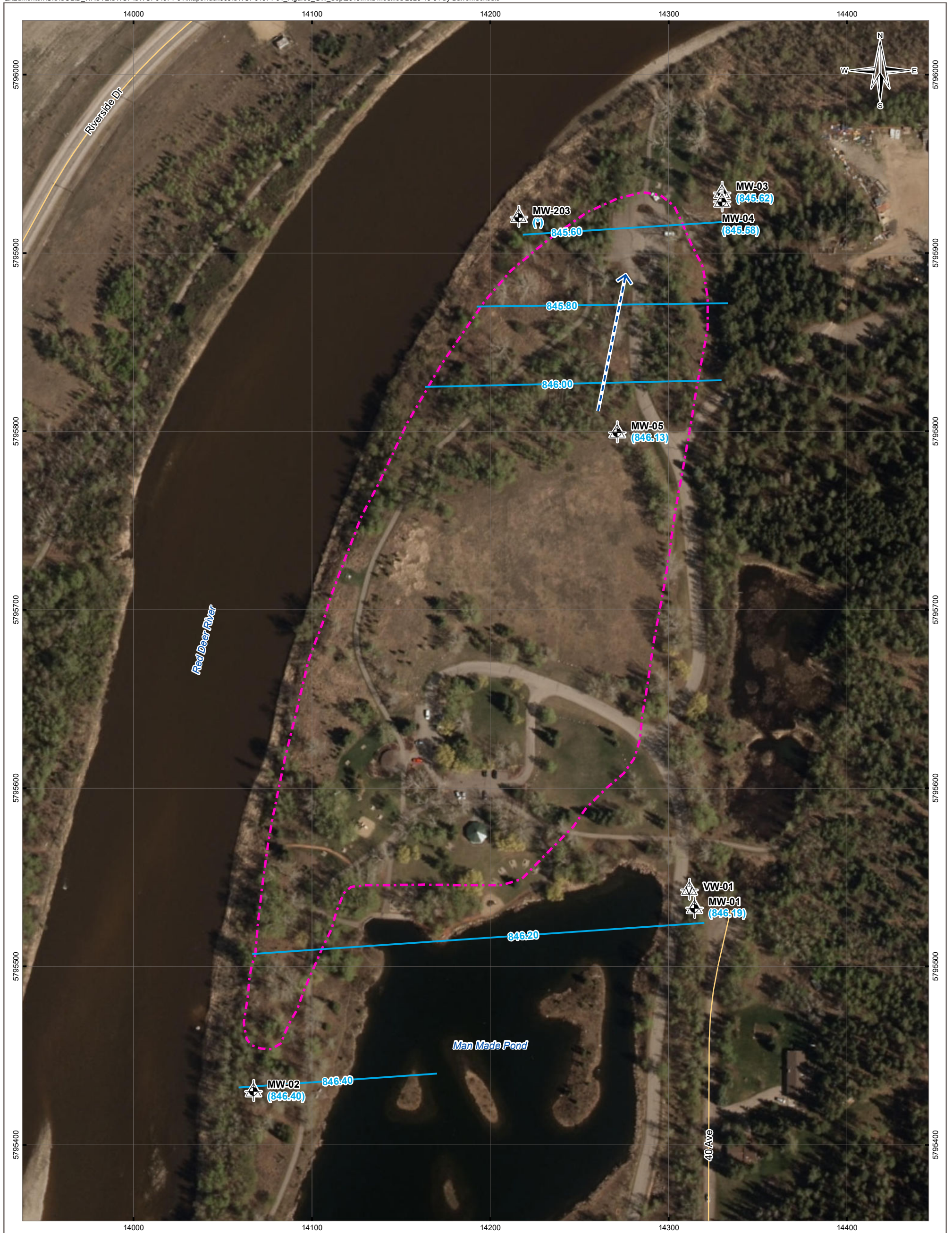


FILE NO.: SWOP04071-01_Figure5_GW_June2019.mxd








OFFICE	DWN	CKD	APVD	REV
Ti-EDM	MRV	SL	MR	0

DATE: October 1, 2020
 PROJECT NO.: SWM.SWOP04071-01.003

Figure 5



LEGEND



-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (84X.XX) Groundwater Elevation (masl)
-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Road

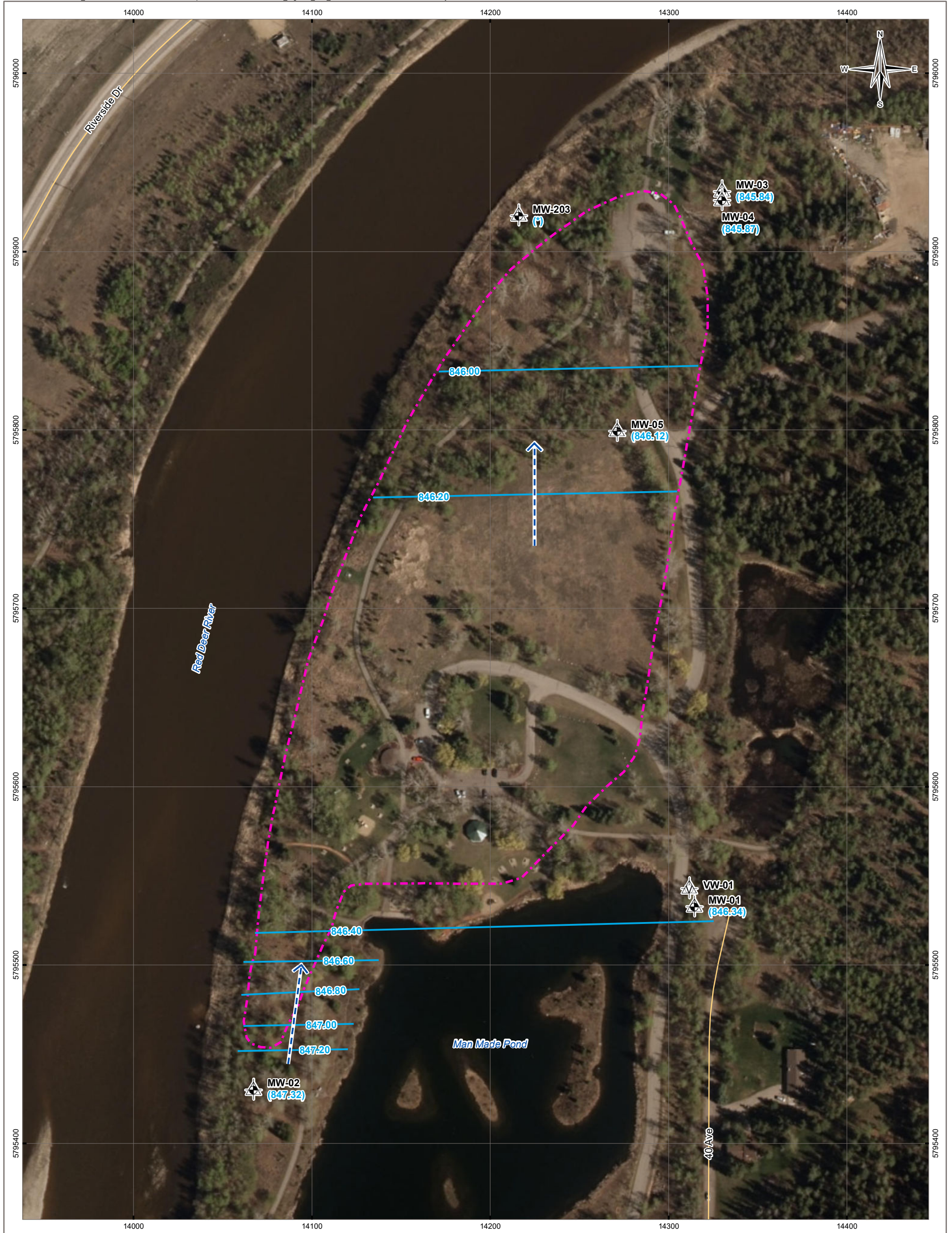
NOTES
 Base data source: Imagery provided by ESRI; Red Deer County (2018)
 Roads from City of Red Deer Open Data, 2018
 masl - metres above sea level
 * - not measured

STATUS
 ISSUED FOR USE








**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 MCKENZIE TRAILS RECREATION AREA**

**Groundwater Elevation Contours
 September 2019**

PROJECTION 3TM 114	DATUM NAD83	CLIENT 
Scale: 1:2,000		
		
FILE NO. SWOP04071-01_Figure6_GW_Sep2019.mxd		
OFFICE Tl-EDM	DWN MRV	CKD SL
DATE October 1, 2020	APVD MR	REV 0
PROJECT NO. SWM.SWOP04071-01.003		Figure 6



LEGEND



-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (84X.XX) Groundwater Elevation (masl)
-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Road

NOTES
 Base data source: Imagery provided by ESRI; Red Deer County (2018)
 Roads from City of Red Deer Open Data, 2018
 masl - metres above sea level
 * - not measured

STATUS
 ISSUED FOR USE

**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 MCKENZIE TRAILS RECREATION AREA**

**Groundwater Elevation Contours
 December 2019**

PROJECTION 3TM 114	DATUM NAD83	CLIENT 
Scale: 1:2,000		
		
FILE NO. SWOP04071-01_Figure7_GW_Dec2019.mxd		
OFFICE Tl-EDM	DWN MRV	CKD SL
DATE October 1, 2020	APVD MR	REV 0
PROJECT NO. SWM.SWOP04071-01.003		Figure 7

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

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Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner

consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by persons other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary investigation and assessment.

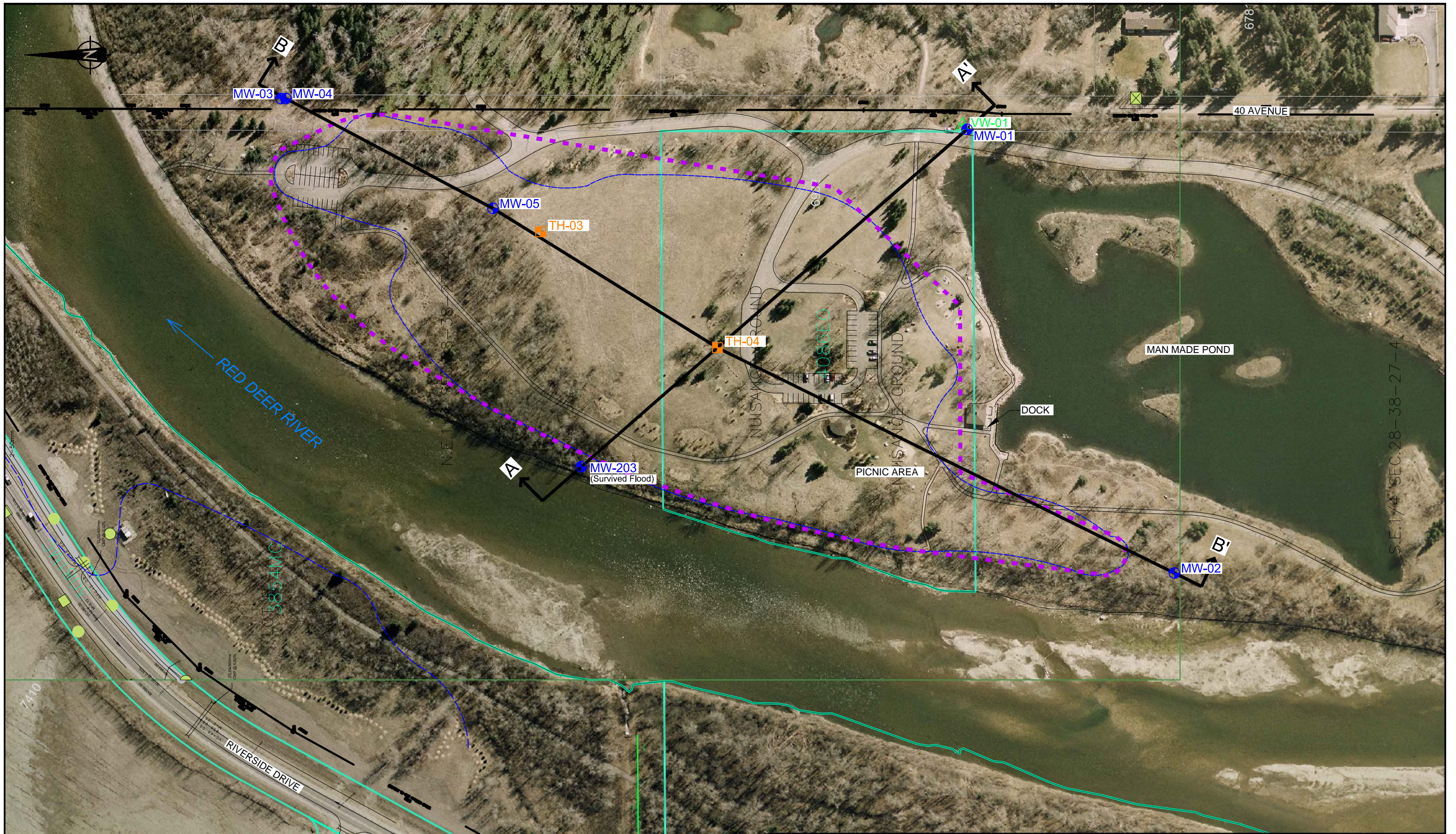
TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 NOTIFICATION OF AUTHORITIES

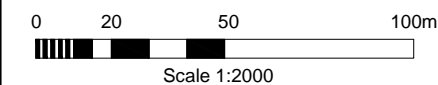
In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

APPENDIX B

CROSS-SECTIONS (TIAMAT 2014)



SOURCE
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PHASE II TEST LOCATIONS
 MW-## GROUNDWATER MONITORING WELL (5)
 TH-## TESTHOLE (2)
 VP-## SOIL VAPOUR MONITORING WELL (1)
 REFER TO TABLE 1 FOR TESTHOLE INFORMATION

LEGEND
 HISTORIC WASTE DISPOSAL
 LOT BOUNDARY
 100 YEAR FLOOD LINE
 CROSS SECTION LOCATION

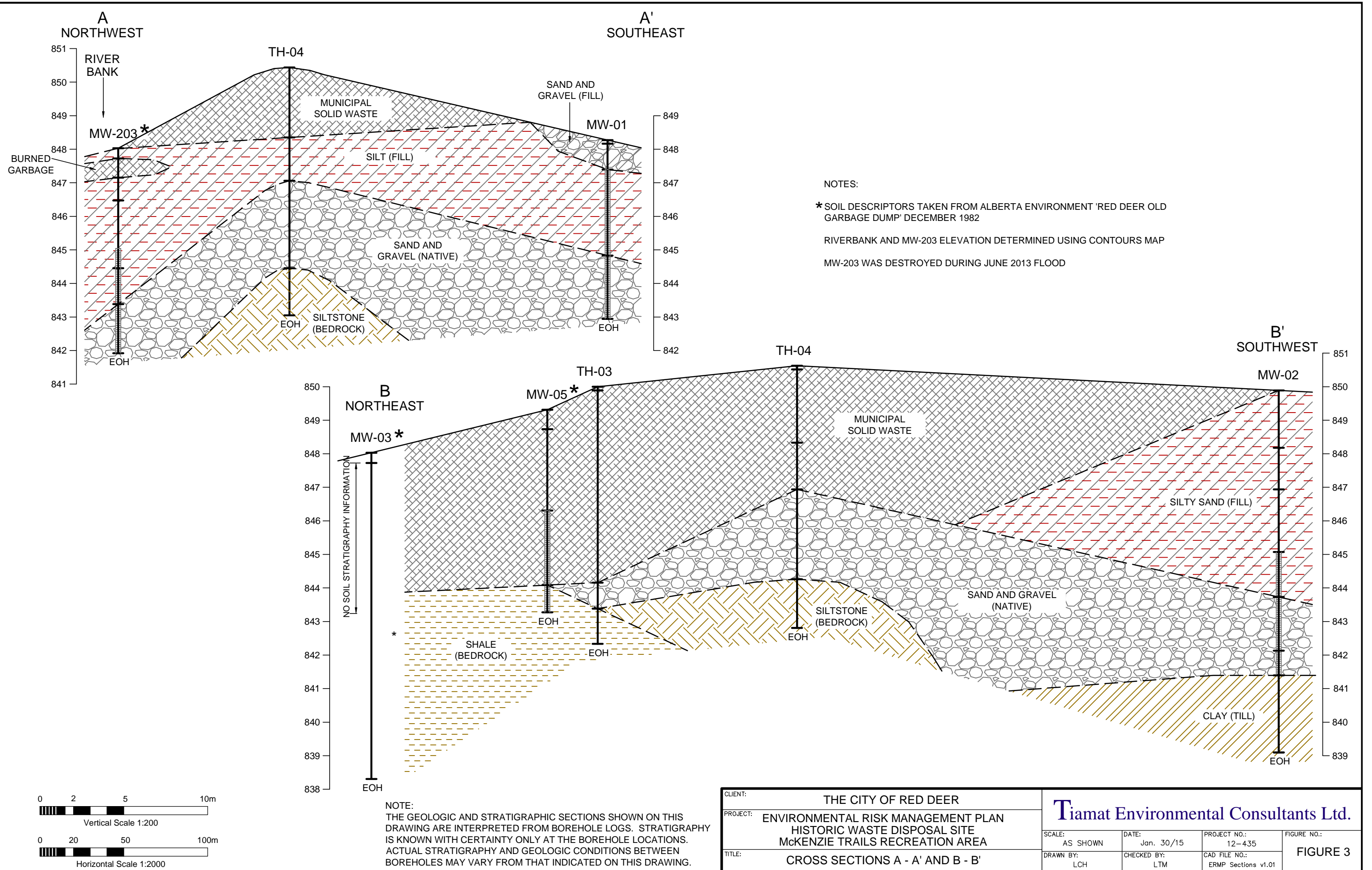
ELECTRICAL
 SANITARY
 STORM
 WATER

NOTE:
LOCATION OF BURIED UTILITIES ARE APPROXIMATE.
ACTUAL LOCATIONS OF THE SHALLOW UTILITIES
AND ANY OTHER UTILITIES SHOULD BE VERIFIED
PRIOR TO ANY GROUND DISTURBANCE ACTIVITY.

CLIENT:	THE CITY OF RED DEER
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE MCKENZIE TRAILS RECREATION AREA
TITLE:	SITE PLAN SHOWING INTERPRETED EXTENT OF WASTE

Tiamat Environmental Consultants Ltd.

SCALE: 1 : 2000	DATE: June 24/14	PROJECT NO.: 12-435	FIGURE NO.:
DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP v1.00.dwg	FIGURE 2



CLIENT:	THE CITY OF RED DEER			
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE McKENZIE TRAILS RECREATION AREA			
TITLE:	CROSS SECTIONS A - A' AND B - B'			SCALE: AS SHOWN
		DATE: Jan. 30/15	PROJECT NO.: 12-435	FIGURE NO.:
	DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP Sections v1.01	FIGURE 3

APPENDIX C

WATER WELL DATA



Reconnaissance Report

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Groundwater Wells

Please click the water Well ID to generate the Water Well Drilling Report.

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIA (in)
96285	13	22	38	27	4	HI-RATE DRILLING COMPANY LTD.	1970-11-10	310.00	Test Hole	Investigation		26		ALTA PUBLIC WORKS#DEERHOME 2A			0.00
96351	SW	27	38	27	4	UNKNOWN DRILLER		8.00	Cathodic Protection	Domestic	1			PROUDFOOT, J.A.	5.00		0.00
96352	SW	27	38	27	4	UNKNOWN DRILLER		150.00	Chemistry	Domestic	1			PROUDFOOT, J.A.			0.00
96353	SW	27	38	27	4	UNKNOWN DRILLER		100.00	Chemistry	Domestic	1			PROUDFOOT, J.A.			0.00
96354	4	27	38	27	4	UNKNOWN DRILLER	1958-09-16	16.00	Chemistry	Domestic	2			JANKE HLDG	12.00		0.00
96355	SW	27	38	27	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic				JOHNSON, DON A.			0.00
96356	SW	27	38	27	4	FORRESTER DRILLING	1977-09-15	147.00	New Well	Domestic		11		GRANDE, RUTH	37.00	20.00	7.00
96357	SW	27	38	27	4	FORRESTER DRILLING	1977-09-13	140.00	New Well	Domestic	1	8		FIVE-O-DEV LTD	30.00	30.00	7.00
96358	SW	27	38	27	4	TELNING	1921-01-01	180.00	Federal Well Survey	Domestic & Stock				NICHOLSON, R.J.	50.00		0.00
96359	SW	27	38	27	4	FORRESTER WATER WELL DRILLING (1981) LTD.	1984-11-27	143.00	New Well	Domestic		18		BORDER PAVING	35.00	42.00	7.00
96360	SW	27	38	27	4	FORRESTER WATER WELL DRILLING (1981) LTD.	1984-11-29	110.00	New Well	Domestic		14		BORDER PAVING	34.00	42.00	7.00
96361	SW	27	38	27	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic				RIVERBEND GOLF COURSE			0.00
96362	4	27	38	27	4	UNKNOWN DRILLER		0.00	Well Inventory	Unknown				NICKELSON			0.00
96363	4	27	38	27	4	UNKNOWN DRILLER		160.00	Chemistry	Domestic	1			POHL, HARRY	75.00		0.00
96364	NW	27	38	27	4	UNKNOWN DRILLER	1934-01-01	25.00	Federal Well Survey	Domestic				FEDRER	20.00		48.00
96365	NW	27	38	27	4	BIG IRON DRILLING LTD.	1987-06-03	160.00	New Well	Domestic		11		RED DEER, CITY OF	26.00	10.00	5.56
96366	NW	27	38	27	4	BIG IRON DRILLING LTD.	1987-06-11	127.00	New Well	Domestic		8		RED DEER, CITY OF	27.00	10.00	5.56
96377		27	38	27	4	UNKNOWN DRILLER		30.00	Chemistry	Domestic	1			POHL, HARRY	26.00		0.00
96378	SE	28	38	27	4	FORRESTER DRILLING	1964-04-13	123.00	New Well	Unknown		12		CNR	40.00	22.00	7.00
96379	1	28	38	27	4	UNKNOWN DRILLER	1952-05-04	630.00	Structure Test Hole	Industrial				CALIFORNIA STANDARD CO			0.00



Reconnaissance Report

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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIA (in)
96380	2	28	38	27	4	HI-RATE DRILLING COMPANY LTD.	1969-11-18	180.00	Test Hole	Investigation		21		RED DEER, CITY OF# TH2-28			5.50
96380	2	28	38	27	4	UNKNOWNDRILLINGCOMP11		180.00	Old Well-Yield	Unknown		1	22	RED DEER	48.78	11.00	
96381	2	28	38	27	4	FORRESTER DRILLING	1961-03-09	44.00	Test Hole	Investigation	1	4		RED DEER, CITY OF# TH1, SITE1			0.00
96382	2	28	38	27	4	FORRESTER DRILLING	1961-03-08	53.00	Test Hole	Investigation	1	5		RED DEER, CITY OF# TH2 SITE 1			0.00
96383	2	28	38	27	4	FORRESTER DRILLING	1961-03-08	85.00	Test Hole	Investigation		4		RED DEER, CITY OF# TH5, SITE 1			0.00
96384	7	28	38	27	4	FORRESTER DRILLING	1961-03-18	15.00	Test Hole	Investigation		3		RED DEER, CITY OF# THRB, SITE1			0.00
96385	7	28	38	27	4	FORRESTER DRILLING	1961-03-11	85.00	Test Hole	Investigation	1	6		RED DEER, CITY OF #TH3 SITE1	26.00	40.00	7.00
96386	7	28	38	27	4	FORRESTER DRILLING	1961-03-17	72.00	Test Hole	Investigation				RED DEER, CITY OF# TH6 SITE 1			0.00
96387	7	28	38	27	4	FORRESTER DRILLING	1961-03-23	80.00	Test Hole	Investigation		10		RED DEER, CITY OF # TH7 SITE 1	20.30	30.00	0.00
96388	7	28	38	27	4	FORRESTER DRILLING	1961-03-25	70.00	Test Hole	Investigation		7		RED DEER, CITY OF# TH8, SITE 1			0.00
96667	7	28	38	27	4	FORRESTER DRILLING	1961-03-29	80.00	Test Hole	Investigation		7		RED DEER, CITY OF# TH 9,SITE 1			0.00
96668	7	28	38	27	4	FORRESTER DRILLING	1961-05-24	42.00	New Well	Investigation		3		RED DEER, CITY OF#TH 10,SITE 1	12.50	131.00	0.00
96669	7	28	38	27	4	FORRESTER DRILLING	1961-05-25	22.00	New Well	Observation		3		RED DEER, CITY OF#TH11, SITE 1			7.00
96684	SE	28	38	27	4	FORRESTER DRILLING	1960-03-18	29.00	New Well	Unknown		5	1	RED DEER, CITY OF	8.50	20.00	6.00
96685	NE	28	38	27	4	FORRESTER DRILLING	1960-03-04	35.00	New Well	Investigation		4		RED DEER, CITY OF# TH 4	13.30		6.00
96686	NE	28	38	27	4	FORRESTER DRILLING	1960-02-29	70.00	New Well	Investigation		7		RED DEER, CITY OF# TH3	25.00		6.00
96687	NE	28	38	27	4	FORRESTER DRILLING	1960-02-23	58.00	New Well	Investigation		7		RED DEER, CITY OF# TH 2	23.30		6.00
96688	NE	28	38	27	4	FORRESTER DRILLING	1960-02-19	72.00	Test Hole	Investigation		5		RED DEER, CITY OF# TH 1			0.00
96689	NE	28	38	27	4	ALBERTA EAGLE DRILLING LTD.	1986-05-07	23.00	Other	Other		3		CAN FRACMASTER			7.00
96690	9	28	38	27	4	FORRESTER DRILLING	1961-03-10	53.00	Test Hole	Investigation	1	4		RED DEER, CITY OF# TH4, SITE 1			0.00



Reconnaissance Report

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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIA (in)
96691	16	28	38	27	4	FORRESTER DRILLING	1961-06-16	308.00	New Well	Industrial		22		RED DEER PACKERS LTD#TH8,WELL1	28.50	160.00	8.63
96692	16	28	38	27	4	FORRESTER DRILLING	1961-05-19	120.00	New Well	Industrial		11		RED DEER PACKERS LTD#TH7	20.00	35.00	8.63
96693	16	28	38	27	4	FORRESTER DRILLING	1961-05-05	30.00	Test Hole	Industrial		5		RED DEER PACKERS LTD#TH6			0.00
96694	16	28	38	27	4	FORRESTER DRILLING	1961-05-04	25.00	Test Hole	Investigation		4		RED DEER PACKERS LTD#TH5			0.00
96695	16	28	38	27	4	FORRESTER DRILLING	1961-05-04	50.00	Test Hole	Investigation		7		RED DEER PACKERS LTD#TH 4			0.00
96696	16	28	38	27	4	FORRESTER DRILLING	1961-05-03	35.00	Test Hole	Investigation		5		RED DEER PACKERS LTD#TH 3			0.00
96697	16	28	38	27	4	FORRESTER DRILLING	1961-05-02	45.00	Test Hole	Investigation		6		RED DEER PACKERS LTD#TH2			0.00
96698	16	28	38	27	4	FORRESTER DRILLING	1961-05-01	55.00	Test Hole	Investigation		8		RED DEER PACKERS LTD#TH 1			0.00
96699	16	28	38	27	4	FORRESTER DRILLING	1961-07-09	306.00	New Well	Industrial		24		RED DEER PACKERS LTD#TH 9, WW2	30.00	24.00	8.63
96699	16	28	38	27	4	FORRESTER DRILLING	1961-07-09	306.00	New Well	Industrial		24		RED DEER PACKERS LTD#TH 9, WW2	31.70	75.00	8.63
96700	16	28	38	27	4	FORRESTER DRILLING	1966-06-16	600.00	New Well	Industrial		46		INTERCONTINENTAL PACKERS LTD			10.75
96701		28	38	27	4	FORRESTER DRILLING	1961-04-27	44.00	New Well	Investigation				RED DEER, CITY OF#TH8, SITE 1	0.00	87.00	0.00
96800	4	34	38	27	4	UNKNOWN DRILLER	1952-04-27	613.00	Structure Test Hole	Industrial				CALIFORNIA STANDARD CO			0.00
152575	SE	28	38	27	4	RANKIN DRILLING	1990-08-09	72.00	New Well	Domestic		7		STENE, GARY	25.00	10.00	5.56
156935	SW	27	38	27	4	LOUSANA WATER WELLS (1987) LTD.	1991-03-12	60.00	New Well	Domestic		11	7	CHAPMAN, BRYCE	12.90	30.00	5.56
166852	SW	27	38	27	4	ALBERTA EAGLE DRILLING LTD.	1992-06-01	180.00	New Well	Domestic & Stock		10		BELICK, NICK	6.00	20.00	6.62
167204	SW	27	38	27	4	LOUSANA WATER WELLS (1987) LTD.	1992-05-07	300.00	New Well	Domestic		18	8	GRANDE, RUTH	40.60	40.00	5.56
237628	SW	27	38	27	4	LOUSANA WATER WELLS (1987) LTD.	1994-04-14	80.00	New Well	Domestic		11	10	WASCHUK, KEVIN	23.60	8.00	5.56
258848	NW	27	38	27	4	ALBERTA EAGLE DRILLING LTD.	1995-06-20	140.00	New Well	Domestic		9	24	RED DEER, CITY OF	30.00	20.00	6.62
282170	SW	27	38	27	4	UNKNOWN DRILLER		15.00	Chemistry	Domestic	2			PROUDFOOT, J.A.			0.00

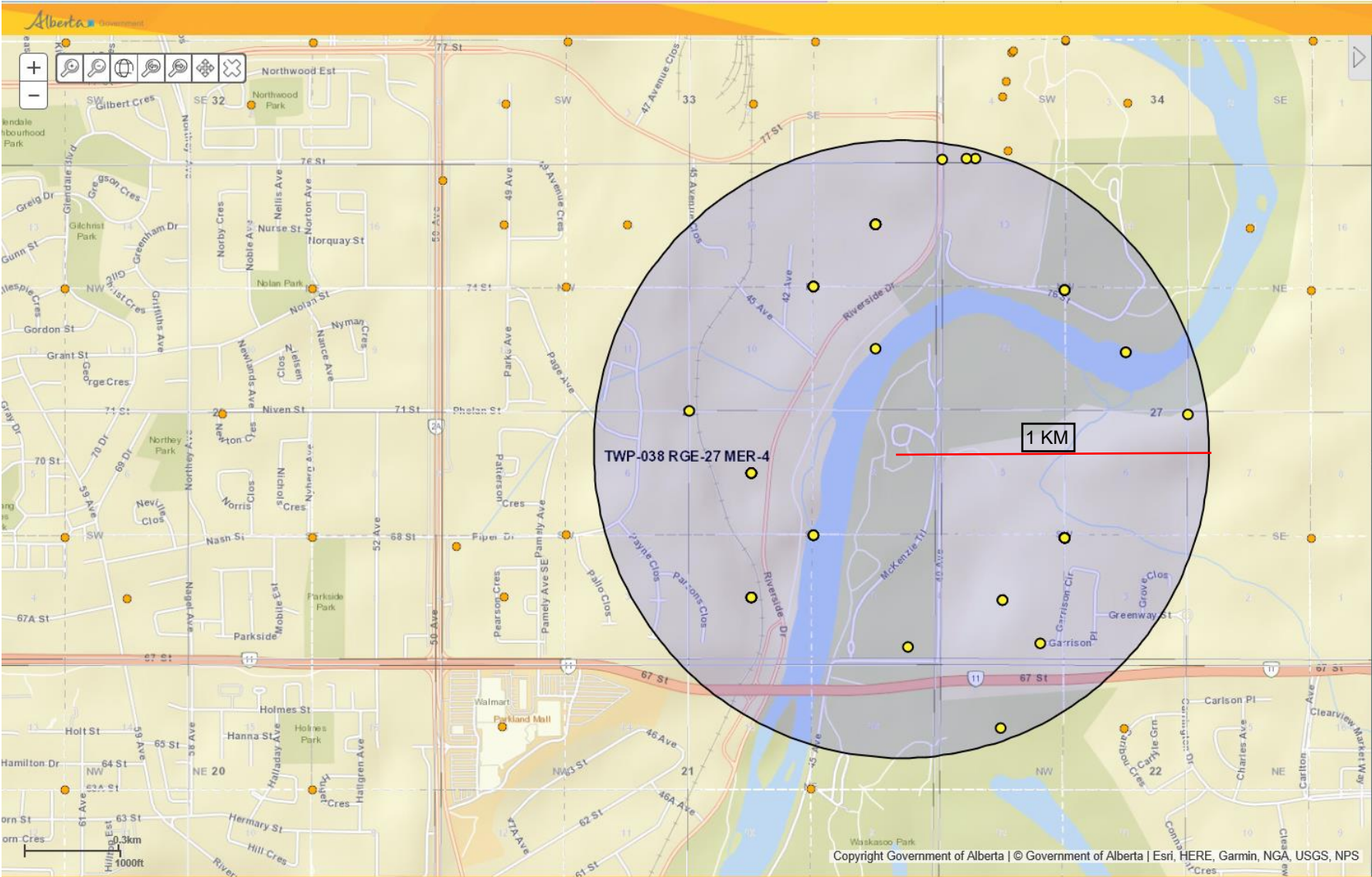


Reconnaissance Report

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GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIA (in)
282171	11	27	38	27	4	UNKNOWN DRILLER		0.00	Well Inventory	Injection				IMPERIAL			0.00
282172	11	27	38	27	4	UNKNOWN DRILLER		0.00	Well Inventory	Injection				IMPERIAL			0.00
285358	SW	27	38	27	4	ALKEN BASIN DRILLING LTD.	1996-08-22	85.00	New Well	Domestic		8	15	GYORI, RIM	26.00	7.00	5.50
298600	SW	27	38	27	4	LOUSANA WATER WELLS (1987) LTD.	2001-08-22	50.00	New Well	Domestic		8	11	SURBEY, SANDY	27.40	7.00	5.56
1735484	4	34	38	27	4	TALL PINE DRILLING LTD.	2008-06-08	166.00	New Well	Other		12	1	RED DEER, CITY OF (S. OLSON)	36.00	150.00	5.56
1735517	SW	34	38	27	4	TALL PINE DRILLING LTD.	2008-06-10	200.00	New Well	Other		12	3	STUART OLSON/ CITY OF RED DEER	126.00	160.00	5.56



APPENDIX D

LABORATORY ANALYTICAL REPORTS



TETRA TECH CANADA INC.
ATTN: Darby Madalena
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Date Received: 06-DEC-19
Report Date: 20-DEC-19 14:32 (MT)
Version: FINAL

Client Phone: 403-203-3355

Certificate of Analysis

Lab Work Order #: L2393410
Project P.O. #: SWM.SWOP04071-01.003
Job Reference: SWM.SWOP04071-01.003
C of C Numbers: MCKENZIE TRAILS
Legal Site Desc:

Inayat Dhaliwal
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-1 MW-01							
Sampled By: RM on 04-DEC-19 @ 08:05							
Matrix: WATER							
F1 (C6-C10) and F2 (>C10-C16)							
CCME F2-4 Hydrocarbons							
F2: (C10-C16)	<0.10		0.10	mg/L	16-DEC-19	16-DEC-19	R4943576
Surrogate: 2-Bromobenzotrifluoride	73.0		60-140	%	16-DEC-19	16-DEC-19	R4943576
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		10-DEC-19	R4938070
F1-BTEX	<0.10		0.10	mg/L		10-DEC-19	R4938070
Surrogate: 3,4-Dichlorotoluene	117.8		70-130	%		10-DEC-19	R4938070
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4949027
Ammonia, Total (as N)	0.477		0.050	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	5.4		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	1.29		0.20	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.412	DLHC	0.025	mg/L		13-DEC-19	R4943276
Volatile fatty/carboxylic acids							
Formic Acid	<50	DLM	50	mg/L		13-DEC-19	R4943956
Acetic Acid	<10		10	mg/L		13-DEC-19	R4943956
Propionic Acid	<5.0		5.0	mg/L		13-DEC-19	R4943956
Butyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isobutyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Valeric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isovaleric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Caproic (Hexanoic) Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Major Ions & Trace Dissolved Metals							
Chloride in Water by IC							
Chloride (Cl)	17.0		0.50	mg/L		07-DEC-19	R4942649
Dissolved Mercury in Water by CVAAS							
Mercury (Hg)-Dissolved	<0.0000050		0.0000050	mg/L		13-DEC-19	R4943011
Dissolved Mercury Filtration Location	FIELD					13-DEC-19	R4942998
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	FIELD					09-DEC-19	R4938487
Aluminum (Al)-Dissolved	0.0033		0.0010	mg/L		09-DEC-19	R4937828
Antimony (Sb)-Dissolved	0.00014		0.00010	mg/L		09-DEC-19	R4937828
Arsenic (As)-Dissolved	0.00828		0.00010	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.421		0.00010	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.024		0.010	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	<0.0000050		0.0000050	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	71.7		0.050	mg/L		09-DEC-19	R4937828
Chromium (Cr)-Dissolved	<0.00010		0.00010	mg/L		09-DEC-19	R4937828
Copper (Cu)-Dissolved	<0.00020		0.00020	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	3.09		0.010	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	26.8		0.0050	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	0.861		0.00010	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.00192		0.00050	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	4.27		0.050	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	0.000104		0.000050	mg/L		09-DEC-19	R4937828
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L		09-DEC-19	R4937828
Sodium (Na)-Dissolved	40.1		0.050	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.000733		0.000010	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L		09-DEC-19	R4937828

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-1 MW-01							
Sampled By: RM on 04-DEC-19 @ 08:05							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	0.094		0.020	mg/L		07-DEC-19	R4942649
Ion Balance Calculation							
Ion Balance	102			%		16-DEC-19	
TDS (Calculated)	378			mg/L		16-DEC-19	
Hardness (as CaCO3)	289			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		07-DEC-19	R4942649
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.022		0.022	mg/L		13-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		07-DEC-19	R4942649
Sulfate in Water by IC							
Sulfate (SO4)	16.0		0.30	mg/L		07-DEC-19	R4942649
pH, Conductivity and Total Alkalinity							
pH	8.13		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	617		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	411		5.0	mg/L		14-DEC-19	R4943994
Carbonate (CO3)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Hydroxide (OH)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Alkalinity, Total (as CaCO3)	337		2.0	mg/L		14-DEC-19	R4943994
EPA 8260 Volatile Organics							
VOCs in Water							
1,1,1,2-Tetrachloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
2,2-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
2-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
4-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
p-Isopropyltoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Benzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromochloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromodichloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromoform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromomethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Carbon tetrachloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-1 MW-01							
Sampled By: RM on 04-DEC-19 @ 08:05							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,2-Dichloroethene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromochloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromomethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylbenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylene dibromide	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Hexachlorobutadiene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Isopropylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
m+p-Xylenes	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Methylene chloride	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Propylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
o-Xylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
sec-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Styrene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
tert-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Tetrachloroethylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Toluene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichlorofluoromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Vinyl chloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Surrogate: 1,4-Difluorobenzene	99.6		70-130	%	10-DEC-19	10-DEC-19	R4937909
Surrogate: 4-Bromofluorobenzene	80.4		70-130	%	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-2 MW-02							
Sampled By: RM on 04-DEC-19 @ 09:45							
Matrix: WATER							
F1 (C6-C10) and F2 (>C10-C16)							
CCME F2-4 Hydrocarbons							
F2: (C10-C16)	<0.10		0.10	mg/L	16-DEC-19	16-DEC-19	R4943576
Surrogate: 2-Bromobenzotrifluoride	66.3		60-140	%	16-DEC-19	16-DEC-19	R4943576
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		10-DEC-19	R4938070
F1-BTEX	<0.10		0.10	mg/L		10-DEC-19	R4938070
Surrogate: 3,4-Dichlorotoluene	120.6		70-130	%		10-DEC-19	R4938070
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4949027
Ammonia, Total (as N)	<0.050		0.050	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	4.6		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	0.23		0.20	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.0202		0.0050	mg/L		13-DEC-19	R4943276
Volatile fatty/carboxylic acids							
Formic Acid	<50	DLM	50	mg/L		13-DEC-19	R4943956
Acetic Acid	<10		10	mg/L		13-DEC-19	R4943956
Propionic Acid	<5.0		5.0	mg/L		13-DEC-19	R4943956
Butyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isobutyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Valeric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isovaleric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Caproic (Hexanoic) Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Major Ions & Trace Dissolved Metals							
Chloride in Water by IC							
Chloride (Cl)	7.67		0.50	mg/L		07-DEC-19	R4942649
Dissolved Mercury in Water by CVAAS							
Mercury (Hg)-Dissolved	<0.0000050		0.0000050	mg/L		13-DEC-19	R4943011
Dissolved Mercury Filtration Location	FIELD					13-DEC-19	R4942998
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	FIELD					09-DEC-19	R4938487
Aluminum (Al)-Dissolved	0.0074		0.0010	mg/L		09-DEC-19	R4937828
Antimony (Sb)-Dissolved	0.00013		0.00010	mg/L		09-DEC-19	R4937828
Arsenic (As)-Dissolved	0.00029		0.00010	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.152		0.00010	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.016		0.010	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.000148		0.0000050	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	72.2		0.050	mg/L		09-DEC-19	R4937828
Chromium (Cr)-Dissolved	<0.00010		0.00010	mg/L		09-DEC-19	R4937828
Copper (Cu)-Dissolved	0.00719		0.00020	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	0.041		0.010	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	0.000219		0.000050	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	21.6		0.0050	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	0.0843		0.00010	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.00099		0.00050	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	2.70		0.050	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	0.000132		0.000050	mg/L		09-DEC-19	R4937828
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L		09-DEC-19	R4937828
Sodium (Na)-Dissolved	16.4		0.050	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.000851		0.000010	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	0.0058		0.0010	mg/L		09-DEC-19	R4937828

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-2 MW-02							
Sampled By: RM on 04-DEC-19 @ 09:45							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	0.086		0.020	mg/L		07-DEC-19	R4942649
Ion Balance Calculation							
Ion Balance	94.0			%		16-DEC-19	
TDS (Calculated)	333			mg/L		16-DEC-19	
Hardness (as CaCO3)	269			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.020		0.020	mg/L		07-DEC-19	R4942649
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.022		0.022	mg/L		13-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.010		0.010	mg/L		07-DEC-19	R4942649
Sulfate in Water by IC							
Sulfate (SO4)	59.6		0.30	mg/L		07-DEC-19	R4942649
pH, Conductivity and Total Alkalinity							
pH	8.22		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	559		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	311		5.0	mg/L		14-DEC-19	R4943994
Carbonate (CO3)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Hydroxide (OH)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Alkalinity, Total (as CaCO3)	255		2.0	mg/L		14-DEC-19	R4943994
EPA 8260 Volatile Organics							
VOCs in Water							
1,1,1,2-Tetrachloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
2,2-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
2-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
4-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
p-Isopropyltoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Benzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromochloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromodichloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromoform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromomethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Carbon tetrachloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-2 MW-02							
Sampled By: RM on 04-DEC-19 @ 09:45							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,2-Dichloroethene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromochloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromomethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylbenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylene dibromide	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Hexachlorobutadiene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Isopropylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
m+p-Xylenes	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Methylene chloride	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Propylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
o-Xylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
sec-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Styrene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
tert-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Tetrachloroethylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Toluene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichlorofluoromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Vinyl chloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Surrogate: 1,4-Difluorobenzene	99.5		70-130	%	10-DEC-19	10-DEC-19	R4937909
Surrogate: 4-Bromofluorobenzene	79.6		70-130	%	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-3 MW-03							
Sampled By: RM on 04-DEC-19 @ 08:55							
Matrix: WATER							
F1 (C6-C10) and F2 (>C10-C16)							
CCME F2-4 Hydrocarbons							
F2: (C10-C16)	<0.10		0.10	mg/L	16-DEC-19	16-DEC-19	R4943576
Surrogate: 2-Bromobenzotrifluoride	71.0		60-140	%	16-DEC-19	16-DEC-19	R4943576
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		10-DEC-19	R4938070
F1-BTEX	<0.10		0.10	mg/L		10-DEC-19	R4938070
Surrogate: 3,4-Dichlorotoluene	89.2		70-130	%		10-DEC-19	R4938070
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4949027
Ammonia, Total (as N)	7.0	DLHC	2.5	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	11.4		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	8.2	DLHC	1.0	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.273	DLHC	0.025	mg/L		13-DEC-19	R4943276
Volatile fatty/carboxylic acids							
Formic Acid	<50	DLM	50	mg/L		13-DEC-19	R4943956
Acetic Acid	<10		10	mg/L		13-DEC-19	R4943956
Propionic Acid	<5.0		5.0	mg/L		13-DEC-19	R4943956
Butyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isobutyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Valeric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isovaleric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Caproic (Hexanoic) Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Major Ions & Trace Dissolved Metals							
Chloride in Water by IC							
Chloride (Cl)	49.6	DLHC	2.5	mg/L		07-DEC-19	R4942649
Dissolved Mercury in Water by CVAAS							
Mercury (Hg)-Dissolved	<0.0000050		0.0000050	mg/L		13-DEC-19	R4943011
Dissolved Mercury Filtration Location	FIELD					13-DEC-19	R4942998
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	FIELD					09-DEC-19	R4938487
Aluminum (Al)-Dissolved	<0.0050	DLDS	0.0050	mg/L		09-DEC-19	R4937828
Antimony (Sb)-Dissolved	<0.00050	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Arsenic (As)-Dissolved	0.00137	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.309	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.875	DLDS	0.050	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	<0.000025	DLDS	0.000025	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	168	DLDS	0.25	mg/L		09-DEC-19	R4937828
Chromium (Cr)-Dissolved	<0.00050	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Copper (Cu)-Dissolved	0.0052	DLDS	0.0010	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	0.123	DLDS	0.050	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	<0.00025	DLDS	0.00025	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	55.0	DLDS	0.025	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	1.02	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.0171	DLDS	0.0025	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	9.68	DLDS	0.25	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	<0.00025	DLDS	0.00025	mg/L		09-DEC-19	R4937828
Silver (Ag)-Dissolved	<0.000050	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Sodium (Na)-Dissolved	174	DLDS	0.25	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.00242	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	0.0247	DLDS	0.0050	mg/L		09-DEC-19	R4937828

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-3 MW-03							
Sampled By: RM on 04-DEC-19 @ 08:55							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	<0.10	DLHC	0.10	mg/L		07-DEC-19	R4942649
Ion Balance Calculation							
Ion Balance	98.6			%		16-DEC-19	
TDS (Calculated)	1090			mg/L		16-DEC-19	
Hardness (as CaCO3)	646			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.10	DLHC	0.10	mg/L		07-DEC-19	R4942649
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.11		0.11	mg/L		13-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLHC	0.050	mg/L		07-DEC-19	R4942649
Sulfate in Water by IC							
Sulfate (SO4)	69.5	DLHC	1.5	mg/L		07-DEC-19	R4942649
pH, Conductivity and Total Alkalinity							
pH	7.77		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	1680		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	1140		5.0	mg/L		14-DEC-19	R4943994
Carbonate (CO3)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Hydroxide (OH)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Alkalinity, Total (as CaCO3)	934		2.0	mg/L		14-DEC-19	R4943994
EPA 8260 Volatile Organics							
VOCs in Water							
1,1,1,2-Tetrachloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
2,2-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
2-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
4-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
p-Isopropyltoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Benzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromochloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromodichloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromoform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromomethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Carbon tetrachloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-3 MW-03							
Sampled By: RM on 04-DEC-19 @ 08:55							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,2-Dichloroethene	0.0036		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromochloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromomethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylbenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylene dibromide	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Hexachlorobutadiene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Isopropylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
m+p-Xylenes	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Methylene chloride	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Propylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
o-Xylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
sec-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Styrene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
tert-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Tetrachloroethylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Toluene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichlorofluoromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Vinyl chloride	0.00070		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Surrogate: 1,4-Difluorobenzene	99.4		70-130	%	10-DEC-19	10-DEC-19	R4937909
Surrogate: 4-Bromofluorobenzene	78.4		70-130	%	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-4 MW-04							
Sampled By: RM on 04-DEC-19 @ 08:35							
Matrix: WATER							
F1 (C6-C10) and F2 (>C10-C16)							
CCME F2-4 Hydrocarbons							
F2: (C10-C16)	<0.10		0.10	mg/L	16-DEC-19	16-DEC-19	R4943576
Surrogate: 2-Bromobenzotrifluoride	61.7		60-140	%	16-DEC-19	16-DEC-19	R4943576
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		10-DEC-19	R4938070
F1-BTEX	<0.10		0.10	mg/L		10-DEC-19	R4938070
Surrogate: 3,4-Dichlorotoluene	102.0		70-130	%		10-DEC-19	R4938070
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4949027
Ammonia, Total (as N)	10.4	DLHC	2.5	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	20.7		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	13.3	DLHC	1.0	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.568	DLHC	0.050	mg/L		13-DEC-19	R4943276
Volatile fatty/carboxylic acids							
Formic Acid	<50	DLM	50	mg/L		13-DEC-19	R4943956
Acetic Acid	<10		10	mg/L		13-DEC-19	R4943956
Propionic Acid	<5.0		5.0	mg/L		13-DEC-19	R4943956
Butyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isobutyric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Valeric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Isovaleric Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Caproic (Hexanoic) Acid	<1.0		1.0	mg/L		13-DEC-19	R4943956
Major Ions & Trace Dissolved Metals							
Chloride in Water by IC							
Chloride (Cl)	42.9	DLHC	2.5	mg/L		07-DEC-19	R4942649
Dissolved Mercury in Water by CVAAS							
Mercury (Hg)-Dissolved	<0.0000050		0.0000050	mg/L		13-DEC-19	R4943011
Dissolved Mercury Filtration Location	FIELD					13-DEC-19	R4942998
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	FIELD					09-DEC-19	R4938487
Aluminum (Al)-Dissolved	0.0348	DLDS	0.0050	mg/L		09-DEC-19	R4937828
Antimony (Sb)-Dissolved	<0.00050	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Arsenic (As)-Dissolved	0.00440	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.253	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.977	DLDS	0.050	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.000083	DLDS	0.000025	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	168	DLDS	0.25	mg/L		09-DEC-19	R4937828
Chromium (Cr)-Dissolved	<0.00050	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Copper (Cu)-Dissolved	<0.0010	DLDS	0.0010	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	3.85	DLDS	0.050	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	<0.00025	DLDS	0.00025	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	59.3	DLDS	0.025	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	1.16	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.0093	DLDS	0.0025	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	20.7	DLDS	0.25	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	<0.00025	DLDS	0.00025	mg/L		09-DEC-19	R4937828
Silver (Ag)-Dissolved	<0.000050	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Sodium (Na)-Dissolved	96.6	DLDS	0.25	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.00297	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	0.0097	DLDS	0.0050	mg/L		09-DEC-19	R4937828

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-4 MW-04							
Sampled By: RM on 04-DEC-19 @ 08:35							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	<0.10	DLHC	0.10	mg/L		07-DEC-19	R4942649
Ion Balance Calculation							
Ion Balance	91.1			%		16-DEC-19	
TDS (Calculated)	1010			mg/L		16-DEC-19	
Hardness (as CaCO3)	664			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	0.17	DLHC	0.10	mg/L		07-DEC-19	R4942649
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	0.17		0.11	mg/L		13-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLHC	0.050	mg/L		07-DEC-19	R4942649
Sulfate in Water by IC							
Sulfate (SO4)	94.7	DLHC	1.5	mg/L		07-DEC-19	R4942649
pH, Conductivity and Total Alkalinity							
pH	7.53		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	1660		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	1060		5.0	mg/L		14-DEC-19	R4943994
Carbonate (CO3)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Hydroxide (OH)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Alkalinity, Total (as CaCO3)	872		2.0	mg/L		14-DEC-19	R4943994
EPA 8260 Volatile Organics							
VOCs in Water							
1,1,1,2-Tetrachloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
2,2-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
2-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
4-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
p-Isopropyltoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Benzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromochloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromodichloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromoform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromomethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Carbon tetrachloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-4 MW-04							
Sampled By: RM on 04-DEC-19 @ 08:35							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,2-Dichloroethene	0.0083		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromochloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromomethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylbenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylene dibromide	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Hexachlorobutadiene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Isopropylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
m+p-Xylenes	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Methylene chloride	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Propylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
o-Xylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
sec-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Styrene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
tert-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Tetrachloroethylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Toluene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichlorofluoromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Vinyl chloride	0.00643		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Surrogate: 1,4-Difluorobenzene	99.4		70-130	%	10-DEC-19	10-DEC-19	R4937909
Surrogate: 4-Bromofluorobenzene	80.7		70-130	%	10-DEC-19	10-DEC-19	R4937909

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-5 MW203							
Sampled By: RM on 05-DEC-19 @ 08:15							
Matrix: WATER							
F1 (C6-C10) and F2 (>C10-C16)							
CCME F2-4 Hydrocarbons							
F2: (C10-C16)	<0.10		0.10	mg/L	16-DEC-19	16-DEC-19	R4943576
Surrogate: 2-Bromobenzotrifluoride	65.2		60-140	%	16-DEC-19	16-DEC-19	R4943576
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		10-DEC-19	R4938070
F1-BTEX	<0.10		0.10	mg/L		10-DEC-19	R4938070
Surrogate: 3,4-Dichlorotoluene	105.9		70-130	%		10-DEC-19	R4938070
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4949027
Ammonia, Total (as N)	13.3	DLHC	2.5	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	9.5		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	15.0	DLHC	1.0	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.350	DLHC	0.050	mg/L		13-DEC-19	R4943276
Volatile fatty/carboxylic acids							
Formic Acid	<50	DLM	50	mg/L		14-DEC-19	R4943956
Acetic Acid	<10		10	mg/L		14-DEC-19	R4943956
Propionic Acid	<5.0		5.0	mg/L		14-DEC-19	R4943956
Butyric Acid	<1.0		1.0	mg/L		14-DEC-19	R4943956
Isobutyric Acid	<1.0		1.0	mg/L		14-DEC-19	R4943956
Valeric Acid	<1.0		1.0	mg/L		14-DEC-19	R4943956
Isovaleric Acid	<1.0		1.0	mg/L		14-DEC-19	R4943956
Caproic (Hexanoic) Acid	<1.0		1.0	mg/L		14-DEC-19	R4943956
Major Ions & Trace Dissolved Metals							
Chloride in Water by IC							
Chloride (Cl)	19.5	DLHC	2.5	mg/L		07-DEC-19	R4942649
Dissolved Mercury in Water by CVAAS							
Mercury (Hg)-Dissolved	<0.0000050		0.0000050	mg/L		13-DEC-19	R4943011
Dissolved Mercury Filtration Location	FIELD					13-DEC-19	R4942998
Dissolved Metals in Water by CRC ICPMS							
Dissolved Metals Filtration Location	FIELD					09-DEC-19	R4938487
Aluminum (Al)-Dissolved	0.0035		0.0010	mg/L		09-DEC-19	R4937828
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L		09-DEC-19	R4937828
Arsenic (As)-Dissolved	0.00796		0.00010	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.188		0.00010	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.494		0.010	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.0000408		0.0000050	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	119		0.050	mg/L		09-DEC-19	R4937828
Chromium (Cr)-Dissolved	0.00015		0.00010	mg/L		09-DEC-19	R4937828
Copper (Cu)-Dissolved	<0.00020		0.00020	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	2.23		0.010	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	33.9		0.0050	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	0.303		0.00010	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.00054		0.00050	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	13.8		0.050	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	0.000242		0.000050	mg/L		09-DEC-19	R4937828
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L		09-DEC-19	R4937828
Sodium (Na)-Dissolved	47.1		0.050	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.000590		0.000010	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	0.0011		0.0010	mg/L		09-DEC-19	R4937828

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-5 MW203							
Sampled By: RM on 05-DEC-19 @ 08:15							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	<0.10	DLHC	0.10	mg/L		07-DEC-19	R4942649
Ion Balance Calculation							
Ion Balance	95.2			%		16-DEC-19	
TDS (Calculated)	633			mg/L		16-DEC-19	
Hardness (as CaCO3)	437			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.10	DLHC	0.10	mg/L		07-DEC-19	R4942649
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.11		0.11	mg/L		13-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLHC	0.050	mg/L		07-DEC-19	R4942649
Sulfate in Water by IC							
Sulfate (SO4)	93.2	DLHC	1.5	mg/L		07-DEC-19	R4942649
pH, Conductivity and Total Alkalinity							
pH	8.03		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	1030		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	622		5.0	mg/L		14-DEC-19	R4943994
Carbonate (CO3)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Hydroxide (OH)	<5.0		5.0	mg/L		14-DEC-19	R4943994
Alkalinity, Total (as CaCO3)	510		2.0	mg/L		14-DEC-19	R4943994
EPA 8260 Volatile Organics							
VOCs in Water							
1,1,1,2-Tetrachloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,1-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,2-Dichloropropane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
1,3-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
2,2-Dichloropropane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
2-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
4-Chlorotoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
p-Isopropyltoluene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Benzene	0.00053		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromobenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromochloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromodichloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromoform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Bromomethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Carbon tetrachloride	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393410-5 MW203							
Sampled By: RM on 05-DEC-19 @ 08:15							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloroform	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Chloromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,2-Dichloroethene	0.0083		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromochloromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dibromomethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylbenzene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Ethylene dibromide	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Hexachlorobutadiene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Isopropylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
m+p-Xylenes	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Methylene chloride	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
n-Propylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
o-Xylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
sec-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Styrene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
tert-Butylbenzene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Tetrachloroethylene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Toluene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichloroethene	<0.00050		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Trichlorofluoromethane	<0.0010		0.0010	mg/L	10-DEC-19	10-DEC-19	R4937909
Vinyl chloride	0.00289		0.00050	mg/L	10-DEC-19	10-DEC-19	R4937909
Surrogate: 1,4-Difluorobenzene	99.1		70-130	%	10-DEC-19	10-DEC-19	R4937909
Surrogate: 4-Bromofluorobenzene	78.0		70-130	%	10-DEC-19	10-DEC-19	R4937909

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AOX-MISA-KL	Water	Adsorbable Organic Halides	EPA 1650
BTXS-HS-MS-CL	Water	BTEX and Styrene	EPA 8260C/5021A
The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. BTEX Target compound concentrations are measured using mass spectrometry detection.			
C-DIS-ORG-CL	Water	Dissolved Organic Carbon	APHA 5310 B-Instrumental
Filtered (0.45 um) sample is acidified and purged to remove inorganic carbon, then injected into a heated reaction chamber where organic carbon is oxidized to CO2 which is then transported in the carrier gas stream and measured via a non-dispersive infrared analyzer.			
CL-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
F-IC-N-CL	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
F1-HS-FID-CL	Water	F1 (C6-C10)	EPA 5021A / CWS PHC Tier 1
This analysis is based on the "Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil - Tier 1 Method, Canadian Council of Ministers of the Environment, December 2001." For F1 (C6-C10) analysis, the water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a GC-FID for analysis.			
F2-4-ME-FID-CL	Water	CCME F2-4 Hydrocarbons	EPA 3511/ CCME PHC CWS GC-FID
Water samples are spiked with 2-BBTF surrogate, and extracted by reciprocal action shaker for 30 minutes using a single micro-extraction with hexane. Instrumental analysis is by GC-FID, as per the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil, Tier 1 Method, CCME, December 2001.			
HG-D-CVAA-CL	Water	Dissolved Mercury in Water by CVAAS	APHA 3030B/EPA 1631E (mod)
Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.			
IONBALANCE-CL	Water	Ion Balance Calculation	APHA 1030E
MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.			
Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-F-CL	Water	Ammonia by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Weston et al.			
NO2-IC-N-CL	Water	Nitrite in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
NO3-IC-N-CL	Water	Nitrate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
P-T-COL-CL	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity	APHA 4500H,2510,2320
All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed)			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
		pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current	
SO4-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
TKN-F-CL	Water	Total Kjeldahl Nitrogen by Fluorescence	APHA 4500-NORG (TKN)
		This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.	
VFA-WP	Water	Volatile fatty/carboxylic acids	ASTM D2908-91
		In the field, water and soil samples are collected in certified clean glass jars. In the laboratory, water samples are filtered and transferred to an autosampler vial for analysis. Soil samples are extracted with water and an aliquot of water is filtered. All extracts have internal standard added prior to injection. Analysis is performed by GC/MS in the selected ion monitoring (SIM) mode.	
VOC-HS-MS-CL	Water	VOCs in Water	EPA 8260C/5021A
		The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. VOC Target compound concentrations are measured using mass spectrometry detection.	
XYLENES-CALC-CL	Water	Sum of Xylene Isomer Concentrations	CALCULATION
		Calculation of Total Xylenes	
		Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.	

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
KL	ALS ENVIRONMENTAL - KELSO, WASHINGTON, USA
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

MCKENZIE TRAILS

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Routine Water Chemistry Report

L2393410

Lab ID	Sample ID				Lab ID	Sample ID			
L2393410-1	MW-01				L2393410-2	MW-02			
Sample Date: 04-DEC-19					Sample Date: 04-DEC-19				
Matrix: WATER					Matrix: WATER				
	Result	UNITS	MEQ/L	MEQ %		Result	UNITS	MEQ/L	MEQ %
Ion Balance	102	%			Ion Balance	94.0	%		
Routine Anions					Routine Anions				
Bicarbonate	411	mg/L	6.74	44	Bicarbonate	311	mg/L	5.10	40
Carbonate	<5.0	mg/L	0	0	Carbonate	<5.0	mg/L	0	0
Hydroxide	<5.0	mg/L	0	0	Hydroxide	<5.0	mg/L	0	0
Chloride	17.0	mg/L	0.48	3	Chloride	7.67	mg/L	0.22	2
Sulfate	16.0	mg/L	0.33	2	Sulfate	59.6	mg/L	1.24	10
Nitrate+Nitrite-N		mg/L	0	0	Nitrate+Nitrite-N		mg/L	0	0
Anion Sum			7.55	50	Anion Sum			6.56	52
Routine Cations					Routine Cations				
Calcium	71.7	mg/L	3.58	24	Calcium	72.2	mg/L	3.60	28
Magnesium	26.8	mg/L	2.21	14	Magnesium	21.6	mg/L	1.78	14
Sodium	40.1	mg/L	1.74	11	Sodium	16.4	mg/L	0.71	6
Potassium	4.27	mg/L	0.11	1	Potassium	2.70	mg/L	0.07	1
Ammonium	0.477	mg/L	0.03	0	Ammonium	<0.050	mg/L	0	0
Cation Sum			7.67	50	Cation Sum			6.16	48
L2393410-3	MW-03				L2393410-4	MW-04			
Sample Date: 04-DEC-19					Sample Date: 04-DEC-19				
Matrix: WATER					Matrix: WATER				
	Result	UNITS	MEQ/L	MEQ %		Result	UNITS	MEQ/L	MEQ %
Ion Balance	98.6	%			Ion Balance	91.1	%		
Routine Anions					Routine Anions				
Bicarbonate	1140	mg/L	18.68	44	Bicarbonate	1060	mg/L	17.37	44
Carbonate	<5.0	mg/L	0	0	Carbonate	<5.0	mg/L	0	0
Hydroxide	<5.0	mg/L	0	0	Hydroxide	<5.0	mg/L	0	0
Chloride	49.6	mg/L	1.40	3	Chloride	42.9	mg/L	1.21	3
Sulfate	69.5	mg/L	1.45	3	Sulfate	94.7	mg/L	1.97	5
Nitrate+Nitrite-N		mg/L	0	0	Nitrate+Nitrite-N		mg/L	0.01	0
Anion Sum			21.53	50	Anion Sum			20.57	52
Routine Cations					Routine Cations				
Calcium	168	mg/L	8.38	20	Calcium	168	mg/L	8.38	21
Magnesium	55.0	mg/L	4.53	11	Magnesium	59.3	mg/L	4.88	12
Sodium	174	mg/L	7.57	18	Sodium	96.6	mg/L	4.20	11
Potassium	9.68	mg/L	0.25	1	Potassium	20.7	mg/L	0.53	1
Ammonium	7.0	mg/L	0.50	1	Ammonium	10.4	mg/L	0.74	2
Cation Sum			21.23	50	Cation Sum			18.74	48

ALS Routine Water Chemistry Report

L2393410

Lab ID	Sample ID	Lab ID	Sample ID
L2393410-5	MW203		
Sample Date: 05-DEC-19			
Matrix: WATER			
	Result	UNITS	MEQ/L
Ion Balance	95.2	%	MEQ %
Routine Anions			
Bicarbonate	622	mg/L	10.19 41
Carbonate	<5.0	mg/L	0 0
Hydroxide	<5.0	mg/L	0 0
Chloride	19.5	mg/L	0.55 2
Sulfate	93.2	mg/L	1.94 8
Nitrate+Nitrite-N		mg/L	0 0
Anion Sum			12.68 51
Routine Cations			
Calcium	119	mg/L	5.94 24
Magnesium	33.9	mg/L	2.79 11
Sodium	47.1	mg/L	2.05 8
Potassium	13.8	mg/L	0.35 1
Ammonium	13.3	mg/L	0.95 4
Cation Sum			12.08 49

ALS LABORATORY GROUP SOIL SALINITY CONVERSION

L2393410

Lab ID	Sample ID				Lab ID	Sample ID			

"Calculations are as per:
Methods of Analysis for Soils, Plants and Waters
Homer D. Chapman and Parker F. Pratt
University of California, Riverside, Cl.
August, 1961."



Quality Control Report

Workorder: L2393410

Report Date: 20-DEC-19

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-DIS-ORG-CL		Water						
Batch	R4943327							
WG3242690-2	LCS							
Dissolved Organic Carbon			106.1		%		80-120	13-DEC-19
WG3242690-1	MB							
Dissolved Organic Carbon			<1.0		mg/L		1	13-DEC-19
CL-IC-N-CL		Water						
Batch	R4942649							
WG3241458-3	DUP	L2392914-1						
Chloride (Cl)		17.2	17.3		mg/L	0.4	20	07-DEC-19
WG3241458-7	DUP	L2393392-1						
Chloride (Cl)		<0.50	<0.50	RPD-NA	mg/L	N/A	20	07-DEC-19
WG3241458-2	LCS							
Chloride (Cl)			102.8		%		90-110	07-DEC-19
WG3241458-6	LCS							
Chloride (Cl)			103.3		%		90-110	07-DEC-19
WG3241458-1	MB							
Chloride (Cl)			<0.50		mg/L		0.5	07-DEC-19
WG3241458-5	MB							
Chloride (Cl)			<0.50		mg/L		0.5	07-DEC-19
WG3241458-4	MS	L2392914-1						
Chloride (Cl)			101.3		%		75-125	07-DEC-19
WG3241458-8	MS	L2393392-1						
Chloride (Cl)			108.4		%		75-125	07-DEC-19
F-IC-N-CL		Water						
Batch	R4942649							
WG3241458-3	DUP	L2392914-1						
Fluoride (F)		0.216	0.222		mg/L	2.7	20	07-DEC-19
WG3241458-7	DUP	L2393392-1						
Fluoride (F)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	07-DEC-19
WG3241458-2	LCS							
Fluoride (F)			104.9		%		90-110	07-DEC-19
WG3241458-6	LCS							
Fluoride (F)			105.9		%		90-110	07-DEC-19
WG3241458-1	MB							
Fluoride (F)			<0.020		mg/L		0.02	07-DEC-19
WG3241458-5	MB							
Fluoride (F)			<0.020		mg/L		0.02	07-DEC-19
WG3241458-4	MS	L2392914-1						
Fluoride (F)			91.4		%		75-125	07-DEC-19



Quality Control Report

Workorder: L2393410

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-CL Water								
Batch	R4942649							
WG3241458-8	MS	L2393392-1						
Fluoride (F)			99.97		%		75-125	07-DEC-19
F1-HS-FID-CL Water								
Batch	R4938070							
WG3238489-3	DUP	L2393363-1						
F1(C6-C10)		<0.10	<0.10	RPD-NA	mg/L	N/A	30	09-DEC-19
WG3238489-2	LCS		72.1		%		70-130	10-DEC-19
F1(C6-C10)								
WG3238489-1	MB		<0.10		mg/L		0.1	09-DEC-19
F1(C6-C10)								
Surrogate: 3,4-Dichlorotoluene			119.7		%		70-130	09-DEC-19
F2-4-ME-FID-CL Water								
Batch	R4943576							
WG3243132-4	LCS							
F2: (C10-C16)			89.0		%		70-130	16-DEC-19
WG3243132-3	MB		<0.10		mg/L		0.1	16-DEC-19
F2: (C10-C16)								
Surrogate: 2-Bromobenzotrifluoride			77.1		%		60-140	16-DEC-19
HG-D-CVAA-CL Water								
Batch	R4943011							
WG3242289-3	DUP	L2393429-4						
Mercury (Hg)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	13-DEC-19
WG3242289-2	LCS		112.0		%		80-120	13-DEC-19
Mercury (Hg)-Dissolved								
WG3242289-1	MB		<0.0000050		mg/L		0.000005	13-DEC-19
Mercury (Hg)-Dissolved								
WG3242289-4	MS	L2393429-4						
Mercury (Hg)-Dissolved			106.0		%		70-130	13-DEC-19
MET-D-CCMS-CL Water								
Batch	R4937828							
WG3238594-3	DUP	L2393336-4						
Aluminum (Al)-Dissolved		0.0013	0.0014		mg/L	9.7	20	13-DEC-19
Antimony (Sb)-Dissolved		0.00028	0.00031		mg/L	7.8	20	13-DEC-19
Arsenic (As)-Dissolved		0.00029	0.00031		mg/L	4.7	20	13-DEC-19
Barium (Ba)-Dissolved		0.115	0.122		mg/L	5.6	20	13-DEC-19



Quality Control Report

Workorder: L2393410

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL								
	Water							
Batch	R4937828							
WG3238594-3	DUP	L2393336-4						
Boron (B)-Dissolved		0.014	0.015		mg/L	5.2	20	13-DEC-19
Cadmium (Cd)-Dissolved		0.0000544	0.0000652		mg/L	18	20	13-DEC-19
Calcium (Ca)-Dissolved		267	260		mg/L	2.7	20	13-DEC-19
Chromium (Cr)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	13-DEC-19
Copper (Cu)-Dissolved		0.00053	0.00061		mg/L	14	20	13-DEC-19
Iron (Fe)-Dissolved		0.388	0.412		mg/L	6.0	20	13-DEC-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	13-DEC-19
Magnesium (Mg)-Dissolved		118	125		mg/L	6.1	20	13-DEC-19
Manganese (Mn)-Dissolved		0.317	0.321		mg/L	1.3	20	13-DEC-19
Nickel (Ni)-Dissolved		0.00663	0.00670		mg/L	1.2	20	13-DEC-19
Potassium (K)-Dissolved		3.10	3.10		mg/L	0.1	20	13-DEC-19
Selenium (Se)-Dissolved		0.183	0.163		mg/L	11	20	13-DEC-19
Silver (Ag)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	13-DEC-19
Sodium (Na)-Dissolved		5.55	6.29		mg/L	12	20	13-DEC-19
Uranium (U)-Dissolved		0.00751	0.00784		mg/L	4.3	20	13-DEC-19
Zinc (Zn)-Dissolved		0.0069	0.0074		mg/L	6.6	20	13-DEC-19
WG3238594-7	DUP	L2393428-4						
Aluminum (Al)-Dissolved		0.0040	0.0040		mg/L	0.9	20	13-DEC-19
Antimony (Sb)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	13-DEC-19
Arsenic (As)-Dissolved		0.00046	0.00042		mg/L	9.4	20	13-DEC-19
Barium (Ba)-Dissolved		0.272	0.288		mg/L	5.6	20	13-DEC-19
Boron (B)-Dissolved		0.070	0.088	J	mg/L	0.018	0.02	13-DEC-19
Cadmium (Cd)-Dissolved		0.0000707	0.0000799		mg/L	12	20	13-DEC-19
Calcium (Ca)-Dissolved		157	168		mg/L	6.4	20	13-DEC-19
Chromium (Cr)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	13-DEC-19
Copper (Cu)-Dissolved		0.00055	0.00061		mg/L	9.8	20	13-DEC-19
Iron (Fe)-Dissolved		0.106	0.118		mg/L	11	20	13-DEC-19
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	13-DEC-19
Magnesium (Mg)-Dissolved		64.7	72.3		mg/L	11	20	13-DEC-19
Manganese (Mn)-Dissolved		1.03	1.12		mg/L	8.4	20	13-DEC-19
Nickel (Ni)-Dissolved		0.00519	0.00553		mg/L	6.3	20	13-DEC-19
Potassium (K)-Dissolved		10.1	9.80		mg/L	3.5	20	13-DEC-19
Selenium (Se)-Dissolved		0.000088	0.000068	J	mg/L	0.000020	0.0001	13-DEC-19



Quality Control Report

Workorder: L2393410

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL								
	Water							
Batch	R4937828							
WG3238594-7	DUP	L2393428-4						
Silver (Ag)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	13-DEC-19
Sodium (Na)-Dissolved		57.5	67.8		mg/L	16	20	13-DEC-19
Uranium (U)-Dissolved		0.00551	0.00604		mg/L	9.2	20	13-DEC-19
Zinc (Zn)-Dissolved		0.0015	0.0015		mg/L	2.8	20	13-DEC-19
WG3238594-2	LCS							
Aluminum (Al)-Dissolved			104.5		%		80-120	13-DEC-19
Antimony (Sb)-Dissolved			105.4		%		80-120	13-DEC-19
Arsenic (As)-Dissolved			101.8		%		80-120	13-DEC-19
Barium (Ba)-Dissolved			104.0		%		80-120	13-DEC-19
Boron (B)-Dissolved			100.6		%		80-120	13-DEC-19
Cadmium (Cd)-Dissolved			101.9		%		80-120	13-DEC-19
Calcium (Ca)-Dissolved			103.6		%		80-120	13-DEC-19
Chromium (Cr)-Dissolved			102.3		%		80-120	13-DEC-19
Copper (Cu)-Dissolved			98.4		%		80-120	13-DEC-19
Iron (Fe)-Dissolved			106.8		%		80-120	13-DEC-19
Lead (Pb)-Dissolved			104.9		%		80-120	13-DEC-19
Magnesium (Mg)-Dissolved			107.5		%		80-120	13-DEC-19
Manganese (Mn)-Dissolved			101.3		%		80-120	13-DEC-19
Nickel (Ni)-Dissolved			99.1		%		80-120	13-DEC-19
Potassium (K)-Dissolved			103.8		%		80-120	13-DEC-19
Selenium (Se)-Dissolved			98.5		%		80-120	13-DEC-19
Silver (Ag)-Dissolved			105.9		%		80-120	13-DEC-19
Sodium (Na)-Dissolved			103.3		%		80-120	13-DEC-19
Uranium (U)-Dissolved			104.2		%		80-120	13-DEC-19
Zinc (Zn)-Dissolved			99.1		%		80-120	13-DEC-19
WG3238594-6	LCS							
Aluminum (Al)-Dissolved			98.2		%		80-120	09-DEC-19
Antimony (Sb)-Dissolved			92.9		%		80-120	09-DEC-19
Arsenic (As)-Dissolved			94.2		%		80-120	09-DEC-19
Barium (Ba)-Dissolved			90.9		%		80-120	09-DEC-19
Boron (B)-Dissolved			93.0		%		80-120	09-DEC-19
Cadmium (Cd)-Dissolved			92.2		%		80-120	09-DEC-19
Calcium (Ca)-Dissolved			106.7		%		80-120	09-DEC-19
Chromium (Cr)-Dissolved			93.7		%		80-120	09-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL		Water						
Batch	R4937828							
WG3238594-6	LCS							
Copper (Cu)-Dissolved			93.4		%		80-120	09-DEC-19
Iron (Fe)-Dissolved			97.2		%		80-120	09-DEC-19
Lead (Pb)-Dissolved			93.4		%		80-120	09-DEC-19
Magnesium (Mg)-Dissolved			91.2		%		80-120	09-DEC-19
Manganese (Mn)-Dissolved			95.8		%		80-120	09-DEC-19
Nickel (Ni)-Dissolved			92.9		%		80-120	09-DEC-19
Potassium (K)-Dissolved			94.9		%		80-120	09-DEC-19
Selenium (Se)-Dissolved			111.2		%		80-120	09-DEC-19
Silver (Ag)-Dissolved			103.0		%		80-120	09-DEC-19
Sodium (Na)-Dissolved			86.0		%		80-120	09-DEC-19
Uranium (U)-Dissolved			103.0		%		80-120	09-DEC-19
Zinc (Zn)-Dissolved			93.6		%		80-120	09-DEC-19
WG3238594-1	MB							
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	09-DEC-19
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Boron (B)-Dissolved			<0.010		mg/L		0.01	09-DEC-19
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	09-DEC-19
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	09-DEC-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	09-DEC-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	09-DEC-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	09-DEC-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	09-DEC-19
Potassium (K)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	09-DEC-19
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	09-DEC-19
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	09-DEC-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	09-DEC-19
WG3238594-5	MB							



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL								
	Water							
Batch	R4937828							
WG3238594-5	MB							
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	09-DEC-19
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Boron (B)-Dissolved			<0.010		mg/L		0.01	09-DEC-19
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	09-DEC-19
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	09-DEC-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	09-DEC-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	09-DEC-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	09-DEC-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	09-DEC-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	09-DEC-19
Potassium (K)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	09-DEC-19
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	09-DEC-19
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	09-DEC-19
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	09-DEC-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	09-DEC-19
WG3238594-4	MS	L2393336-4						
Aluminum (Al)-Dissolved			115.7		%		70-130	14-DEC-19
Antimony (Sb)-Dissolved			107.3		%		70-130	14-DEC-19
Arsenic (As)-Dissolved			120.1		%		70-130	14-DEC-19
Barium (Ba)-Dissolved			128.0		%		70-130	14-DEC-19
Boron (B)-Dissolved			103.6		%		70-130	14-DEC-19
Cadmium (Cd)-Dissolved			117.9		%		70-130	14-DEC-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Chromium (Cr)-Dissolved			115.3		%		70-130	14-DEC-19
Copper (Cu)-Dissolved			117.4		%		70-130	14-DEC-19
Iron (Fe)-Dissolved			103.7		%		70-130	14-DEC-19
Lead (Pb)-Dissolved			113.0		%		70-130	14-DEC-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	14-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL								
	Water							
Batch	R4937828							
WG3238594-4 MS		L2393336-4						
Nickel (Ni)-Dissolved			119.4		%		70-130	14-DEC-19
Potassium (K)-Dissolved			124.0		%		70-130	14-DEC-19
Selenium (Se)-Dissolved			99.0		%		70-130	14-DEC-19
Silver (Ag)-Dissolved			104.2		%		70-130	14-DEC-19
Sodium (Na)-Dissolved			116.9		%		70-130	14-DEC-19
Uranium (U)-Dissolved			115.2		%		70-130	14-DEC-19
Zinc (Zn)-Dissolved			116.5		%		70-130	14-DEC-19
WG3238594-8 MS		L2393428-4						
Aluminum (Al)-Dissolved			120.8		%		70-130	14-DEC-19
Antimony (Sb)-Dissolved			103.8		%		70-130	14-DEC-19
Arsenic (As)-Dissolved			120.6		%		70-130	14-DEC-19
Barium (Ba)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Boron (B)-Dissolved			111.5		%		70-130	14-DEC-19
Cadmium (Cd)-Dissolved			121.0		%		70-130	14-DEC-19
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Chromium (Cr)-Dissolved			117.2		%		70-130	14-DEC-19
Copper (Cu)-Dissolved			117.4		%		70-130	14-DEC-19
Iron (Fe)-Dissolved			103.6		%		70-130	14-DEC-19
Lead (Pb)-Dissolved			108.0		%		70-130	14-DEC-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Nickel (Ni)-Dissolved			119.6		%		70-130	14-DEC-19
Potassium (K)-Dissolved			127.0		%		70-130	14-DEC-19
Selenium (Se)-Dissolved			110.4		%		70-130	14-DEC-19
Silver (Ag)-Dissolved			92.2		%		70-130	14-DEC-19
Sodium (Na)-Dissolved			N/A	MS-B	%		-	14-DEC-19
Uranium (U)-Dissolved			110.8		%		70-130	14-DEC-19
Zinc (Zn)-Dissolved			117.1		%		70-130	14-DEC-19
NH3-F-CL								
	Water							
Batch	R4943991							
WG3242302-14 LCS								
Ammonia, Total (as N)			94.7		%		85-115	16-DEC-19
WG3242302-13 MB								
Ammonia, Total (as N)			<0.050		mg/L		0.05	16-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-IC-N-CL								
	Water							
Batch	R4942649							
WG3241458-3	DUP	L2392914-1						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	07-DEC-19
WG3241458-2	LCS							
Nitrite (as N)			105.5		%		90-110	07-DEC-19
WG3241458-6	LCS							
Nitrite (as N)			106.1		%		90-110	07-DEC-19
WG3241458-1	MB							
Nitrite (as N)			<0.010		mg/L		0.01	07-DEC-19
WG3241458-5	MB							
Nitrite (as N)			<0.010		mg/L		0.01	07-DEC-19
WG3241458-4	MS	L2392914-1						
Nitrite (as N)			104.0		%		75-125	07-DEC-19
NO3-IC-N-CL								
	Water							
Batch	R4942649							
WG3241458-3	DUP	L2392914-1						
Nitrate (as N)		1.48	1.46		mg/L	0.8	20	07-DEC-19
WG3241458-2	LCS							
Nitrate (as N)			103.2		%		90-110	07-DEC-19
WG3241458-6	LCS							
Nitrate (as N)			104.0		%		90-110	07-DEC-19
WG3241458-1	MB							
Nitrate (as N)			<0.020		mg/L		0.02	07-DEC-19
WG3241458-5	MB							
Nitrate (as N)			<0.020		mg/L		0.02	07-DEC-19
WG3241458-4	MS	L2392914-1						
Nitrate (as N)			99.6		%		75-125	07-DEC-19
P-T-COL-CL								
	Water							
Batch	R4943276							
WG3242072-6	LCS							
Phosphorus (P)-Total			91.3		%		80-120	13-DEC-19
WG3242072-5	MB							
Phosphorus (P)-Total			<0.0050		mg/L		0.005	13-DEC-19
PH/EC/ALK-CL								
	Water							
Batch	R4943994							
WG3243425-8	LCS							
Conductivity (EC)			98.6		%		90-110	14-DEC-19
Alkalinity, Total (as CaCO3)			104.1		%		85-115	14-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH/EC/ALK-CL		Water						
Batch	R4943994							
WG3243425-7	MB							
Conductivity (EC)			<2.0		uS/cm		2	14-DEC-19
Bicarbonate (HCO3)			<5.0		mg/L		5	14-DEC-19
Carbonate (CO3)			<5.0		mg/L		5	14-DEC-19
Hydroxide (OH)			<5.0		mg/L		5	14-DEC-19
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-DEC-19
SO4-IC-N-CL		Water						
Batch	R4942649							
WG3241458-3	DUP	L2392914-1						
Sulfate (SO4)		14.5	14.5		mg/L	0.1	20	07-DEC-19
WG3241458-7	DUP	L2393392-1						
Sulfate (SO4)		<0.30	0.40	RPD-NA	mg/L	N/A	20	07-DEC-19
WG3241458-2	LCS		99.5		%		90-110	07-DEC-19
Sulfate (SO4)								
WG3241458-6	LCS		100.3		%		90-110	07-DEC-19
Sulfate (SO4)								
WG3241458-1	MB		<0.30		mg/L		0.3	07-DEC-19
Sulfate (SO4)								
WG3241458-5	MB		<0.30		mg/L		0.3	07-DEC-19
Sulfate (SO4)								
WG3241458-4	MS	L2392914-1	96.5		%		75-125	07-DEC-19
Sulfate (SO4)								
WG3241458-8	MS	L2393392-1	105.6		%		75-125	07-DEC-19
Sulfate (SO4)								
TKN-F-CL		Water						
Batch	R4943090							
WG3242367-15	DUP	L2393430-1						
Total Kjeldahl Nitrogen		0.69	0.64		mg/L	8.0	20	12-DEC-19
WG3242367-17	DUP	L2393876-2						
Total Kjeldahl Nitrogen		18	17		mg/L	0.5	20	12-DEC-19
WG3242367-18	DUP	L2393879-1						
Total Kjeldahl Nitrogen		74	71		mg/L	4.4	20	12-DEC-19
WG3242367-3	DUP	L2394735-1						
Total Kjeldahl Nitrogen		3.93	3.82		mg/L	2.8	20	12-DEC-19
WG3242367-10	LCS		102.0		%		75-125	12-DEC-19
Total Kjeldahl Nitrogen								
WG3242367-14	LCS							



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Client: TETRA TECH CANADA INC.
 110, 140 Quarry Park Blvd SE
 Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TKN-F-CL		Water						
Batch	R4943090							
WG3242367-14	LCS							
Total Kjeldahl Nitrogen			102.0		%		75-125	12-DEC-19
WG3242367-2	LCS							
Total Kjeldahl Nitrogen			98.4		%		75-125	12-DEC-19
WG3242367-6	LCS							
Total Kjeldahl Nitrogen			100.2		%		75-125	12-DEC-19
WG3242367-1	MB							
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	12-DEC-19
WG3242367-13	MB							
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	12-DEC-19
WG3242367-5	MB							
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	12-DEC-19
WG3242367-9	MB							
Total Kjeldahl Nitrogen			<0.20		mg/L		0.2	12-DEC-19
WG3242367-16	MS	L2393430-1						
Total Kjeldahl Nitrogen			99.9		%		70-130	12-DEC-19
WG3242367-4	MS	L2394735-1						
Total Kjeldahl Nitrogen			107.0		%		70-130	12-DEC-19
VFA-WP		Water						
Batch	R4943956							
WG3243150-3	DUP	L2393425-3						
Formic Acid		<50	<50	RPD-NA	mg/L	N/A	30	14-DEC-19
Acetic Acid		<10	<10	RPD-NA	mg/L	N/A	30	14-DEC-19
Propionic Acid		<5.0	<5.0	RPD-NA	mg/L	N/A	30	14-DEC-19
Butyric Acid		<1.0	<1.0	RPD-NA	mg/L	N/A	30	14-DEC-19
Isobutyric Acid		<1.0	<1.0	RPD-NA	mg/L	N/A	30	14-DEC-19
Valeric Acid		<1.0	<1.0	RPD-NA	mg/L	N/A	30	14-DEC-19
Isovaleric Acid		<1.0	<1.0	RPD-NA	mg/L	N/A	30	14-DEC-19
Caproic (Hexanoic) Acid		<1.0	<1.0	RPD-NA	mg/L	N/A	30	14-DEC-19
WG3243150-2	LCS							
Formic Acid			126.9		%		70-130	16-DEC-19
Acetic Acid			79.8		%		70-130	16-DEC-19
Propionic Acid			82.0		%		70-130	16-DEC-19
Butyric Acid			72.2		%		70-130	16-DEC-19
Isobutyric Acid			78.9		%		70-130	16-DEC-19
Valeric Acid			73.7		%		70-130	16-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed	
VFA-WP									
	Water								
Batch	R4943956								
WG3243150-2	LCS								
Isovaleric Acid			70.0		%		70-130	16-DEC-19	
Caproic (Hexanoic) Acid			82.3		%		70-130	16-DEC-19	
WG3243150-1	MB								
Formic Acid			<30		mg/L		30	13-DEC-19	
Acetic Acid			<10		mg/L		10	13-DEC-19	
Propionic Acid			<5.0		mg/L		5	13-DEC-19	
Butyric Acid			<1.0		mg/L		1	13-DEC-19	
Isobutyric Acid			<1.0		mg/L		1	13-DEC-19	
Valeric Acid			<1.0		mg/L		1	13-DEC-19	
Isovaleric Acid			<1.0		mg/L		1	13-DEC-19	
Caproic (Hexanoic) Acid			<1.0		mg/L		1	13-DEC-19	
WG3243150-4	MS	L2393410-5							
Formic Acid			89.8		%		70-130	13-DEC-19	
Acetic Acid			82.9		%		70-130	13-DEC-19	
Propionic Acid			79.8		%		70-130	13-DEC-19	
Butyric Acid			79.4		%		70-130	13-DEC-19	
Isobutyric Acid			80.4		%		70-130	13-DEC-19	
Valeric Acid			85.5		%		70-130	13-DEC-19	
Isovaleric Acid			75.3		%		70-130	13-DEC-19	
Caproic (Hexanoic) Acid			97.3		%		70-130	13-DEC-19	
VOC-HS-MS-CL									
	Water								
Batch	R4937909								
WG3238459-5	DUP	L2393231-1							
1,1,1,2-Tetrachloroethane			<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1,1-Trichloroethane			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1,2,2-Tetrachloroethane			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1,2-Trichloroethane			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1-Dichloroethane			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1-Dichloroethene			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,1-Dichloropropene			<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2,3-Trichlorobenzene			<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2,3-Trichloropropane			<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2,4-Trichlorobenzene			<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2,4-Trimethylbenzene			<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-5	DUP	L2393231-1						
1,2-Dibromo-3-chloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2-Dichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,2-Dichloropropane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,3,5-Trimethylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,3-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
1,3-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
1,4-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
2,2-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
2-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
4-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
p-Isopropyltoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	10-DEC-19
Benzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Bromobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Bromochloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Bromodichloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Bromoform		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Bromomethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Carbon tetrachloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Chlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Chloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Chloroform		0.00166	0.00171		mg/L	3.0	30	10-DEC-19
Chloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
cis-1,2-Dichloroethene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
cis-1,3-Dichloropropene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Dibromochloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Dibromomethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Dichlorodifluoromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Ethylbenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Ethylene dibromide		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Hexachlorobutadiene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Isopropylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
m+p-Xylenes		<0.00050	<0.00050		mg/L			10-DEC-19



Quality Control Report

Workorder: L2393410

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-5	DUP	L2393231-1						
m+p-Xylenes		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Methylene chloride		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
n-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
n-Propylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
o-Xylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
sec-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Styrene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
tert-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Tetrachloroethylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Toluene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
trans-1,2-Dichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
trans-1,3-Dichloropropene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Trichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
Trichlorofluoromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-DEC-19
Vinyl chloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-DEC-19
WG3238459-2	LCS							
1,1,1,2-Tetrachloroethane			104.2		%		70-130	09-DEC-19
1,1,1-Trichloroethane			96.0		%		70-130	09-DEC-19
1,1,1,2,2-Tetrachloroethane			94.1		%		70-130	09-DEC-19
1,1,2-Trichloroethane			93.3		%		70-130	09-DEC-19
1,1-Dichloroethane			100.0		%		70-130	09-DEC-19
1,1-Dichloroethene			99.8		%		70-130	09-DEC-19
1,1-Dichloropropene			87.0		%		70-130	09-DEC-19
1,2,3-Trichlorobenzene			95.0		%		70-130	09-DEC-19
1,2,3-Trichloropropane			98.2		%		70-130	09-DEC-19
1,2,4-Trichlorobenzene			96.7		%		70-130	09-DEC-19
1,2,4-Trimethylbenzene			100.5		%		70-130	09-DEC-19
1,2-Dibromo-3-chloropropane			88.1		%		70-130	09-DEC-19
1,2-Dichlorobenzene			101.3		%		70-130	09-DEC-19
1,2-Dichloroethane			93.1		%		70-130	09-DEC-19
1,2-Dichloropropane			95.9		%		70-130	09-DEC-19
1,3,5-Trimethylbenzene			101.4		%		70-130	09-DEC-19
1,3-Dichlorobenzene			100.6		%		70-130	09-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-2	LCS							
1,3-Dichloropropane			92.3		%		70-130	09-DEC-19
1,4-Dichlorobenzene			106.6		%		70-130	09-DEC-19
2,2-Dichloropropane			94.4		%		70-130	09-DEC-19
2-Chlorotoluene			98.4		%		70-130	09-DEC-19
4-Chlorotoluene			94.9		%		70-130	09-DEC-19
p-Isopropyltoluene			96.2		%		50-150	09-DEC-19
Benzene			96.6		%		70-130	09-DEC-19
Bromobenzene			101.9		%		70-130	09-DEC-19
Bromochloromethane			92.5		%		70-130	09-DEC-19
Bromodichloromethane			98.0		%		70-130	09-DEC-19
Bromoform			96.4		%		70-130	09-DEC-19
Bromomethane			111.8		%		60-140	09-DEC-19
Carbon tetrachloride			94.1		%		70-130	09-DEC-19
Chlorobenzene			103.2		%		70-130	09-DEC-19
Chloroethane			126.5		%		60-140	09-DEC-19
Chloroform			96.6		%		70-130	09-DEC-19
Chloromethane			120.3		%		60-140	09-DEC-19
cis-1,2-Dichloroethene			92.9		%		70-130	09-DEC-19
cis-1,3-Dichloropropene			85.8		%		70-130	09-DEC-19
Dibromochloromethane			97.9		%		70-130	09-DEC-19
Dibromomethane			94.2		%		70-130	09-DEC-19
Dichlorodifluoromethane			122.0		%		60-140	09-DEC-19
Ethylbenzene			97.2		%		70-130	09-DEC-19
Ethylene dibromide			88.4		%		70-130	09-DEC-19
Hexachlorobutadiene			102.7		%		70-130	09-DEC-19
Isopropylbenzene			98.0		%		70-130	09-DEC-19
m+p-Xylenes			104.8		%		70-130	09-DEC-19
Methylene chloride			92.5		%		60-140	09-DEC-19
n-Butylbenzene			98.5		%		70-130	09-DEC-19
n-Propylbenzene			92.2		%		70-130	09-DEC-19
o-Xylene			92.6		%		70-130	09-DEC-19
sec-Butylbenzene			103.6		%		70-130	09-DEC-19
Styrene			87.5		%		70-130	09-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL		Water						
Batch	R4937909							
WG3238459-2	LCS							
tert-Butylbenzene			98.5		%		70-130	09-DEC-19
Tetrachloroethylene			102.0		%		70-130	09-DEC-19
Toluene			89.9		%		70-130	09-DEC-19
trans-1,2-Dichloroethene			98.2		%		70-130	09-DEC-19
trans-1,3-Dichloropropene			91.6		%		70-130	09-DEC-19
Trichloroethene			98.1		%		70-130	09-DEC-19
Trichlorofluoromethane			122.0		%		60-140	09-DEC-19
Vinyl chloride			117.5		%		60-140	09-DEC-19
WG3238459-1	MB							
1,1,1,2-Tetrachloroethane			<0.0010		mg/L		0.001	09-DEC-19
1,1,1-Trichloroethane			<0.00050		mg/L		0.0005	09-DEC-19
1,1,2,2-Tetrachloroethane			<0.00050		mg/L		0.0005	09-DEC-19
1,1,2-Trichloroethane			<0.00050		mg/L		0.0005	09-DEC-19
1,1-Dichloroethane			<0.00050		mg/L		0.0005	09-DEC-19
1,1-Dichloroethene			<0.00050		mg/L		0.0005	09-DEC-19
1,1-Dichloropropene			<0.0010		mg/L		0.001	09-DEC-19
1,2,3-Trichlorobenzene			<0.0010		mg/L		0.001	09-DEC-19
1,2,3-Trichloropropane			<0.00050		mg/L		0.0005	09-DEC-19
1,2,4-Trichlorobenzene			<0.0010		mg/L		0.001	09-DEC-19
1,2,4-Trimethylbenzene			<0.0010		mg/L		0.001	09-DEC-19
1,2-Dibromo-3-chloropropane			<0.0010		mg/L		0.001	09-DEC-19
1,2-Dichlorobenzene			<0.00050		mg/L		0.0005	09-DEC-19
1,2-Dichloroethane			<0.0010		mg/L		0.001	09-DEC-19
1,2-Dichloropropane			<0.00050		mg/L		0.0005	09-DEC-19
1,3,5-Trimethylbenzene			<0.0010		mg/L		0.001	09-DEC-19
1,3-Dichlorobenzene			<0.00050		mg/L		0.0005	09-DEC-19
1,3-Dichloropropane			<0.0010		mg/L		0.001	09-DEC-19
1,4-Dichlorobenzene			<0.00050		mg/L		0.0005	09-DEC-19
2,2-Dichloropropane			<0.0010		mg/L		0.001	09-DEC-19
2-Chlorotoluene			<0.0010		mg/L		0.001	09-DEC-19
4-Chlorotoluene			<0.0010		mg/L		0.001	09-DEC-19
p-Isopropyltoluene			<0.0010		mg/L		0.001	09-DEC-19
Benzene			<0.00050		mg/L		0.0005	09-DEC-19
Bromobenzene			<0.0010		mg/L		0.001	09-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-1 MB								
Bromochloromethane			<0.0010		mg/L		0.001	09-DEC-19
Bromodichloromethane			<0.00050		mg/L		0.0005	09-DEC-19
Bromoform			<0.00050		mg/L		0.0005	09-DEC-19
Bromomethane			<0.0010		mg/L		0.001	09-DEC-19
Carbon tetrachloride			<0.00050		mg/L		0.0005	09-DEC-19
Chlorobenzene			<0.00050		mg/L		0.0005	09-DEC-19
Chloroethane			<0.0010		mg/L		0.001	09-DEC-19
Chloroform			<0.00050		mg/L		0.0005	09-DEC-19
Chloromethane			<0.0010		mg/L		0.001	09-DEC-19
cis-1,2-Dichloroethene			<0.0010		mg/L		0.001	09-DEC-19
cis-1,3-Dichloropropene			<0.00050		mg/L		0.0005	09-DEC-19
Dibromochloromethane			<0.00050		mg/L		0.0005	09-DEC-19
Dibromomethane			<0.00050		mg/L		0.0005	09-DEC-19
Dichlorodifluoromethane			<0.00050		mg/L		0.0005	09-DEC-19
Ethylbenzene			<0.00050		mg/L		0.0005	09-DEC-19
Ethylene dibromide			<0.00050		mg/L		0.0005	09-DEC-19
Hexachlorobutadiene			<0.0010		mg/L		0.001	09-DEC-19
Isopropylbenzene			<0.0010		mg/L		0.001	09-DEC-19
m+p-Xylenes			<0.00050		mg/L		0.0005	09-DEC-19
Methylene chloride			<0.0010		mg/L		0.001	09-DEC-19
n-Butylbenzene			<0.0010		mg/L		0.001	09-DEC-19
n-Propylbenzene			<0.0010		mg/L		0.001	09-DEC-19
o-Xylene			<0.00050		mg/L		0.0005	09-DEC-19
sec-Butylbenzene			<0.0010		mg/L		0.001	09-DEC-19
Styrene			<0.00050		mg/L		0.0005	09-DEC-19
tert-Butylbenzene			<0.0010		mg/L		0.001	09-DEC-19
Tetrachloroethylene			<0.00050		mg/L		0.0005	09-DEC-19
Toluene			<0.00050		mg/L		0.0005	09-DEC-19
trans-1,2-Dichloroethene			<0.00050		mg/L		0.0005	09-DEC-19
trans-1,3-Dichloropropene			<0.0010		mg/L		0.001	09-DEC-19
Trichloroethene			<0.00050		mg/L		0.0005	09-DEC-19
Trichlorofluoromethane			<0.0010		mg/L		0.001	09-DEC-19
Vinyl chloride			<0.00050		mg/L		0.0005	09-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-1	MB							
Surrogate: 1,4-Difluorobenzene			100.6		%		70-130	09-DEC-19
Surrogate: 4-Bromofluorobenzene			80.9		%		70-130	09-DEC-19
WG3238459-6	MS	L2393231-2						
1,1,1,2-Tetrachloroethane			99.0		%		50-140	09-DEC-19
1,1,1-Trichloroethane			99.0		%		50-140	09-DEC-19
1,1,2,2-Tetrachloroethane			87.1		%		50-140	09-DEC-19
1,1,2-Trichloroethane			88.5		%		50-140	09-DEC-19
1,1-Dichloroethane			101.6		%		50-140	09-DEC-19
1,1-Dichloroethene			102.3		%		50-140	09-DEC-19
1,1-Dichloropropene			94.7		%		50-140	09-DEC-19
1,2,3-Trichlorobenzene			109.6		%		50-140	09-DEC-19
1,2,3-Trichloropropane			89.8		%		70-130	09-DEC-19
1,2,4-Trichlorobenzene			106.1		%		50-140	09-DEC-19
1,2,4-Trimethylbenzene			102.6		%		50-140	09-DEC-19
1,2-Dibromo-3-chloropropane			92.5		%		50-140	09-DEC-19
1,2-Dichlorobenzene			100.5		%		50-140	09-DEC-19
1,2-Dichloroethane			89.2		%		50-140	09-DEC-19
1,2-Dichloropropane			96.1		%		50-140	09-DEC-19
1,3,5-Trimethylbenzene			103.0		%		50-140	09-DEC-19
1,3-Dichlorobenzene			98.8		%		50-140	09-DEC-19
1,3-Dichloropropane			88.8		%		50-140	09-DEC-19
1,4-Dichlorobenzene			104.7		%		50-140	09-DEC-19
2,2-Dichloropropane			98.2		%		50-140	09-DEC-19
2-Chlorotoluene			99.5		%		50-140	09-DEC-19
4-Chlorotoluene			95.2		%		50-140	09-DEC-19
p-Isopropyltoluene			101.3		%		50-140	09-DEC-19
Benzene			98.9		%		50-140	09-DEC-19
Bromobenzene			98.7		%		50-140	09-DEC-19
Bromochloromethane			90.1		%		50-140	09-DEC-19
Bromodichloromethane			95.6		%		50-140	09-DEC-19
Bromoform			89.3		%		50-140	09-DEC-19
Bromomethane			113.0		%		50-140	09-DEC-19
Carbon tetrachloride			96.1		%		50-140	09-DEC-19
Chlorobenzene			100.3		%		50-140	09-DEC-19



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Client: TETRA TECH CANADA INC.
 110, 140 Quarry Park Blvd SE
 Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HS-MS-CL								
	Water							
Batch	R4937909							
WG3238459-6 MS		L2393231-2						
Chloroethane			127.7		%		50-140	09-DEC-19
Chloroform			96.5		%		50-140	09-DEC-19
Chloromethane			120.4		%		50-140	09-DEC-19
cis-1,2-Dichloroethene			95.9		%		50-140	09-DEC-19
cis-1,3-Dichloropropene			89.3		%		50-140	09-DEC-19
Dibromochloromethane			95.2		%		50-140	09-DEC-19
Dibromomethane			89.7		%		50-140	09-DEC-19
Dichlorodifluoromethane			122.6		%		50-140	09-DEC-19
Ethylbenzene			101.7		%		50-140	09-DEC-19
Ethylene dibromide			84.8		%		50-140	09-DEC-19
Hexachlorobutadiene			104.6		%		50-140	09-DEC-19
Isopropylbenzene			100.7		%		50-140	09-DEC-19
m+p-Xylenes			102.3		%		50-140	09-DEC-19
Methylene chloride			91.4		%		50-140	09-DEC-19
n-Butylbenzene			100.9		%		50-140	09-DEC-19
n-Propylbenzene			98.8		%		50-140	09-DEC-19
o-Xylene			97.8		%		50-140	09-DEC-19
sec-Butylbenzene			103.9		%		50-140	09-DEC-19
Styrene			92.3		%		50-140	09-DEC-19
tert-Butylbenzene			101.5		%		50-140	09-DEC-19
Tetrachloroethylene			102.1		%		50-140	09-DEC-19
Toluene			95.8		%		50-140	09-DEC-19
trans-1,2-Dichloroethene			99.0		%		50-140	09-DEC-19
trans-1,3-Dichloropropene			92.1		%		50-140	09-DEC-19
Trichloroethene			101.5		%		50-140	09-DEC-19
Trichlorofluoromethane			110.9		%		50-140	09-DEC-19
Vinyl chloride			122.7		%		50-140	09-DEC-19

Quality Control Report

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

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Contact: Darby Madalena

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



December 20, 2019

Service Request No:K1911628

Inayat Dhaliwal
ALS Environmental - Canada
2559 29 Street NE
Calgary, AB T1Y 7B5

Laboratory Results for: L2393410

Dear Inayat,

Enclosed are the results of the sample(s) submitted to our laboratory December 12, 2019
For your reference, these analyses have been assigned our service request number **K1911628**.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3293. You may also contact me via email at Elizabeth.Harris@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Elizabeth Harris
Project Manager

ADDRESS 1317 S. 13th Avenue, Kelso, WA 98626
PHONE +1 360 577 7222 | FAX +1 360 636 1068
ALS Group USA, Corp.
dba ALS Environmental



Narrative Documents

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water

Service Request: K1911628
Date Received: 12/12/2019

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples for the Tier II level requested by the client.


Sample Receipt:

Five water samples were received for analysis at ALS Environmental on 12/12/2019. Any discrepancies upon initial sample inspection are annotated on the sample receipt and preservation form included within this report. The samples were stored at minimum in accordance with the analytical method requirements.

General Chemistry:

No significant anomalies were noted with this analysis.

Approved by



Date

12/20/2019



Sample Receipt Information

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com

Client: ALS Environmental - Canada
Project: L2393410

Service Request:K1911628

SAMPLE CROSS-REFERENCE

<u>SAMPLE #</u>	<u>CLIENT SAMPLE ID</u>	<u>DATE</u>	<u>TIME</u>
K1911628-001	L2393410-1	12/4/2019	
K1911628-002	L2393410-2	12/4/2019	
K1911628-003	L2393410-3	12/4/2019	
K1911628-004	L2393410-4	12/4/2019	
K1911628-005	L2393410-5	12/5/2019	

K1911628

L2393410

CALGARY



Subcontract Request Form

Subcontract To:

ALS ENVIRONMENTAL - KELSO, WASHINGTON, USA

1317 S. 13TH AVE
KELSO, WA 98626

NOTES: Please reference on final report and invoice: PO# L2393410
ALS requires QC data to be provided with your final results.

Please see enclosed 5 sample(s) in 5 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2393410-1 MW-01	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 4/ 2019	
		12/30/2019	
L2393410-2 MW-02	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 4/ 2019	
		12/30/2019	
L2393410-3 MW-03	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 4/ 2019	
		12/30/2019	
L2393410-4 MW-04	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 4/ 2019	
		12/30/2019	
L2393410-5 MW203	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 5/ 2019	
		12/30/2019	

Subcontract Info Contact: John Forbes (403) 291-9897
 Analysis and reporting info contact: Inayat Dhaliwal
 2559 29 STREET NE
 CALGARY, AB T1Y 7B5
 Phone: (403) 291-9897 Email: inayat.dhaliwal@alsglobal.com

Please email confirmation of receipt to: inayat.dhaliwal@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: [Signature] 12/12/19 Date Received: 12/12/19 1000

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____



Cooler Receipt and Preservation Form

Client ALS CANADA Service Request K1911628
 Received: 12/12/19 Opened: 12/12/19 By: CG Unloaded: 12/12/19 By: CG

1. Samples were received via? USPS Fed Ex UPS DHL PDX Courier Hand Delivered
2. Samples were received in: (circle) Cooler Box Envelope Other _____ NA
3. Were custody seals on coolers? NA Y N If yes, how many and where? _____
 If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID	Tracking Number	NA	Filed
0.1	0.4	/	/	+0.3	403	NA	777200688607	NA	

4. Packing material: Inserts Baggies Bubble Wrap Gel Packs Wet Ice Dry Ice Sleeves _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Were samples received in good condition (temperature, unbroken)? Indicate in the table below. NA Y N
 If applicable, tissue samples were received: Frozen Partially Thawed Thawed
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? Indicate major discrepancies in the table on page 2. NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (see SMO GEN SOP) received at the appropriate pH? Indicate in the table below NA Y N
11. Were VOA vials received without headspace? Indicate in the table below. NA Y N
12. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count	Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____



Miscellaneous Forms

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
 - i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

**ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses**

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L16-58-R4
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjllabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/analyte is offered by that state.

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

ALS Group USA, Corp.
dba ALS Environmental

Analyst Summary report

Client: ALS Environmental - Canada
Project: L2393410/

Service Request: K1911628

Sample Name: L2393410-1
Lab Code: K1911628-001
Sample Matrix: Water

Date Collected: 12/4/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393410-2
Lab Code: K1911628-002
Sample Matrix: Water

Date Collected: 12/4/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393410-3
Lab Code: K1911628-003
Sample Matrix: Water

Date Collected: 12/4/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393410-4
Lab Code: K1911628-004
Sample Matrix: Water

Date Collected: 12/4/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393410-5
Lab Code: K1911628-005
Sample Matrix: Water

Date Collected: 12/5/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS



Sample Results

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com



General Chemistry

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www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: L2393410-1
Lab Code: K1911628-001

Service Request: K1911628
Date Collected: 12/04/19
Date Received: 12/12/19 10:00
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.50	50	12/17/19 09:06	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: L2393410-2
Lab Code: K1911628-002

Service Request: K1911628
Date Collected: 12/04/19
Date Received: 12/12/19 10:00
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.025	2.5	12/17/19 09:06	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: L2393410-3
Lab Code: K1911628-003

Service Request: K1911628
Date Collected: 12/04/19
Date Received: 12/12/19 10:00
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.10	10	12/17/19 09:06	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: L2393410-4
Lab Code: K1911628-004

Service Request: K1911628
Date Collected: 12/04/19
Date Received: 12/12/19 10:00
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.10	10	12/17/19 09:06	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: L2393410-5
Lab Code: K1911628-005

Service Request: K1911628
Date Collected: 12/05/19
Date Received: 12/12/19 10:00
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.050	5	12/17/19 09:06	



QC Summary Forms

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
www.alsglobal.com



General Chemistry

ALS Environmental—Kelso Laboratory
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www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water
Sample Name: Method Blank
Lab Code: K1911628-MB

Service Request: K1911628
Date Collected: NA
Date Received: NA
Basis: NA

General Chemistry Parameters

<u>Analyte Name</u>	<u>Analysis Method</u>	<u>Result</u>	<u>Units</u>	<u>MRL</u>	<u>Dil.</u>	<u>Date Analyzed</u>	<u>Q</u>
Halides, Adsorbable Organic (AOX)	1650C	ND U	mg/L	0.010	1	12/17/19 09:06	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: ALS Environmental - Canada
Project: L2393410/
Sample Matrix: Water

Service Request: K1911628
Date Collected: NA
Date Received: NA
Date Analyzed: 12/17/2019
Analysis Lot: 663572

Calibration and Method Blank Summary
Halides, Adsorbable Organic (AOX)
1650C

	Halide Check Standard (ug)	Instrument Calibration Standard (ug)	PAR Standard (ug/L)
True Value	3.64	10.0	0.100
Run A	3.81	10.2	0.095
Percent Recovery A	105	102	95
Run B	3.32	10.4	
Percent Recovery B	91	104	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: ALS Environmental - Canada
Project: L2393410
Sample Matrix: Water

Service Request: K1911628
Date Collected: N/A
Date Received: N/A
Date Analyzed: 12/17/19
Date Extracted: NA

Duplicate Matrix Spike Summary
Halides, Adsorbable Organic (AOX)

Sample Name: Batch QC
Lab Code: KQ1918589-09
Analysis Method: 1650C
Prep Method: None

Units: mg/L
Basis: NA

Analyte Name	Sample Result	Matrix Spike KQ1918589-09MS			Duplicate Matrix Spike KQ1918589-09DMS			% Rec Limits	RPD	RPD Limit
		Result	Spike Amount	% Rec	Result	Spike Amount	% Rec			
Halides, Adsorbable Organic (AOX)	3.13	13.5	10.0	103	13.5	10.0	104	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

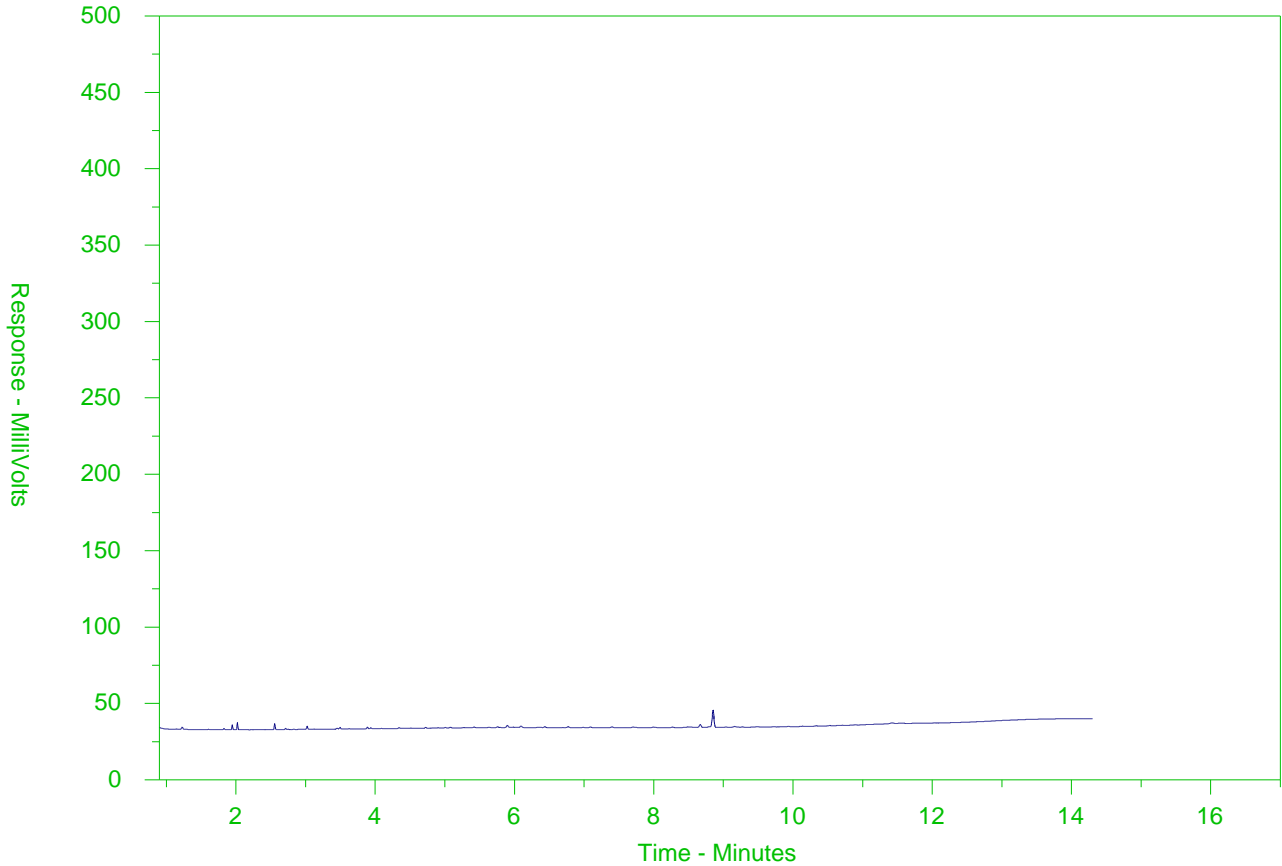
Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2393410-1
 Client Sample ID: MW-01



← F2 →		← F3 →		← F4 →	
nC10	nC16		nC34	nC50	
174°C	287°C		481°C	575°C	
346°F	549°F		898°F	1067°F	
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

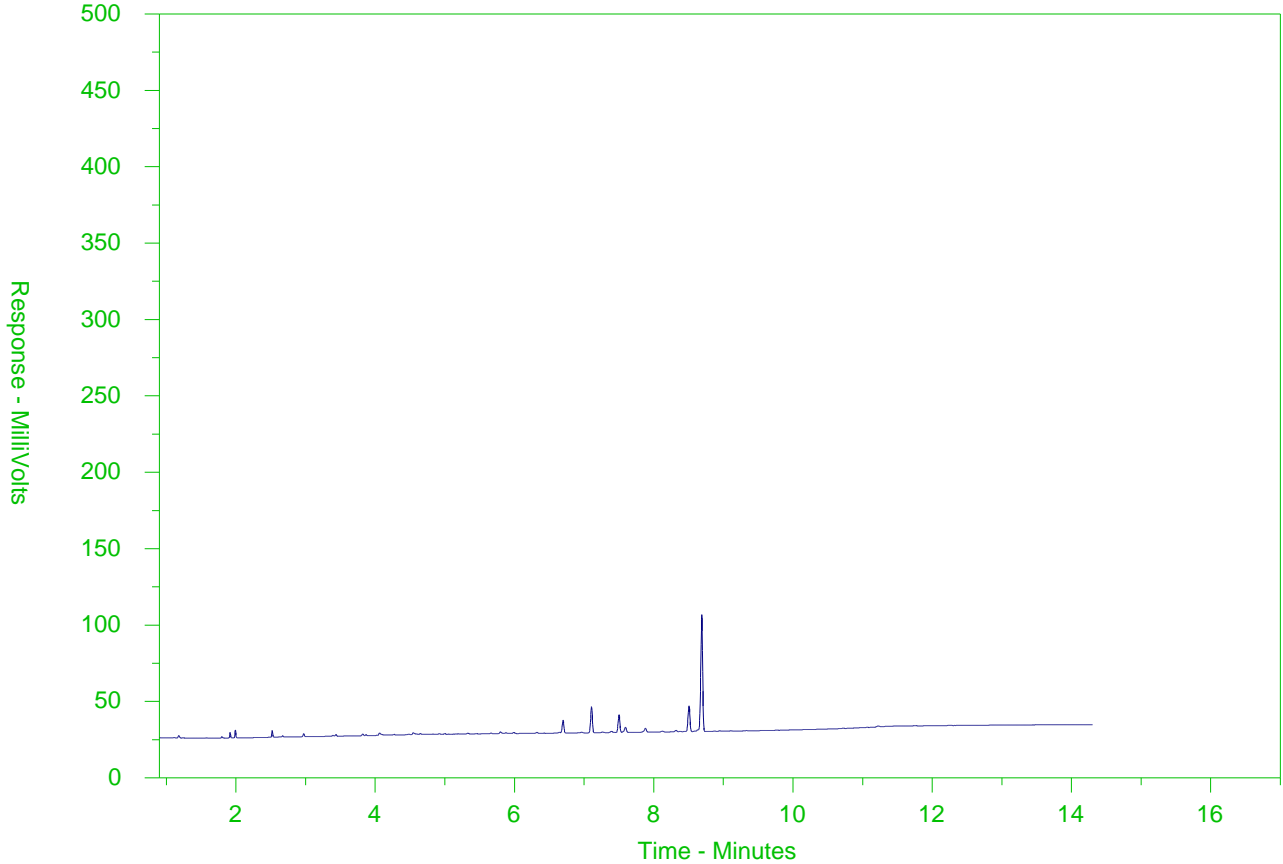
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2393410-2
 Client Sample ID: MW-02



← F2 →		← F3 →		← F4 →	
nC10	nC16			nC34	nC50
174°C	287°C			481°C	575°C
346°F	549°F			898°F	1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

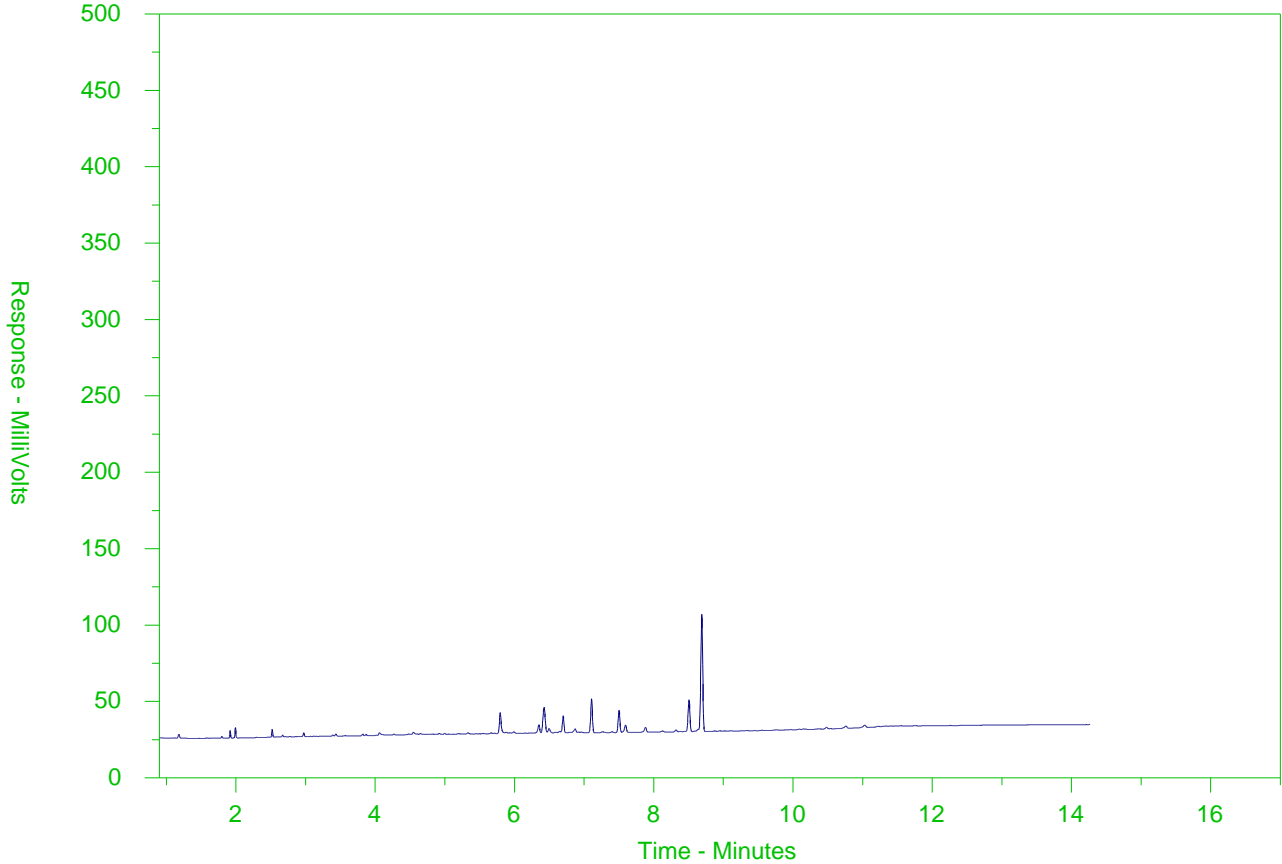
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2393410-3
 Client Sample ID: MW-03



← F2 →		← F3 →		← F4 →	
nC10	nC16			nC34	nC50
174°C	287°C			481°C	575°C
346°F	549°F			898°F	1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

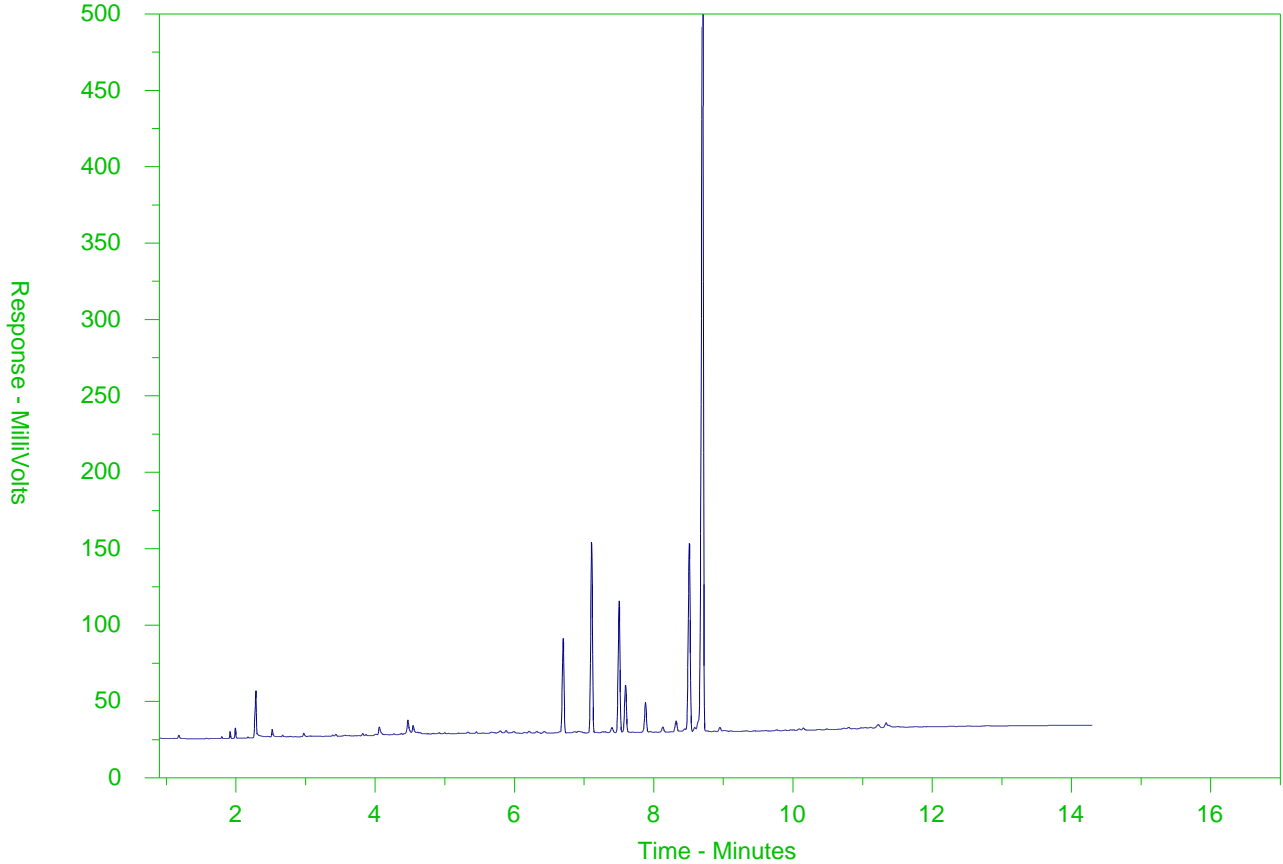
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2393410-4
 Client Sample ID: MW-04



← F2 →		← F3 →		← F4 →	
nC10	nC16			nC34	nC50
174°C	287°C			481°C	575°C
346°F	549°F			898°F	1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

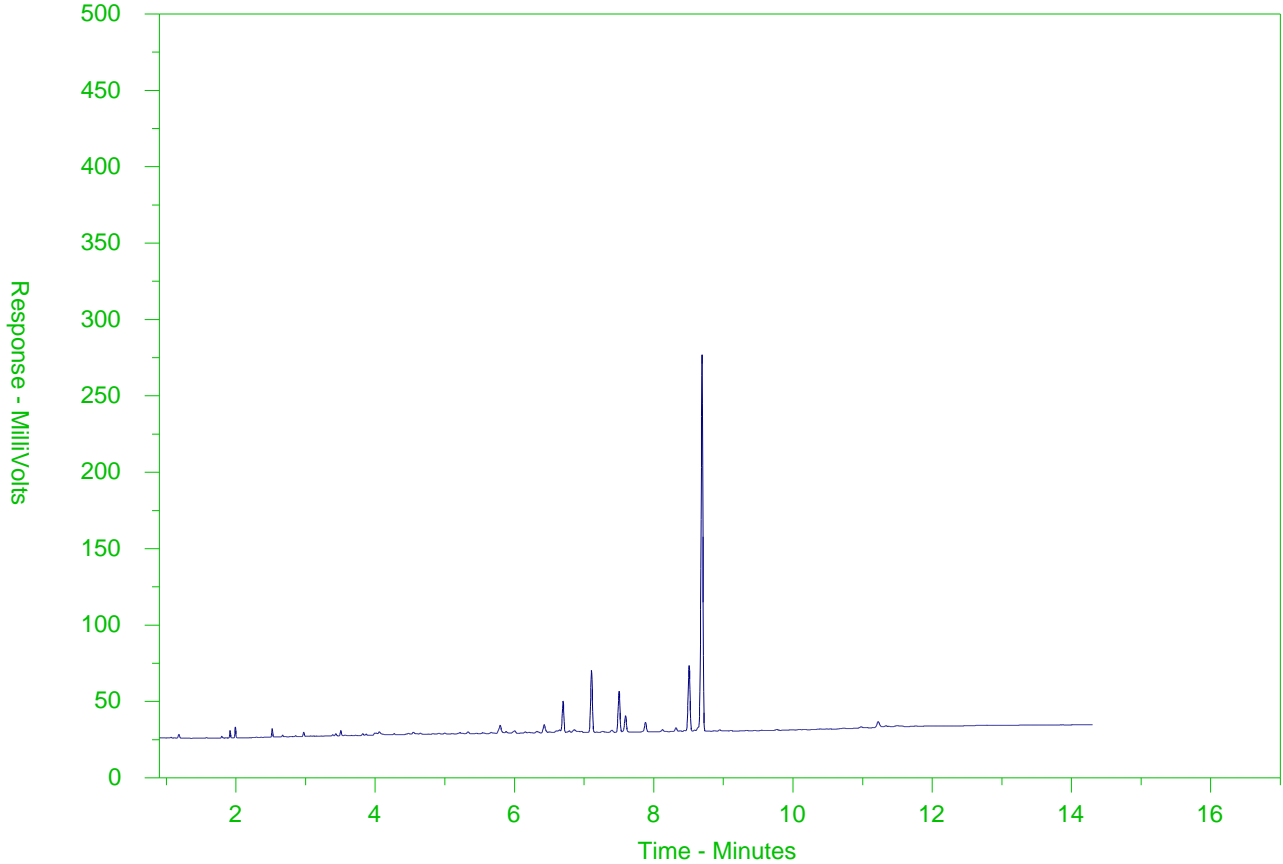
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.

CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT



ALS Sample ID: L2393410-5
 Client Sample ID: MW203



← F2 →		← F3 →		← F4 →	
nC10	nC16			nC34	nC50
174°C	287°C			481°C	575°C
346°F	549°F			898°F	1067°F
← Gasoline →			← Motor Oils/ Lube Oils/ Grease →		
← Diesel/ Jet Fuels →					

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR library can be found at www.alsglobal.com.



L2393410-COFC

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES



Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # CORD McKenzie Trails

Page 1 of 1

Report to:		Report Format / Distribution			Service Requested:												
Company: Tetra Tech Canada Inc.		<input type="checkbox"/> Standard <input type="checkbox"/> Other			<input checked="" type="checkbox"/> Regular Service (Default)												
Contact: Darby Madalena		<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Fax			<input type="checkbox"/> Rush Service (2-3 Days)												
Address: 110, 140 Quarry Park Blvd SE, Calgary, AB T2C 3G3		Email 1: darby.madalena@tetratech.com			<input type="checkbox"/> Priority Service (1 Day or ASAP)												
Phone: 403-723-6867 Fax: 403-203-3301		Email 2:			<input type="checkbox"/> Emergency Service (<1 Day / Wkend) - Contact ALS												
Invoice To: <input checked="" type="checkbox"/> Same as Report		ALS Digital Crosstab results			Analysis Request												
Company: SAME AS REPORT		Indicate Bottles: Filtered / Preserved (F/P) -->															
Contact:		Client / Project Information:															
Address:		Job #: SWM.SWOP04071-01.003															
Sample:		PO/AFE: SWM.SWOP04071-01.003															
Phone: Fax:		Legal Site Description:															
		Quote #: Q71650															
Lab Work Order # (lab use only)		ALS Contact: Wendy Sears		Sampler (Initials): RM													
Sample #	Sample Identification (This description will appear on the report)	Date dd-mm-yy	Time hh:mm	Sample Type (Select from drop-down list)	BTX-F1-F2-CL	VOC-8260-CL	TKN-F-CL	ROU-MET_D-ABT1-CL	C-DIS-ORG-CL	NH3-F-CL	P-T-COL-CL	AOX-MISA-KL	VFA-WP	Hazardous?	Highly Contaminated?	Number of Containers	
1	MW-01	04-12-19	08:05	Water	X	X	X	X	X	X	X	X	X			12	
2	MW-02	04-12-19	09:45	Water	X	X	X	X	X	X	X	X	X			12	
3	MW-03	04-12-19	08:55	Water	X	X	X	X	X	X	X	X	X			12	
4	MW-04	04-12-19	08:35	Water	X	X	X	X	X	X	X	X	X			12	
5	MW-05 DRY			Water	X	X	X	X	X	X	X	X	X			12	
6	MW203	05-12-19	0815	Water	X	X	X	X	X	X	X	X	X			12	
Guidelines / Regulations					Special Instructions / Hazardous Details												
					metals + Hs + DOC EIP												
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																	
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.																	
Relinquished By:	Ryan Miller	Date & Time:	Dec 6/19	Received By:	[Signature]	Date & Time:	12/10	Sample Condition (lab use only)									
Relinquished By:	[Signature]	Date & Time:	1600	Received By:	[Signature]	Date & Time:	4:50	Temperature	Samples Received in Good Condition? Y / N (if no provided details)								



L2393410-COFC

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES



Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # CORD McKenzie Trails

Page 1 of 1

Report to:		Report Format / Distribution			Service Requested:											
Company: Tetra Tech Canada Inc.		<input type="checkbox"/> Standard <input type="checkbox"/> Other			<input checked="" type="checkbox"/> Regular Service (Default)											
Contact: Darby Madalena		<input checked="" type="checkbox"/> PDF <input checked="" type="checkbox"/> Excel <input type="checkbox"/> Fax			<input type="checkbox"/> Rush Service (2-3 Days)											
Address: 110, 140 Quarry Park Blvd SE, Calgary, AB T2C 3G3		Email 1: darby.madalena@tetratech.com			<input type="checkbox"/> Priority Service (1 Day or ASAP)											
Phone: 403-723-6867 Fax: 403-203-3301		Email 2:			<input type="checkbox"/> Emergency Service (<1 Day / Wkend) - Contact ALS											
Invoice To: <input checked="" type="checkbox"/> Same as Report		ALS Digital Crosstab results			Analysis Request											
Company: SAME AS REPORT		Indicate Bottles: Filtered / Preserved (F/P) →														
Contact:		Client / Project Information:														
Address:		Job #: SWM.SWOP04071-01.003														
Sample:		PO/AFE: SWM.SWOP04071-01.003														
Phone: Fax:		Legal Site Description:														
		Quote #: Q71650														
Lab Work Order # (lab use only)		ALS Contact: Wendy Sears		Sampler (Initials): RM												
Sample #	Sample Identification (This description will appear on the report)	Date dd-mm-yy	Time hh:mm	Sample Type (Select from drop-down list)	BTX-F1-F2-CL	VOC-8260-CL	TKN-F-CL	ROU-MET_D-ABT1-CL	C-DIS-ORG-CL	NH3-F-CL	P-T-COL-CL	AOX-MISA-KL	VFA-WP	Hazardous?	Highly Contaminated?	Number of Containers
1	MW-01	04-12-19	08:05	Water	X	X	X	X	X	X	X	X	X			12
2	MW-02	04-12-19	09:45	Water	X	X	X	X	X	X	X	X	X			12
3	MW-03	04-12-19	08:55	Water	X	X	X	X	X	X	X	X	X			12
4	MW-04	04-12-19	08:35	Water	X	X	X	X	X	X	X	X	X			12
5	MW-05 DRY			Water	X	X	X	X	X	X	X	X	X			12
6	MW203	05-12-19	0815	Water	X	X	X	X	X	X	X	X	X			12
Guidelines / Regulations					Special Instructions / Hazardous Details											
					metals + Hs + DOC EIP											
Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.																
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the adjacent worksheet.																
Relinquished By: Ryan Miller	Date & Time: Dec 6/19	Received By: [Signature]	Date & Time: 12/10	Sample Condition (lab use only)												
Relinquished By: [Signature]	Date & Time: 1600	Received By: [Signature]	Date & Time: 4:50	Temperature: 5	Samples Received in Good Condition? Y / N (if no provided details)											


INVOICE #: **E1898295**
SOLD TO:
REPORTED TO:

10175

TETRA TECH CANADA INC.
ATTN: Accounts Payable
Suite 110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

TETRA TECH CANADA INC.
ATTN: Darby Madalena
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3
JOB #: SWM.SWOP04071-01.003
Quote #: Q71650

Date	Account #	Terms	Due Date	PO Number/Reference
20-Dec-2019	10175	Net 30 Days	19-Jan-2020	SWM.SWOP04071-01.003

Matrix Analysis	Description	Surcharge Qty	Unit Price	Total Price
Water AOX-MISA-KL	Adsorbable Organic Halides	5	\$175.00	\$875.00
Water C-DIS-ORG-CL	Dissolved Organic Carbon	5	\$19.35	\$96.75
Water F1,F2-CL	F1 (C6-C10) and F2 (>C10-C16)	5	\$52.00	\$260.00
Water NH3-F-CL	Ammonia by Fluorescence	5	\$6.60	\$33.00
Water P-T-COL-CL	Total P in Water by Colour	5	\$9.00	\$45.00
Water ROU+MET_D-ABT1-CL	Major Ions & Trace Dissolved Metals	5	\$69.00	\$345.00
Water TKN-F-CL	Total Kjeldahl Nitrogen by Fluorescence	5	\$12.00	\$60.00
Water VFA-WP	Volatile fatty/carboxylic acids	5	\$115.00	\$575.00
Water VOC-8260-PKG-CL	EPA 8260 Volatile Organics	5	\$72.00	\$360.00
Misc. SAMPLE-DISPOSAL-CL	Sample Handling and Disposal Fee	5	\$2.00	\$10.00

ALS Work Order Numbers and Receive Dates:

L2393410 06-DEC-2019

Sub-total: \$2,659.75

GST (5%): \$132.99

GST/HST BN 100938885
Total (CAD): \$2,792.74

PRICES REFLECT DISCOUNT

Contact Information:

Inayat Dhaliwal
 Phone #: (403) 407-1800
 Fax #: (403) 291-0298
 CALGARY

Please remit payment to **ALS Canada Ltd.** at the address below. We accept Visa and Mastercard.

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TETRA TECH CANADA INC.
ATTN: Darby Madalena
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Date Received: 06-DEC-19
Report Date: 24-DEC-19 13:35 (MT)
Version: FINAL

Client Phone: 403-203-3355

Certificate of Analysis

Lab Work Order #: L2393598
Project P.O. #: SWM.SWOP04071-01.003
Job Reference: SWM.SWOP04071-01.003 (MCKENZIE TRAILS
RECREATION AREA)
C of C Numbers:
Legal Site Desc:

Inayat Dhaliwal
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 15:00							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	17		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	<15		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	16		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	<15		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	98.2		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	74.7		1.0	%		13-DEC-19	R4944389
Oxygen	19.5		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	1.76		0.050	%		13-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		13-DEC-19	R4944389
Methane	<0.050		0.050	%		13-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<2.6		2.6	ug/m3		23-DEC-19	R4953168
Naphthalene	<0.50		0.50	ppb(V)		23-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.9		50-150	%		23-DEC-19	R4953168
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		23-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1-Dichloroethane	<0.81		0.81	ug/m3		23-DEC-19	R4953168
1,1-Dichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
1,1-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		23-DEC-19	R4953168
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dibromoethane	<1.5		1.5	ug/m3		23-DEC-19	R4953168
1,2-Dibromoethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichloroethane	<0.81		0.81	ug/m3		23-DEC-19	R4953168
1,2-Dichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichloropropane	<0.92		0.92	ug/m3		23-DEC-19	R4953168
1,2-Dichloropropane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3-Butadiene	<0.44		0.44	ug/m3		23-DEC-19	R4953168
1,3-Butadiene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 15:00							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,4-Dioxane	<0.72		0.72	ug/m3		23-DEC-19	R4953168
1,4-Dioxane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
2-Hexanone	<4.1		4.1	ug/m3		23-DEC-19	R4953168
2-Hexanone	<1.0		1.0	ppb(V)		23-DEC-19	R4953168
4-Ethyltoluene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
4-Ethyltoluene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Acetone	2.3		1.2	ug/m3		23-DEC-19	R4953168
Acetone	0.99		0.50	ppb(V)		23-DEC-19	R4953168
Allyl chloride	<0.63		0.63	ug/m3		23-DEC-19	R4953168
Allyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Benzene	<0.64		0.64	ug/m3		23-DEC-19	R4953168
Benzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Benzyl chloride	<1.0		1.0	ug/m3		23-DEC-19	R4953168
Benzyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromodichloromethane	<1.3		1.3	ug/m3		23-DEC-19	R4953168
Bromodichloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromoform	<2.1		2.1	ug/m3		23-DEC-19	R4953168
Bromoform	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromomethane	<0.78		0.78	ug/m3		23-DEC-19	R4953168
Bromomethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Carbon Disulfide	<0.62		0.62	ug/m3		23-DEC-19	R4953168
Carbon Disulfide	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Carbon Tetrachloride	<1.3		1.3	ug/m3		23-DEC-19	R4953168
Carbon Tetrachloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chlorobenzene	<0.92		0.92	ug/m3		23-DEC-19	R4953168
Chlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloroethane	<0.53		0.53	ug/m3		23-DEC-19	R4953168
Chloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloroform	<0.98		0.98	ug/m3		23-DEC-19	R4953168
Chloroform	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloromethane	<0.41		0.41	ug/m3		23-DEC-19	R4953168
Chloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		23-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Cyclohexane	<0.69		0.69	ug/m3		23-DEC-19	R4953168
Cyclohexane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Dibromochloromethane	<1.7		1.7	ug/m3		23-DEC-19	R4953168
Dibromochloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Dichlorodifluoromethane	1.89		0.99	ug/m3		23-DEC-19	R4953168
Dichlorodifluoromethane	0.38		0.20	ppb(V)		23-DEC-19	R4953168
Ethyl acetate	<0.72		0.72	ug/m3		23-DEC-19	R4953168
Ethyl acetate	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Ethylbenzene	<0.87		0.87	ug/m3		23-DEC-19	R4953168
Ethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Freon 113	<1.5		1.5	ug/m3		23-DEC-19	R4953168
Freon 113	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Freon 114	<1.4		1.4	ug/m3		23-DEC-19	R4953168

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 15:00							
Matrix: SG							
Canister EPA TO-15							
Freon 114	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Hexachlorobutadiene	<2.1		2.1	ug/m3		23-DEC-19	R4953168
Hexachlorobutadiene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Isooctane	<0.93		0.93	ug/m3		23-DEC-19	R4953168
Isooctane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Isopropyl alcohol	<2.5		2.5	ug/m3		23-DEC-19	R4953168
Isopropyl alcohol	<1.0		1.0	ppb(V)		23-DEC-19	R4953168
Isopropylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
Isopropylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
m&p-Xylene	<1.7		1.7	ug/m3		23-DEC-19	R4953168
m&p-Xylene	<0.40		0.40	ppb(V)		23-DEC-19	R4953168
Methyl ethyl ketone	<0.59		0.59	ug/m3		23-DEC-19	R4953168
Methyl ethyl ketone	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Methyl isobutyl ketone	<0.82		0.82	ug/m3		23-DEC-19	R4953168
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Methylene chloride	<0.69		0.69	ug/m3		23-DEC-19	R4953168
Methylene chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
MTBE	<0.72		0.72	ug/m3		23-DEC-19	R4953168
MTBE	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
n-Heptane	<0.82		0.82	ug/m3		23-DEC-19	R4953168
n-Heptane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
n-Hexane	<0.70		0.70	ug/m3		23-DEC-19	R4953168
n-Hexane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
o-Xylene	<0.87		0.87	ug/m3		23-DEC-19	R4953168
o-Xylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Propylene	<0.34		0.34	ug/m3		23-DEC-19	R4953168
Propylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Styrene	<0.85		0.85	ug/m3		23-DEC-19	R4953168
Styrene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Tetrachloroethylene	<1.4		1.4	ug/m3		23-DEC-19	R4953168
Tetrachloroethylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Tetrahydrofuran	<0.59		0.59	ug/m3		23-DEC-19	R4953168
Tetrahydrofuran	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Toluene	<0.75		0.75	ug/m3		23-DEC-19	R4953168
Toluene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		23-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Trichloroethylene	<1.1		1.1	ug/m3		23-DEC-19	R4953168
Trichloroethylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Trichlorofluoromethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
Trichlorofluoromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Vinyl acetate	<1.8		1.8	ug/m3		23-DEC-19	R4953168
Vinyl acetate	<0.50		0.50	ppb(V)		23-DEC-19	R4953168
Vinyl bromide	<0.87		0.87	ug/m3		23-DEC-19	R4953168
Vinyl bromide	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Vinyl chloride	<0.51		0.51	ug/m3		23-DEC-19	R4953168
Vinyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.9		50-150	%		23-DEC-19	R4953168
Sum of Xylene Isomer Concentrations							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 15:00							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.45		0.45	ppb(V)		23-DEC-19	
Xylenes (Total)	<2.0		2.0	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.00017		0.00010	%		10-DEC-19	R4944650
Ethane	<0.00020		0.00020	%		10-DEC-19	R4944650
Ethene	<0.00020		0.00020	%		10-DEC-19	R4944650
Propane	<0.00020		0.00020	%		10-DEC-19	R4944650
Propene	<0.00020		0.00020	%		10-DEC-19	R4944650
Butane	<0.00020		0.00020	%		10-DEC-19	R4944650
Pentane	<0.00020		0.00020	%		10-DEC-19	R4944650
Canister Information							
Pressure on Receipt	-9.2		-30	in Hg	17-DEC-19	17-DEC-19	R4944737
Canister ID	01400-0340				17-DEC-19	17-DEC-19	R4944737
Regulator ID	G169				17-DEC-19	17-DEC-19	R4944737
Batch Proof ID	191119.123				17-DEC-19	17-DEC-19	R4944737

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-2 19DUP01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 12:00							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	29		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	41		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	62		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	<15		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	98.6		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	75.8		1.0	%		12-DEC-19	R4944389
Oxygen	20.1		0.10	%		12-DEC-19	R4944389
Carbon Dioxide	1.73		0.050	%		12-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		12-DEC-19	R4944389
Methane	<0.050		0.050	%		12-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<2.6		2.6	ug/m3		23-DEC-19	R4953168
Naphthalene	<0.50		0.50	ppb(V)		23-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.3		50-150	%		23-DEC-19	R4953168
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		23-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1-Dichloroethane	<0.81		0.81	ug/m3		23-DEC-19	R4953168
1,1-Dichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,1-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
1,1-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		23-DEC-19	R4953168
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dibromoethane	<1.5		1.5	ug/m3		23-DEC-19	R4953168
1,2-Dibromoethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichloroethane	<0.81		0.81	ug/m3		23-DEC-19	R4953168
1,2-Dichloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,2-Dichloropropane	<0.92		0.92	ug/m3		23-DEC-19	R4953168
1,2-Dichloropropane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3-Butadiene	<0.44		0.44	ug/m3		23-DEC-19	R4953168
1,3-Butadiene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-2 19DUP01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 12:00							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		23-DEC-19	R4953168
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
1,4-Dioxane	<0.72		0.72	ug/m3		23-DEC-19	R4953168
1,4-Dioxane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
2-Hexanone	<4.1		4.1	ug/m3		23-DEC-19	R4953168
2-Hexanone	<1.0		1.0	ppb(V)		23-DEC-19	R4953168
4-Ethyltoluene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
4-Ethyltoluene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Acetone	3.5		1.2	ug/m3		23-DEC-19	R4953168
Acetone	1.47		0.50	ppb(V)		23-DEC-19	R4953168
Allyl chloride	<0.63		0.63	ug/m3		23-DEC-19	R4953168
Allyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Benzene	<0.64		0.64	ug/m3		23-DEC-19	R4953168
Benzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Benzyl chloride	<1.0		1.0	ug/m3		23-DEC-19	R4953168
Benzyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromodichloromethane	<1.3		1.3	ug/m3		23-DEC-19	R4953168
Bromodichloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromoform	<2.1		2.1	ug/m3		23-DEC-19	R4953168
Bromoform	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Bromomethane	<0.78		0.78	ug/m3		23-DEC-19	R4953168
Bromomethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Carbon Disulfide	<0.62		0.62	ug/m3		23-DEC-19	R4953168
Carbon Disulfide	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Carbon Tetrachloride	<1.3		1.3	ug/m3		23-DEC-19	R4953168
Carbon Tetrachloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chlorobenzene	<0.92		0.92	ug/m3		23-DEC-19	R4953168
Chlorobenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloroethane	<0.53		0.53	ug/m3		23-DEC-19	R4953168
Chloroethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloroform	<0.98		0.98	ug/m3		23-DEC-19	R4953168
Chloroform	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Chloromethane	<0.41		0.41	ug/m3		23-DEC-19	R4953168
Chloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		23-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Cyclohexane	<0.69		0.69	ug/m3		23-DEC-19	R4953168
Cyclohexane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Dibromochloromethane	<1.7		1.7	ug/m3		23-DEC-19	R4953168
Dibromochloromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Dichlorodifluoromethane	2.40		0.99	ug/m3		23-DEC-19	R4953168
Dichlorodifluoromethane	0.49		0.20	ppb(V)		23-DEC-19	R4953168
Ethyl acetate	<0.72		0.72	ug/m3		23-DEC-19	R4953168
Ethyl acetate	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Ethylbenzene	<0.87		0.87	ug/m3		23-DEC-19	R4953168
Ethylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Freon 113	<1.5		1.5	ug/m3		23-DEC-19	R4953168
Freon 113	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Freon 114	<1.4		1.4	ug/m3		23-DEC-19	R4953168

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-2 19DUP01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 12:00							
Matrix: SG							
Canister EPA TO-15							
Freon 114	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Hexachlorobutadiene	<2.1		2.1	ug/m3		23-DEC-19	R4953168
Hexachlorobutadiene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Isooctane	<0.93		0.93	ug/m3		23-DEC-19	R4953168
Isooctane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Isopropyl alcohol	<2.5		2.5	ug/m3		23-DEC-19	R4953168
Isopropyl alcohol	<1.0		1.0	ppb(V)		23-DEC-19	R4953168
Isopropylbenzene	<0.98		0.98	ug/m3		23-DEC-19	R4953168
Isopropylbenzene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
m&p-Xylene	6.0		1.7	ug/m3		23-DEC-19	R4953168
m&p-Xylene	1.38		0.40	ppb(V)		23-DEC-19	R4953168
Methyl ethyl ketone	<0.59		0.59	ug/m3		23-DEC-19	R4953168
Methyl ethyl ketone	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Methyl isobutyl ketone	<0.82		0.82	ug/m3		23-DEC-19	R4953168
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Methylene chloride	<0.69		0.69	ug/m3		23-DEC-19	R4953168
Methylene chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
MTBE	<0.72		0.72	ug/m3		23-DEC-19	R4953168
MTBE	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
n-Heptane	<0.82		0.82	ug/m3		23-DEC-19	R4953168
n-Heptane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
n-Hexane	<0.70		0.70	ug/m3		23-DEC-19	R4953168
n-Hexane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
o-Xylene	1.38		0.87	ug/m3		23-DEC-19	R4953168
o-Xylene	0.32		0.20	ppb(V)		23-DEC-19	R4953168
Propylene	<0.34		0.34	ug/m3		23-DEC-19	R4953168
Propylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Styrene	<0.85		0.85	ug/m3		23-DEC-19	R4953168
Styrene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Tetrachloroethylene	<1.4		1.4	ug/m3		23-DEC-19	R4953168
Tetrachloroethylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Tetrahydrofuran	<0.59		0.59	ug/m3		23-DEC-19	R4953168
Tetrahydrofuran	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Toluene	2.67		0.75	ug/m3		23-DEC-19	R4953168
Toluene	0.71		0.20	ppb(V)		23-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		23-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		23-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Trichloroethylene	<1.1		1.1	ug/m3		23-DEC-19	R4953168
Trichloroethylene	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Trichlorofluoromethane	<1.1		1.1	ug/m3		23-DEC-19	R4953168
Trichlorofluoromethane	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Vinyl acetate	<1.8		1.8	ug/m3		23-DEC-19	R4953168
Vinyl acetate	<0.50		0.50	ppb(V)		23-DEC-19	R4953168
Vinyl bromide	<0.87		0.87	ug/m3		23-DEC-19	R4953168
Vinyl bromide	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Vinyl chloride	<0.51		0.51	ug/m3		23-DEC-19	R4953168
Vinyl chloride	<0.20		0.20	ppb(V)		23-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.3		50-150	%		23-DEC-19	R4953168
Sum of Xylene Isomer Concentrations							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-2 19DUP01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 12:00							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	1.70		0.45	ppb(V)		23-DEC-19	
Xylenes (Total)	7.4		2.0	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.00013		0.00010	%		10-DEC-19	R4944650
Ethane	<0.00020		0.00020	%		10-DEC-19	R4944650
Ethene	<0.00020		0.00020	%		10-DEC-19	R4944650
Propane	<0.00020		0.00020	%		10-DEC-19	R4944650
Propene	<0.00020		0.00020	%		10-DEC-19	R4944650
Butane	<0.00020		0.00020	%		10-DEC-19	R4944650
Pentane	<0.00020		0.00020	%		10-DEC-19	R4944650
Canister Information							
Pressure on Receipt	-9.2		-30	in Hg	17-DEC-19	17-DEC-19	R4944737
Canister ID	01400-0472				17-DEC-19	17-DEC-19	R4944737
Regulator ID	G169				17-DEC-19	17-DEC-19	R4944737
Batch Proof ID	191119.101				17-DEC-19	17-DEC-19	R4944737

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393598-3 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 17:20							
Matrix: SG							
Miscellaneous Parameters							
Air volume	.06			L		10-DEC-19	R4939247
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		18-DEC-19	R4945277
D3(CVMS)	<10		10	ng		18-DEC-19	R4945277
D4(CVMS)	<170		170	ug/m3		18-DEC-19	R4945277
D4(CVMS)	<10		10	ng		18-DEC-19	R4945277
D5(CVMS)	<170		170	ug/m3		18-DEC-19	R4945277
D5(CVMS)	<10		10	ng		18-DEC-19	R4945277
D6(CVMS)	<170		170	ug/m3		18-DEC-19	R4945277
D6(CVMS)	<10		10	ng		18-DEC-19	R4945277
MM(LVMS)	<170		170	ug/m3		18-DEC-19	R4945277
MM(LVMS)	<10		10	ng		18-DEC-19	R4945277
MDM(LVMS)	<170		170	ug/m3		18-DEC-19	R4945277
MDM(LVMS)	<10		10	ng		18-DEC-19	R4945277
MD2M(LVMS)	<170		170	ug/m3		18-DEC-19	R4945277
MD2M(LVMS)	<10		10	ng		18-DEC-19	R4945277
MD3M(LVMS)	<170		170	ug/m3		18-DEC-19	R4945277
MD3M(LVMS)	<10		10	ng		18-DEC-19	R4945277
Surrogate: 4-Bromofluorobenzene	103.6		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150636SVI					13-DEC-19	R4942791
Batch Proof ID	19-Nov-19					13-DEC-19	R4942791
Tube Usage Number	N/A					13-DEC-19	R4942791
Tube Manufacturer Date	N/A					13-DEC-19	R4942791

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AIR VOLUME-WT	Misc.	Air volume (L)	DATA ENTRY
ALIPH/AROM-GCMS-WT	Canister	Aliphatic/Aromatic PHC Sub-Fractionation	EPA TO-15, Atlantic RBCA
<p>This analysis is performed using procedures adapted from EPA TO-15 & Atlantic RBCA. A volume of air is removed from a canister & injected into a GCMS with preconcentrator for analysis. The concentrations of the hydrocarbon aliphatic & aromatic sub-fractions are calculated using gas standards. The canister samples will be retained for 7 calendar days after final report.</p>			
BTEX+NAPH-GCMS-WT	Canister	BTEX and Naphthalene	EPA TO-15
<p>This analysis is performed using procedures adapted from EPA Method TO-15. Air samples are collected into cleaned evacuated canisters. A volume of air sample is transferred from the canister to a preconcentrator system where the analytes are trapped & focused. The analytes are then thermally desorbed into a GC-MSD for analysis. Test results are not blank corrected unless indicated by a qualifier.</p> <p>Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your account manager.</p>			
C1-C5-FID-WT	Canister	Select list of 7 C1-C5 hydrocarbon gases	EPA Method 3C & ASTM D1946
<p>This analysis is performed using procedures adapted from ASTM D1946/EPA Method 3C. Air samples are collected into cleaned evacuated canisters. A volume of air is removed from the canister & injected into a GC-FID for analysis. Hydrocarbon gas concentrations are calculated against a gas standard. Test results are not blank corrected unless indicated by a qualifier.</p> <p>Canister samples will be retained for 7 calendar days after final report. If you require longer canister storage time, please contact your account manager.</p>			
CAN-DATA-WT	Canister	Canister Information	EPA TO-15
<p>Batch Proof ID, Canister ID, Pressure on Receipt, Regulator ID.</p>			
F1-F2-GCMS-WT	Canister	Total F1and F2 fractions (not corrected)	EPATO-15
<p>This analysis is performed using procedures adapted from EPA Method TO-15. Air samples are collected into cleaned evacuated canisters. A volume of air sample is transferred from the canister to a preconcentrator system where the analytes are trapped & focused. The analytes are then thermally desorbed into a GC-MSD for analysis. Test results are not blank corrected unless indicated by a qualifier.</p> <p>Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your account manager.</p>			
FIXED GASES-TCD-WT	Canister	High Level Fixed Gases by TCD	EPA Method 3C & ASTM D1946
<p>This analysis is performed using procedures adapted from EPA Method 3C & ASTM D1946. Air samples are collected into cleaned evacuated canisters. A volume of air is removed from the canister and injected by means of a gas-sampling/backflush valve onto a series of packed GC columns and measured using a thermal conductivity detector (TCD).</p> <p>Oxygen is not separated from Argon.</p> <p>Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your account manager.</p>			
SILOXANES-GCMS-WT	Tube	Linear & Cyclic Methyl Siloxanes	EPA TO-17
<p>This analysis is performed using procedures adapted from EPA Method TO-17, ISO Method 16017 & NIOSH Method 2549. Air samples actively collected on PE VI TD tubes are thermally stripped & the analytes are re-collected on trapping material of a focusing trap in the thermal desorber. The analytes are then thermally desorbed into a GC-MSD for analysis. Test results are not blank corrected unless indicated by a qualifier.</p> <p>This analysis was performed under AIHA-IHLAP Scope of Accreditation, GC/MS Field of Testing which is compliant with AIHA-LAP, LLC Accreditation Policy Modules & ISO/IEC 17025:2005 Standard.</p> <p>TD tube samples will be retained for 7 calendar days after final report. If you require a longer TD tube storage time, please contact your account manager.</p>			
TO15-GCMS-WT	Canister	Canister EPA TO-15	EPA TO-15
<p>This analysis is performed using procedures adapted from EPA Method TO-15. Air samples are collected into cleaned evacuated canisters. A volume of air sample is transferred from the canister to a preconcentrator system where the analytes are trapped & focused. The analytes are then thermally desorbed into a GC-MSD for analysis. Test results are not blank corrected unless indicated by a qualifier.</p> <p>Canister samples will be retained for 7 calendar days after final report. If you require a longer canister storage time, please contact your account manager.</p>			
XYLENES-SUM-CALC-WT	Canister	Sum of Xylene Isomer Concentrations	CALCULATION

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
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WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
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Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg wwt - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS LABORATORY GROUP SOIL SALINITY CONVERSION

L2393598

Lab ID	Sample ID				Lab ID	Sample ID			

"Calculations are as per:
Methods of Analysis for Soils, Plants and Waters
Homer D. Chapman and Parker F. Pratt
University of California, Riverside, Cl.
August, 1961."



Quality Control Report

Workorder: L2393598

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALIPH/AROM-GCMS-WT Canister								
Batch R4953011								
WG3247105-2 LCS								
Aliphatic C6-C8			121.6		%		50-150	23-DEC-19
Aliphatic C>8-C10			101.0		%		50-150	23-DEC-19
Aliphatic C>10-C12			117.1		%		50-150	23-DEC-19
Aliphatic C>12-C16			128.7		%		50-150	23-DEC-19
Aromatic C>8-C10			105.7		%		50-150	23-DEC-19
Aromatic C>10-C12			101.0		%		50-150	23-DEC-19
Aromatic C>12-C16			87.2		%		50-150	23-DEC-19
WG3247105-3 LCSD WG3247105-2								
Aliphatic C6-C8		121.6	128.6		%	5.6	50	23-DEC-19
Aliphatic C>8-C10		101.0	103.8		%	2.8	50	23-DEC-19
Aliphatic C>10-C12		117.1	119.5		%	2.0	50	23-DEC-19
Aliphatic C>12-C16		128.7	136.9		%	6.2	50	23-DEC-19
Aromatic C>8-C10		105.7	108.2		%	2.3	50	23-DEC-19
Aromatic C>10-C12		101.0	104.3		%	3.2	50	23-DEC-19
Aromatic C>12-C16		87.2	95.6		%	9.2	50	23-DEC-19
WG3247105-1 MB								
Aliphatic C6-C8			<15		ug/m3		15	23-DEC-19
Aliphatic C>8-C10			<15		ug/m3		15	23-DEC-19
Aliphatic C>10-C12			<15		ug/m3		15	23-DEC-19
Aliphatic C>12-C16			<30		ug/m3		30	23-DEC-19
Aromatic C>8-C10			<15		ug/m3		15	23-DEC-19
Aromatic C>10-C12			<15		ug/m3		15	23-DEC-19
Aromatic C>12-C16			<30		ug/m3		30	23-DEC-19
BTEX+NAPH-GCMS-WT Canister								
Batch R4953168								
WG3247636-4 DUP L2393586-1								
Naphthalene		<0.50	<0.50	RPD-NA	ppb(V)	N/A	30	23-DEC-19
WG3247636-2 LCS								
Naphthalene			111.7		%		70-130	23-DEC-19
WG3247636-3 LCSD WG3247636-2								
Naphthalene		111.7	96.1		%	15	50	23-DEC-19
WG3247636-1 MB								
Naphthalene			<0.50		ppb(V)		0.5	23-DEC-19
Surrogate: 4-Bromofluorobenzene			94.2		%		50-150	23-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C1-C5-FID-WT		Canister						
Batch	R4944650							
WG3239341-4	DUP	L2393570-1						
Methane		0.00029	0.00027		%	7.3	20	10-DEC-19
Ethane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Ethene		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Propane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Propene		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Butane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Pentane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
WG3239341-1	LCS							
Methane			78.8		%		70-130	10-DEC-19
Ethane			88.3		%		70-130	10-DEC-19
Ethene			84.4		%		70-130	10-DEC-19
Propane			88.8		%		70-130	10-DEC-19
Propene			96.7		%		70-130	10-DEC-19
Pentane			92.4		%		70-130	10-DEC-19
WG3239341-2	LCSD	WG3239341-1						
Methane		78.8	82.3		%	4.4	50	10-DEC-19
Ethane		88.3	89.4		%	1.2	50	10-DEC-19
Ethene		84.4	84.6		%	0.1	50	10-DEC-19
Propane		88.8	88.5		%	0.4	50	10-DEC-19
Propene		96.7	96.9		%	0.2	50	10-DEC-19
Pentane		92.4	92.2		%	0.2	50	10-DEC-19
WG3239341-3	MB							
Methane			<0.00010		%		0.0001	10-DEC-19
Ethane			<0.00020		%		0.0002	10-DEC-19
Ethene			<0.00020		%		0.0002	10-DEC-19
Propane			<0.00020		%		0.0002	10-DEC-19
Propene			<0.00020		%		0.0002	10-DEC-19
Butane			<0.00020		%		0.0002	10-DEC-19
Pentane			<0.00020		%		0.0002	10-DEC-19
CAN-DATA-WT		Canister						
Batch	R4944737							
WG3244055-1	MB							
Pressure on Receipt			-29.8		in Hg			17-DEC-19



Quality Control Report

Workorder: L2393598

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Client: TETRA TECH CANADA INC.
 110, 140 Quarry Park Blvd SE
 Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-F2-GCMS-WT		Canister						
Batch	R4953011							
WG3247105-2	LCS							
F1 (C6-C10)			110.1		%		50-150	23-DEC-19
WG3247105-3	LCSD	WG3247105-2						
F1 (C6-C10)		110.1	108.4		%	1.5	50	23-DEC-19
WG3247105-1	MB							
F1 (C6-C10)			<15		ug/m3		15	23-DEC-19
F2 (C10-C16)			<15		ug/m3		15	23-DEC-19
Surrogate: 4-Bromofluorobenzene			98.3		%		50-150	23-DEC-19
FIXED GASES-TCD-WT		Canister						
Batch	R4944389							
WG3236065-8	DUP	L2393575-4						
Nitrogen		75.8	76.0		%	0.3	30	13-DEC-19
Oxygen		19.6	19.6		%	0.3	30	13-DEC-19
Carbon Dioxide		2.84	2.76		%	2.7	30	13-DEC-19
Carbon Monoxide		<0.050	<0.050	RPD-NA	%	N/A	30	13-DEC-19
Methane		<0.050	<0.050	RPD-NA	%	N/A	30	13-DEC-19
WG3236065-5	LCS							
Nitrogen			98.5		%		70-130	13-DEC-19
Oxygen			97.5		%		70-130	13-DEC-19
Carbon Dioxide			95.4		%		70-130	13-DEC-19
Carbon Monoxide			95.7		%		70-130	13-DEC-19
Methane			98.3		%		70-130	13-DEC-19
WG3236065-6	LCSD	WG3236065-5						
Nitrogen		98.5	98.6		%	0.1	25	13-DEC-19
Oxygen		97.5	97.6		%	0.2	25	13-DEC-19
Carbon Dioxide		95.4	96.1		%	0.8	25	13-DEC-19
Carbon Monoxide		95.7	95.9		%	0.2	25	13-DEC-19
Methane		98.3	98.3		%	0.0	25	13-DEC-19
WG3236065-7	MB							
Nitrogen			<1.0		%		1	13-DEC-19
Oxygen			<0.10		%		0.1	13-DEC-19
Carbon Dioxide			<0.050		%		0.05	13-DEC-19
Carbon Monoxide			<0.050		%		0.05	13-DEC-19
Methane			<0.050		%		0.05	13-DEC-19
TO15-GCMS-WT	Canister							



Quality Control Report

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-4	DUP	L2393586-1						
1,1,1-Trichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,1,2,2-Tetrachloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,1,2-Trichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,1-Dichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,1-Dichloroethene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2,4-Trichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2,4-Trimethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2-Dibromoethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2-Dichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,2-Dichloropropane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,3,5-Trimethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,3-Butadiene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,3-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,4-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
1,4-Dioxane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
2-Hexanone		<1.0	<1.0	RPD-NA	ppb(V)	N/A	30	23-DEC-19
4-Ethyltoluene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Acetone		1.97	1.94		ppb(V)	1.5	30	23-DEC-19
Allyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Benzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Benzyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Bromodichloromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Bromoform		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Bromomethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Carbon Disulfide		1.30	1.28		ppb(V)	1.2	30	23-DEC-19
Carbon Tetrachloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Chlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Chloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Chloroform		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Chloromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
cis-1,2-Dichloroethene		0.78	0.72		ppb(V)	8.0	30	23-DEC-19
cis-1,3-Dichloropropene		<0.20	<0.20		ppb(V)			23-DEC-19



Quality Control Report

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Report Date: 24-DEC-19

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-4	DUP	L2393586-1						
cis-1,3-Dichloropropene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Cyclohexane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Dibromochloromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Dichlorodifluoromethane		0.69	0.68		ppb(V)	2.6	30	23-DEC-19
Ethyl acetate		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Ethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Freon 113		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Freon 114		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Hexachlorobutadiene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Isooctane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Isopropyl alcohol		<1.0	<1.0	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Isopropylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	50	23-DEC-19
m&p-Xylene		0.72	0.70		ppb(V)	3.4	30	23-DEC-19
Methyl ethyl ketone		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Methyl isobutyl ketone		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Methylene chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
MTBE		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
n-Heptane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
n-Hexane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
o-Xylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Propylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Styrene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Tetrachloroethylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Tetrahydrofuran		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Toluene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
trans-1,2-Dichloroethene		0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
trans-1,3-Dichloropropene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Trichloroethylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Trichlorofluoromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Vinyl acetate		<0.50	<0.50	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Vinyl bromide		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
Vinyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	23-DEC-19
WG3247636-2	LCS							



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Client: TETRA TECH CANADA INC.
 110, 140 Quarry Park Blvd SE
 Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT	Canister							
Batch	R4953168							
WG3247636-2 LCS								
1,1,1-Trichloroethane			88.6		%		70-130	23-DEC-19
1,1,2,2-Tetrachloroethane			91.9		%		70-130	23-DEC-19
1,1,2-Trichloroethane			86.6		%		70-130	23-DEC-19
1,1-Dichloroethane			92.4		%		70-130	23-DEC-19
1,1-Dichloroethene			90.6		%		70-130	23-DEC-19
1,2,4-Trichlorobenzene			108.3		%		70-130	23-DEC-19
1,2,4-Trimethylbenzene			92.4		%		70-130	23-DEC-19
1,2-Dibromoethane			90.8		%		70-130	23-DEC-19
1,2-Dichlorobenzene			92.5		%		70-130	23-DEC-19
1,2-Dichloroethane			90.4		%		70-130	23-DEC-19
1,2-Dichloropropane			90.0		%		70-130	23-DEC-19
1,3,5-Trimethylbenzene			90.6		%		70-130	23-DEC-19
1,3-Butadiene			89.8		%		70-130	23-DEC-19
1,3-Dichlorobenzene			91.1		%		70-130	23-DEC-19
1,4-Dichlorobenzene			94.2		%		70-130	23-DEC-19
1,4-Dioxane			92.9		%		70-130	23-DEC-19
2-Hexanone			92.2		%		70-130	23-DEC-19
4-Ethyltoluene			90.5		%		70-130	23-DEC-19
Acetone			91.2		%		70-130	23-DEC-19
Allyl chloride			88.3		%		70-130	23-DEC-19
Benzene			92.1		%		70-130	23-DEC-19
Benzyl chloride			87.4		%		70-130	23-DEC-19
Bromodichloromethane			88.1		%		70-130	23-DEC-19
Bromoform			88.4		%		70-130	23-DEC-19
Bromomethane			92.9		%		70-130	23-DEC-19
Carbon Disulfide			84.8		%		70-130	23-DEC-19
Carbon Tetrachloride			87.6		%		70-130	23-DEC-19
Chlorobenzene			90.8		%		70-130	23-DEC-19
Chloroethane			90.9		%		70-130	23-DEC-19
Chloroform			94.1		%		70-130	23-DEC-19
Chloromethane			93.2		%		70-130	23-DEC-19
cis-1,2-Dichloroethene			89.8		%		70-130	23-DEC-19
cis-1,3-Dichloropropene			89.0		%		70-130	23-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-2	LCS							
Cyclohexane			92.0		%		70-130	23-DEC-19
Dibromochloromethane			86.9		%		70-130	23-DEC-19
Dichlorodifluoromethane			89.3		%		70-130	23-DEC-19
Ethyl acetate			89.3		%		70-130	23-DEC-19
Ethylbenzene			89.4		%		70-130	23-DEC-19
Freon 113			89.0		%		70-130	23-DEC-19
Freon 114			95.4		%		70-130	23-DEC-19
Hexachlorobutadiene			103.3		%		70-130	23-DEC-19
Isooctane			90.2		%		70-130	23-DEC-19
Isopropyl alcohol			83.3		%		70-130	23-DEC-19
Isopropylbenzene			87.4		%		50-150	23-DEC-19
m&p-Xylene			91.2		%		70-130	23-DEC-19
Methyl ethyl ketone			89.5		%		70-130	23-DEC-19
Methyl isobutyl ketone			89.1		%		70-130	23-DEC-19
Methylene chloride			95.2		%		70-130	23-DEC-19
MTBE			90.7		%		70-130	23-DEC-19
n-Heptane			89.9		%		70-130	23-DEC-19
n-Hexane			90.8		%		70-130	23-DEC-19
o-Xylene			90.5		%		70-130	23-DEC-19
Propylene			88.6		%		70-130	23-DEC-19
Styrene			89.1		%		70-130	23-DEC-19
Tetrachloroethylene			90.2		%		70-130	23-DEC-19
Tetrahydrofuran			92.0		%		70-130	23-DEC-19
Toluene			91.9		%		70-130	23-DEC-19
trans-1,2-Dichloroethene			91.7		%		70-130	23-DEC-19
trans-1,3-Dichloropropene			87.5		%		70-130	23-DEC-19
Trichloroethylene			91.3		%		70-130	23-DEC-19
Trichlorofluoromethane			89.8		%		70-130	23-DEC-19
Vinyl acetate			89.2		%		70-130	23-DEC-19
Vinyl bromide			92.1		%		70-130	23-DEC-19
Vinyl chloride			89.8		%		70-130	23-DEC-19
WG3247636-3	LCS	WG3247636-2						
1,1,1-Trichloroethane		88.6	77.4		%	13	25	23-DEC-19
1,1,2,2-Tetrachloroethane		91.9	80.2		%	14	25	23-DEC-19

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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-3	LCSD	WG3247636-2						
1,1,2-Trichloroethane		86.6	74.9		%	14	25	23-DEC-19
1,1-Dichloroethane		92.4	77.3		%	18	25	23-DEC-19
1,1-Dichloroethene		90.6	75.4		%	18	25	23-DEC-19
1,2,4-Trichlorobenzene		108.3	91.8		%	16	25	23-DEC-19
1,2,4-Trimethylbenzene		92.4	79.2		%	15	25	23-DEC-19
1,2-Dibromoethane		90.8	77.8		%	15	25	23-DEC-19
1,2-Dichlorobenzene		92.5	79.7		%	15	25	23-DEC-19
1,2-Dichloroethane		90.4	78.5		%	14	25	23-DEC-19
1,2-Dichloropropane		90.0	78.6		%	13	25	23-DEC-19
1,3,5-Trimethylbenzene		90.6	77.2		%	16	25	23-DEC-19
1,3-Butadiene		89.8	79.7		%	12	25	23-DEC-19
1,3-Dichlorobenzene		91.1	78.3		%	15	25	23-DEC-19
1,4-Dichlorobenzene		94.2	81.2		%	15	25	23-DEC-19
1,4-Dioxane		92.9	82.0		%	12	25	23-DEC-19
2-Hexanone		92.2	81.0		%	13	25	23-DEC-19
4-Ethyltoluene		90.5	78.4		%	14	25	23-DEC-19
Acetone		91.2	77.4		%	16	25	23-DEC-19
Allyl chloride		88.3	77.2		%	13	25	23-DEC-19
Benzene		92.1	78.2		%	16	25	23-DEC-19
Benzyl chloride		87.4	76.4		%	13	25	23-DEC-19
Bromodichloromethane		88.1	77.3		%	13	25	23-DEC-19
Bromoform		88.4	74.5		%	17	25	23-DEC-19
Bromomethane		92.9	79.7		%	15	25	23-DEC-19
Carbon Disulfide		84.8	73.4		%	15	25	23-DEC-19
Carbon Tetrachloride		87.6	77.2		%	13	25	23-DEC-19
Chlorobenzene		90.8	78.1		%	15	25	23-DEC-19
Chloroethane		90.9	79.4		%	13	25	23-DEC-19
Chloroform		94.1	80.5		%	16	25	23-DEC-19
Chloromethane		93.2	79.5		%	16	25	23-DEC-19
cis-1,2-Dichloroethene		89.8	79.2		%	12	25	23-DEC-19
cis-1,3-Dichloropropene		89.0	76.0		%	16	25	23-DEC-19
Cyclohexane		92.0	77.5		%	17	25	23-DEC-19
Dibromochloromethane		86.9	76.1		%			23-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-3	LCSD	WG3247636-2						
Dibromochloromethane		86.9	76.1		%	13	25	23-DEC-19
Dichlorodifluoromethane		89.3	77.0		%	15	25	23-DEC-19
Ethyl acetate		89.3	75.4		%	17	25	23-DEC-19
Ethylbenzene		89.4	78.0		%	14	25	23-DEC-19
Freon 113		89.0	75.4		%	17	25	23-DEC-19
Freon 114		95.4	82.0		%	15	25	23-DEC-19
Hexachlorobutadiene		103.3	88.9		%	15	25	23-DEC-19
Isooctane		90.2	79.3		%	13	25	23-DEC-19
Isopropyl alcohol		83.3	72.3		%	14	25	23-DEC-19
Isopropylbenzene		87.4	76.3		%	14	50	23-DEC-19
m&p-Xylene		91.2	80.3		%	13	25	23-DEC-19
Methyl ethyl ketone		89.5	78.2		%	13	25	23-DEC-19
Methyl isobutyl ketone		89.1	75.6		%	16	25	23-DEC-19
Methylene chloride		95.2	76.9		%	21	25	23-DEC-19
MTBE		90.7	77.2		%	16	25	23-DEC-19
n-Heptane		89.9	77.9		%	14	25	23-DEC-19
n-Hexane		90.8	78.3		%	15	25	23-DEC-19
o-Xylene		90.5	78.6		%	14	25	23-DEC-19
Propylene		88.6	74.1		%	18	25	23-DEC-19
Styrene		89.1	76.4		%	15	25	23-DEC-19
Tetrachloroethylene		90.2	76.6		%	16	25	23-DEC-19
Tetrahydrofuran		92.0	79.5		%	15	25	23-DEC-19
Toluene		91.9	79.4		%	15	25	23-DEC-19
trans-1,2-Dichloroethene		91.7	77.5		%	17	25	23-DEC-19
trans-1,3-Dichloropropene		87.5	76.1		%	14	25	23-DEC-19
Trichloroethylene		91.3	77.8		%	16	25	23-DEC-19
Trichlorofluoromethane		89.8	77.5		%	15	25	23-DEC-19
Vinyl acetate		89.2	99.98		%	11	25	23-DEC-19
Vinyl bromide		92.1	78.8		%	16	25	23-DEC-19
Vinyl chloride		89.8	78.0		%	14	25	23-DEC-19
WG3247636-1	MB							
1,1,1-Trichloroethane			<0.20		ppb(V)		0.2	23-DEC-19
1,1,2,2-Tetrachloroethane			<0.20		ppb(V)		0.2	23-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-1 MB								
1,1,2-Trichloroethane			<0.20		ppb(V)		0.2	23-DEC-19
1,1-Dichloroethane			<0.20		ppb(V)		0.2	23-DEC-19
1,1-Dichloroethene			<0.20		ppb(V)		0.2	23-DEC-19
1,2,4-Trichlorobenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,2,4-Trimethylbenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,2-Dibromoethane			<0.20		ppb(V)		0.2	23-DEC-19
1,2-Dichlorobenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,2-Dichloroethane			<0.20		ppb(V)		0.2	23-DEC-19
1,2-Dichloropropane			<0.20		ppb(V)		0.2	23-DEC-19
1,3,5-Trimethylbenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,3-Butadiene			<0.20		ppb(V)		0.2	23-DEC-19
1,3-Dichlorobenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,4-Dichlorobenzene			<0.20		ppb(V)		0.2	23-DEC-19
1,4-Dioxane			<0.20		ppb(V)		0.2	23-DEC-19
2-Hexanone			<1.0		ppb(V)		1	23-DEC-19
4-Ethyltoluene			<0.20		ppb(V)		0.2	23-DEC-19
Acetone			<0.50		ppb(V)		0.5	23-DEC-19
Allyl chloride			<0.20		ppb(V)		0.2	23-DEC-19
Benzene			<0.20		ppb(V)		0.2	23-DEC-19
Benzyl chloride			<0.20		ppb(V)		0.2	23-DEC-19
Bromodichloromethane			<0.20		ppb(V)		0.2	23-DEC-19
Bromoform			<0.20		ppb(V)		0.2	23-DEC-19
Bromomethane			<0.20		ppb(V)		0.2	23-DEC-19
Carbon Disulfide			<0.20		ppb(V)		0.2	23-DEC-19
Carbon Tetrachloride			<0.20		ppb(V)		0.2	23-DEC-19
Chlorobenzene			<0.20		ppb(V)		0.2	23-DEC-19
Chloroethane			<0.20		ppb(V)		0.2	23-DEC-19
Chloroform			<0.20		ppb(V)		0.2	23-DEC-19
Chloromethane			<0.20		ppb(V)		0.2	23-DEC-19
cis-1,2-Dichloroethene			<0.20		ppb(V)		0.2	23-DEC-19
cis-1,3-Dichloropropene			<0.20		ppb(V)		0.2	23-DEC-19
Cyclohexane			<0.20		ppb(V)		0.2	23-DEC-19
Dibromochloromethane			<0.20		ppb(V)		0.2	23-DEC-19



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TO15-GCMS-WT		Canister						
Batch	R4953168							
WG3247636-1 MB								
Dichlorodifluoromethane			<0.20		ppb(V)		0.2	23-DEC-19
Ethyl acetate			<0.20		ppb(V)		0.2	23-DEC-19
Ethylbenzene			<0.20		ppb(V)		0.2	23-DEC-19
Freon 113			<0.20		ppb(V)		0.2	23-DEC-19
Freon 114			<0.20		ppb(V)		0.2	23-DEC-19
Hexachlorobutadiene			<0.20		ppb(V)		0.2	23-DEC-19
Isooctane			<0.20		ppb(V)		0.2	23-DEC-19
Isopropyl alcohol			<1.0		ppb(V)		1	23-DEC-19
Isopropylbenzene			<0.20		ppb(V)		0.2	23-DEC-19
m&p-Xylene			<0.40		ppb(V)		0.4	23-DEC-19
Methyl ethyl ketone			<0.20		ppb(V)		0.2	23-DEC-19
Methyl isobutyl ketone			<0.20		ppb(V)		0.2	23-DEC-19
Methylene chloride			<0.20		ppb(V)		0.2	23-DEC-19
MTBE			<0.20		ppb(V)		0.2	23-DEC-19
n-Heptane			<0.20		ppb(V)		0.2	23-DEC-19
n-Hexane			<0.20		ppb(V)		0.2	23-DEC-19
o-Xylene			<0.20		ppb(V)		0.2	23-DEC-19
Propylene			<0.20		ppb(V)		0.2	23-DEC-19
Styrene			<0.20		ppb(V)		0.2	23-DEC-19
Tetrachloroethylene			<0.20		ppb(V)		0.2	23-DEC-19
Tetrahydrofuran			<0.20		ppb(V)		0.2	23-DEC-19
Toluene			<0.20		ppb(V)		0.2	23-DEC-19
trans-1,2-Dichloroethene			<0.20		ppb(V)		0.2	23-DEC-19
trans-1,3-Dichloropropene			<0.20		ppb(V)		0.2	23-DEC-19
Trichloroethylene			<0.20		ppb(V)		0.2	23-DEC-19
Trichlorofluoromethane			<0.20		ppb(V)		0.2	23-DEC-19
Vinyl acetate			<0.50		ppb(V)		0.5	23-DEC-19
Vinyl bromide			<0.20		ppb(V)		0.2	23-DEC-19
Vinyl chloride			<0.20		ppb(V)		0.2	23-DEC-19
Surrogate: 4-Bromofluorobenzene			94.2		%		50-150	23-DEC-19

SILOXANES-GCMS-WT **Tube**



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Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Contact: Darby Madalena

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SILOXANES-GCMS-WT								
	Tube							
Batch	R4945277							
WG3242059-2	LCS							
D3(CVMS)			116.0		%		70-130	18-DEC-19
D4(CVMS)			117.6		%		70-130	18-DEC-19
D5(CVMS)			127.7		%		70-130	18-DEC-19
D6(CVMS)			121.6		%		70-130	18-DEC-19
MM(LVMS)			122.0		%		70-130	18-DEC-19
MDM(LVMS)			124.9		%		70-130	18-DEC-19
MD2M(LVMS)			118.9		%		70-130	18-DEC-19
MD3M(LVMS)			114.1		%		70-130	18-DEC-19
WG3242059-3	LCSD	WG3242059-2						
D3(CVMS)		116.0	118.1		%	1.7	50	18-DEC-19
D4(CVMS)		117.6	121.2		%	3.0	50	18-DEC-19
D5(CVMS)		127.7	131.7		%	3.1	50	18-DEC-19
D6(CVMS)		121.6	125.5		%	3.2	50	18-DEC-19
MM(LVMS)		122.0	94.5		%	25	50	18-DEC-19
MDM(LVMS)		124.9	123.7		%	0.9	50	18-DEC-19
MD2M(LVMS)		118.9	116.5		%	2.0	50	18-DEC-19
MD3M(LVMS)		114.1	106.2		%	7.2	50	18-DEC-19
WG3242059-1	MB							
D3(CVMS)			<10		ng		10	18-DEC-19
D4(CVMS)			<10		ng		10	18-DEC-19
D5(CVMS)			<10		ng		10	18-DEC-19
D6(CVMS)			<10		ng		10	18-DEC-19
MM(LVMS)			<10		ng		10	18-DEC-19
MDM(LVMS)			<10		ng		10	18-DEC-19
MD2M(LVMS)			<10		ng		10	18-DEC-19
MD3M(LVMS)			<10		ng		10	18-DEC-19
Surrogate: 4-Bromofluorobenzene			100.4		%		50-150	18-DEC-19

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Workorder: L2393598

Report Date: 24-DEC-19

Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

Page 13 of 13

Contact: Darby Madalena

Legend:

Limit ALS Control Limit (Data Quality Objectives)
DUP Duplicate
RPD Relative Percent Difference
N/A Not Available
LCS Laboratory Control Sample
SRM Standard Reference Material
MS Matrix Spike
MSD Matrix Spike Duplicate
ADE Average Desorption Efficiency
MB Method Blank
IRM Internal Reference Material
CRM Certified Reference Material
CCV Continuing Calibration Verification
CVS Calibration Verification Standard
LCSD Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Batch Proof Report

Batch ID	Canister ID	Parameters	Value	Units	Date	Analyst
B191119.112	01400-0480	1,1,1-Trichloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,1,1,2-Tetrachloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,1,2,2-Tetrachloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,1,2-Trichloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,1-Dichloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,1-Dichloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2,4-Trichlorobenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2,4-Trimethylbenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2-Dibromoethane	<0.01	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2-Dichlorobenzene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2-Dichloroethane	<0.01	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,2-Dichloropropane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,3,5-Trimethylbenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,3-Butadiene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,3-Dichlorobenzene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,4-Dichlorobenzene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	1,4-Dioxane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	2-Chlorophenol	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	2-Hexanone	<1.0	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	4-Ethyltoluene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Acetone	<0.50	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Allyl Chloride	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Benzene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Benzyl Chloride	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Bromodichloromethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Bromobenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Bromoform	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Bromomethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Carbon Disulfide	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Carbon Tetrachloride	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Chlorobenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Chloroethane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Chloroform	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Chloromethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	cis-1,2-Dichloroethene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	cis-1,3-Dichloropropene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Cyclohexane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Dibromochloromethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Dichlorodifluoromethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Ethyl Acetate	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Ethyl Benzene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Freon 113	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Freon 114	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Hexachlorobutadiene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Isooctane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Isopropyl Alcohol	<1.0	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Isopropylbenzene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	m&p-Xylene	<0.04	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Methyl Ethyl Ketone	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Methylcyclohexane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Methyl Isobutyl Ketone	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Methylene Chloride	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	MTBE	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Naphthalene	<0.05	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	n-Decane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	n-Heptane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	n-Hexane	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	o-Xylene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Propylene	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Styrene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Tetrachloroethylene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Tetrahydrofuran	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Toluene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	trans-1,2-Dichloroethene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	trans-1,3-Dichloropropene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Trichloroethylene	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Trichlorofluoromethane	<0.20	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Vinyl Acetate	<0.50	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	Vinyl Bromide	<0.20	ppb(V)	21-Nov-19	DT1

ADDRESS 60 Northland Rd, Unit 1 Waterloo, ON, N2V 2B8 Canada | PHONE +1 519 886-6910 | FAX +1 519 886-9047

ALS CANADA LTD. Part of the ALS Group A Campbell Brothers Limited Company



B191119.112
B191119.112

01400-0480
01400-0480

Vinyl Chloride
4-Bromofluorobenzene

<0.02 ppb(V)
103.1 %

21-Nov-19
21-Nov-19

DT1
DT1



L2393598-COFC

60 NORTHLAI
WATERLOO, C

Phone: (519) 880-0910

Environmental

Fax: (519) 886-9047

Toll Free: 1-800-668-9878

AIR QUALITY CHAIN OF CUSTODY FORM - Canister/Tube/Gas Bag

Note: all TAT Quoted material is in business days which exclude statutory holidays and weekends. TAT of samples received past 3:00 pm or Saturday / Sunday begin the next day.	Specify date required	Service Requested	Rush 3 day (100%)	<input type="checkbox"/>
		10 day (regular)	Rush 2 day (200%)	<input checked="" type="checkbox"/>
		Rush 5 day (50%)	Rush 1 day (300%) - Enquire	<input type="checkbox"/>

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SPECIAL INSTRUCTIONS/COMMENTS		This Chain of Custody Form is only to be used for Air Quality Samples										SAMPLE CONDITION AS RECEIVED			
		Soil Gas Vapour = SG		Indoor Air = IA										FROZEN COLD	
		Ambient Air = AA		Industrial Hygiene = IH										COOLING INITIATED	
														AMBIENT	
SAMPLED BY: Megan Rouse		DATE & TIME Dec 6/19		RECEIVED BY: [Signature]				DATE & TIME 12/6/19				OBSERVATIONS Yes <input type="checkbox"/> No <input type="checkbox"/> If yes add SIF		MEAN TEMP [REDACTED]	
RELINQUISHED BY: [Signature]		DATE & TIME 1600		RECEIVED AT LAB BY: [Signature]				DATE & TIME 12/6/19				UNIT			

Notes

- Quote number must be provided to ensure proper pricing
- TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.
- Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.

REV4-2012



L2393598-COFC

60 NORTHLAI
WATERLOO, C

Phone: (519) 880-0910

Fax: (519) 886-9047

Toll Free: 1-800-668-9878

Environmental

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SPECIAL INSTRUCTIONS/COMMENTS		This Chain of Custody Form is only to be used for Air Quality Samples		<table border="1"> <tr> <td>Matrix Type</td> <td>Soil Gas Vapour = SG</td> <td>Indoor Air = IA</td> </tr> <tr> <td></td> <td>Ambient Air = AA</td> <td>Industrial Hygiene = IH</td> </tr> </table>										Matrix Type	Soil Gas Vapour = SG	Indoor Air = IA		Ambient Air = AA	Industrial Hygiene = IH	SAMPLE CONDITION AS RECEIVED																																																															
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RELINQUISHED BY: [Signature]		DATE & TIME 1600		RECEIVED BY: [Signature]		DATE & TIME 12/6/19		RECEIVED AT LAB BY: [Signature]		DATE & TIME 12/6/19		OBSERVATIONS Yes <input type="checkbox"/> No <input type="checkbox"/> If yes add SIF		MEAN TEMP [REDACTED]																																																																					

Notes

- Quote number must be provided to ensure proper pricing
- TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.
- Any known or suspected hazards relating to a sample must be noted on the chain of custody in comments section.

REV4-2012


INVOICE #: **E1899421**
SOLD TO:

TETRA TECH CANADA INC.
ATTN: Accounts Payable
Suite 110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3

REPORTED TO:

10175

TETRA TECH CANADA INC.
ATTN:Darby Madalena
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3
JOB #: SWM.SWOP04071-01.003
(MCKENZIE TRAILS RECREATION AREA)
Quote #: Q71650

Date	Account #	Terms	Due Date	PO Number/Reference
24-Dec-2019	10175	Net 30 Days	23-Jan-2020	SWM.SWOP04071-01.003

Matrix Analysis	Description	Surcharge Qty	Unit Price	Total Price
Canister C1-C5-FID-WT	Select list of 7 C1-C5 hydrocarbon gases	2	\$150.00	\$300.00
Canister FIXED GASES-TCD-WT	High Level Fixed Gases by TCD	2	\$120.00	\$240.00
Canister PREP-CANISTER-WT	Canister Prep Charge	2	\$95.00	\$190.00
Canister TO15,F1F2SFRA+NAP-WT	TO15, F1-F2, SFRAC+T+NAPH	2	\$450.00	\$900.00
Misc. SAMPLE-DISPOSAL-CL	Sample Handling and Disposal Fee	3	\$2.00	\$6.00
Tube PREP-TD-TUBE-WT	Tube Prep and Supply Charge	1	\$45.00	\$45.00
Tube SILOXANES-GCMS-WT	Linear & Cyclic Methyl Siloxanes	1	\$350.00	\$350.00

ALS Work Order Numbers and Receive Dates:

L2393598 06-DEC-2019

GST/HST BN 100938885

Sub-total: \$2,031.00
 GST (5%): \$101.55

Total (CAD): \$2,132.55

PRICES REFLECT DISCOUNT

Contact Information:

Inayat Dhaliwal
 Phone #: (403) 407-1800
 Fax #: (403) 291-0298
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Please remit payment to ALS Canada Ltd. at the address below. We accept Visa and Mastercard.

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APPENDIX E

HISTORICAL ANALYTICAL DATA

Table 4A
Groundwater Indices Measured at Time of Sampling

Monitoring Well	pH	Electrical Conductivity (µg/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Dissolved Solid (mg/L)	Redox (±mV)
MW-01	7.50	449.5	12.9	0.58	379.60	-121.2
MW-02	7.59	423.3	13.7	3.87	347.75	-21.9
MW-03	7.97	1,078	7.9	3.24	1,040.00	-133.4
MW-04	--	--	--	--	--	--
MW-05	7.22	1,585	9.7	3.53	1,438.50	-139.3

Notes:

- 1) Measurement of groundwater indices by YSI Pro Plus.
- 2) Groundwater sampled on Monday, August 19, 2013.

Table 4B
Analytical Results - Groundwater - General Water Quality

Parameter	Unit	Detection Limit	MW-01	MW-02	MW-03	MW-05	Tier 1 Guideline
			08/19/2013				
General Water Quality							
Biochemical Oxygen Demand (BOD)	mg/L	2	14	3.8	ND	38	--
Chemical Oxygen Demand (COD)	mg/L	5.0 - 25	150	32	47	200	--
Conductivity	µS/cm	1	590	560	1,700	2,200	--
pH	Unitless	N/A	7.88	7.82	8.07	7.89	6.5-8.5
Total Organic Carbon (C)	mg/L	0.50 - 2.5	15	13	21	38	--
Dissolved Cadmium (Cd)	µg/L	0.005	0.012	NT	0.037	0.097	--
Total Cadmium (Cd)	µg/L	0.005	0.73	0.33	0.98	0.79	0.060*
Alkalinity (Total as CaCO ₃)	mg/L	0.5	280	260	800	740	--
Bicarbonate (HCO ₃)	mg/L	0.5	340	320	980	910	--
Carbonate (CO ₃)	mg/L	0.5	ND	ND	ND	ND	--
Hydroxide (OH)	mg/L	0.5	ND	ND	ND	ND	--
Sulphate (SO ₄)	mg/L	1.0 - 5.0	17	27	32	450	--
Chloride (Cl)	mg/L	1	9.3	7.2	70	62	--
Total Ammonia (N)	mg/L	0.050 - 0.50	0.47	ND	6.3	30	1.37*
Total Phosphorus (P)	mg/L	0.0030 - 0.030	1.5	0.068	0.38	2.1	--
Total Nitrogen (N)	mg/L	0.05	2.1	0.58	6.9	35	--
Total Kjeldahl Nitrogen	mg/L	0.050 - 1.3	2.1	0.57	6.9	35	--
Nitrite (as N)	mg/L	0.003	ND	ND	0.010	0.018	--
Nitrate (as N)	mg/L	0.003	0.015	0.0079	0.017	0.054	--
Nitrate plus Nitrite (N)	mg/L	0.0003	0.015	0.0080	0.027	0.072	--
Trace Organics							
Acetic Acid	mg/L	50	ND	NT	ND	ND	--
Formic Acid	mg/L	50	ND	NT	ND	ND	--
Propionic Acid	mg/L	50	ND	NT	ND	ND	--
Adsorbable Organic halogens	mg/L	0.02	0.03	NT	0.07	0.04	--

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for residential/parkland land use.
- 2) * Surface Water Quality Guidelines for Use in Alberta (AENV, 1999) on aquatic life pathway. Canadian Council of Ministers of the Environment (CCME) guidelines are referenced.
- 3) ND - Not Detected, less than the limit of method detection.
- 4) NT - Not Tested
- 5) -- No value established in the reference criteria.
- 6) Bold & Shaded - Exceeds the referenced Alberta Tier 1 Guidelines and CCME guidelines.
- 7) For further laboratory information, refer to the specific laboratory report in Appendix A.

Table 4C
Analytical Results - Groundwater - Metals

Parameter	Detection Limit	MW-01	MW-02	MW-03	MW-05	Tier 1 Guideline
		08/19/2013				
Total Metals						
Aluminum (Al)	0.0030	10	0.73	7.9	0.37	0.1*
Antimony (Sb)	0.00060	0.00063	ND	ND	0.0017	0.006
Arsenic (As)	0.00020	0.015	0.0011	0.0071	0.0089	0.005
Barium (Ba)	0.010	0.72	0.015	0.5	0.37	1
Beryllium (Be)	0.0010	ND	ND	ND	ND	--
Boron (B)	0.020	0.041	0.022	0.43	1.8	1.5
Calcium (Ca)	0.30	120	78	150	240	--
Chromium (Cr)	0.0010	0.018	0.0035	0.014	0.003	0.001*
Cobalt (Co)	0.00030	0.011	0.00087	0.008	0.012	--
Copper (Cu)	0.00020	0.042	0.0043	0.023	0.026	0.003*
Iron (Fe)	0.060	25	1.6	19	22	0.3
Lead (Pb)	0.00020	0.019	0.0017	0.012	0.11	0.004*
Lithium (Li)	0.020	0.025	ND	0.075	0.031	--
Magnesium (Mg)	0.20	46	22	40	91	--
Manganese (Mn)	0.0040	1.4	0.1	0.9	0.6	0.05
Molybdenum (Mo)	0.00020	0.004	0.0025	0.0017	0.0021	--
Nickel (Ni)	0.00050	0.0340	0.0035	0.025	0.012	0.11*
Phosphorus (P)	0.10	1.10	ND	1.2	0.94	--
Potassium (K)	0.30	6.8	3.5	6.2	45	--
Selenium (Se)	0.00020	0.00074	ND	0.00076	0.0004	0.001
Silicon (Si)	0.10	22	5.6	20	8.4	--
Silver (Ag)	0.00010	0.0002	ND	0.00022	ND	0.0001*
Sodium (Na)	0.50	45	20	310	110	--
Strontium (Sr)	0.020	0.45	0.38	1.1	1.3	--
Sulphur (S)	0.20	5.1	7.8	15	130	--
Thallium (Tl)	0.00020	ND	ND	ND	ND	--
Tin (Sn)	0.0010	0.0015	0.003	0.0021	0.0065	--
Titanium (Ti)	0.0010	0.14	0.025	0.0174	0.007	--
Uranium (U)	0.00010	0.0018	0.0012	0.0022	0.0017	0.02
Vanadium (V)	0.0010	0.03	0.0024	0.021	0.0015	--
Zinc (Zn)	0.0030	0.11	0.078	0.25	0.12	0.03
Dissolved Metals						
Aluminum (Al)	0.0030	0.0067	NT	0.040	0.0052	--
Antimony (Sb)	0.00060	ND	NT	ND	0.00076	--
Arsenic (As)	0.00020	0.0062	NT	0.0021	0.0079	--
Barium (Ba)	0.010	0.28	NT	0.42	0.33	--
Beryllium (Be)	0.0010	ND	NT	ND	ND	--
Boron (B)	0.020	0.044	NT	0.64	1.9	--
Calcium (Ca)	0.30	49	NT	110	230	--
Chromium (Cr)	0.0010	ND	NT	ND	ND	--
Cobalt (Co)	0.00030	0.00066	NT	0.0013	0.0048	--
Copper (Cu)	0.00020	0.00027	NT	0.00098	0.00044	--
Iron (Fe)	0.060	3	NT	0.52	17	--
Lead (Pb)	0.00020	ND	NT	ND	0.00027	--
Lithium (Li)	0.020	ND	NT	0.062	0.03	--
Magnesium (Mg)	0.20	24	NT	34	92	--
Manganese (Mn)	0.0040	0.84	NT	0.63	0.67	--
Molybdenum (Mo)	0.00020	0.0042	NT	0.0025	0.00088	--
Nickel (Ni)	0.00050	0.0014	NT	0.0032	0.0042	--
Phosphorus (P)	0.10	ND	NT	0.16	ND	--
Potassium (K)	0.30	4.5	NT	7.0	40	--
Selenium (Se)	0.00020	0.00047	NT	ND	0.0002	--
Silicon (Si)	0.10	5	NT	6	8	--
Silver (Ag)	0.00010	ND	NT	ND	ND	--
Sodium (Na)	0.50 - 2.5	43	NT	280	120	--
Strontium (Sr)	0.020	0.34	NT	1.3	1.40	--
Sulphur (S)	0.20 -1.0	4.5	NT	17	150	--
Thallium (Tl)	0.00020	ND	NT	ND	ND	--
Tin (Sn)	0.0010	ND	NT	ND	0.0018	--
Titanium (Ti)	0.0010	ND	NT	ND	ND	--
Uranium (U)	0.00010	0.00048	NT	0.0024	0.00085	--
Vanadium (V)	0.0010	ND	NT	0.0011	ND	--
Zinc (Zn)	0.0030	ND	NT	ND	0.02	--

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for residential/parkland land use.
- 2) * Surface Water Quality Guidelines for Use in Alberta (AENV, 1999) on aquatic life pathway. Canadian Council of Ministers of the Environment (CCME) guidelines are referenced.
- 3) ND - Not Detected, less than the limit of method detection.
- 4) NT - Not Tested.
- 5) Unless specified all units are mg/L.
- 6) -- No value established in the reference criteria.
- 7) Bold & Shaded - Exceeds the referenced Alberta Tier 1 and CCME guidelines.
- 8) For further laboratory information, refer to the specific laboratory report in Appendix A.

Table 4D
Analytical Results - Groundwater -VOCs

Parameter	Detection Limit	MW-01	MW-02	MW-03	MW-05	Tier 1 Guideline
		08/19/2013				
Volatile Organic Compounds						
Benzene	0.00040	ND	ND	ND	0.0014	0.005
Toluene	0.00040	ND	ND	0.0011	0.00063	0.024
Ethylbenzene	0.00040	ND	ND	ND	ND	0.0024
Xylenes (Total)	0.00080	ND	ND	ND	ND	0.3
F1 (C ₆ -C ₁₀)	0.10	ND	ND	ND	ND	0.81
F2 (C ₁₀ -C ₁₆)	0.10	ND	ND	ND	ND	1.1
Total Trihalomethanes	0.0020	ND	ND	ND	ND	0.1
Bromodichloromethane	0.00050	ND	ND	ND	ND	--
Bromoform	0.00050	ND	ND	ND	ND	--
Bromomethane	0.0020	ND	ND	ND	ND	--
Carbon tetrachloride	0.00050	ND	ND	ND	ND	0.00056
Chlorobenzene	0.00050	ND	ND	ND	ND	0.0013
Chlorodibromomethane	0.0010	ND	ND	ND	ND	--
Chloroethane	0.0010	ND	ND	ND	ND	--
Chloroform	0.00050	ND	ND	ND	ND	0.0018
Chloromethane	0.0020	ND	ND	ND	ND	--
1,2-dibromoethane	0.00050	ND	ND	ND	ND	--
1,2-dichlorobenzene	0.00050	ND	ND	ND	ND	0.0007
1,3-dichlorobenzene	0.00050	ND	ND	ND	ND	--
1,4-dichlorobenzene	0.00050	ND	ND	ND	ND	0.001
1,1-dichloroethane	0.00050	ND	ND	ND	ND	--
1,2-dichloroethane	0.00050	ND	ND	ND	ND	0.005
1,1-dichloroethene	0.00050	ND	ND	ND	ND	0.014
cis-1,2-dichloroethene	0.00050	ND	ND	0.0012	0.0037	--
trans-1,2-dichloroethene	0.00050	ND	ND	ND	ND	--
Dichloromethane	0.0020	ND	ND	ND	ND	0.05
1,2-dichloropropane	0.00050	ND	ND	ND	ND	--
cis-1,3-dichloropropene	0.00050	ND	ND	ND	ND	--
trans-1,3-dichloropropene	0.00050	ND	ND	ND	ND	--
Methyl methacrylate	0.00050	ND	ND	ND	ND	0.47
Methyl-tert-butylether (MTBE)	0.00050	ND	ND	ND	ND	0.015
Styrene	0.00050	ND	ND	ND	ND	0.072
1,1,1,2-tetrachloroethane	0.0020	ND	ND	ND	ND	--
1,1,2,2-tetrachloroethane	0.0020	ND	ND	ND	ND	--
Tetrachloroethene	0.00050	ND	ND	ND	0.0033	0.03
1,2,3-trichlorobenzene	0.0010	ND	ND	ND	ND	0.008
1,2,4-trichlorobenzene	0.0010	ND	ND	ND	ND	0.015
1,3,5-trichlorobenzene	0.00050	ND	ND	ND	ND	0.014
1,1,1-trichloroethane	0.00050	ND	ND	ND	ND	--
1,1,2-trichloroethane	0.00050	ND	ND	ND	ND	--
Trichloroethene	0.00050	ND	ND	ND	ND	0.005
Trichlorofluoromethane	0.00050	ND	ND	ND	ND	--
1,2,4-trimethylbenzene	0.00050	ND	ND	ND	ND	--
1,3,5-trimethylbenzene	0.00050	ND	ND	ND	ND	--
Vinyl chloride	0.00050	ND	ND	ND	0.0007	0.0011

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for residential/parkland land use.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) Unless specified all units are mg/L
- 4) -- No value established in the reference criteria.
- 5) Bold & Shaded - Exceeds the referenced Alberta Tier 1 Guidelines.
- 6) For further laboratory information, refer to the specific laboratory report in Appendix A.

Table 5A
Summary of Monitoring Parameters During Sampling of Soil Vapour

Parameter Unit	Well Diameter (mm)	Well Depth (m)	Headspace Volume (cm ³)	Purge Rate (cm ³ /min)	Purge Time (min)	Pressure	
						Ambient (psi)	Vapour Well (psi)
VW-01	25	5.5	2,700.0	943.3	5	15.00	15.00

Notes:

- 1) Measurement of pressure by digital Cole-Parmer absolute pressure gauge.
- 2) Purge time is elapsed time prior to the collection of a soil vapour sample.
- 3) Soil Vapour sampling was completed on August 19, 2013.

Table 5B
Analytical Results - Soil Vapour - General Indices

Parameter	Unit	Detection Limit	VW-01
<u>Gauge Pressure</u>			
Following sampling	psi	--	
Reported by laboratory	psi	--	(-4.0)
<u>Fixed Gases</u>			
Oxygen	% v/v	0.2	5.8
Nitrogen	% v/v	0.2	84.7
Carbon monoxide	% v/v	0.2	ND
Methane	% v/v	0.2	ND
Carbon dioxide	% v/v	0.2	9.5

Notes:

- 1) Soil vapour sample collected on Saturday, August 17, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) -- No value established in the detection limit and reference criteria.
- 4) For further information, the reader should refer to the laboratory report in Appendix A.

Table 5C
Analytical Results - Soil Vapour - VOCs

Parameter	Unit	Detection Limit	VW-01
			08/17/2013
Hydrocarbon Fractions			
Aliphatic >C ₃ -C ₆	µg/m ³	5.0	6.3
Aliphatic >C ₆ -C ₈	µg/m ³	5.0	37.4
Aliphatic >C ₈ -C ₁₀	µg/m ³	5.0	36.9
Aliphatic >C ₁₀ -C ₁₂	µg/m ³	5.0	55.2
Aliphatic >C ₁₂ -C ₁₆	µg/m ³	5.0	18.4
Aromatic >C ₇ -C ₈ (TEX Excluded)	µg/m ³	5.0	ND
Aromatic >C ₈ -C ₁₀	µg/m ³	5.0	10.2
Aromatic >C ₁₀ -C ₁₂	µg/m ³	5.0	10.0
Aromatic >C ₁₂ -C ₁₆	µg/m ³	5.0	ND
Select Volatile Gases			
Acetylene	ppm	0.2	ND
Ethane	ppm	0.2	ND
Ethylene	ppm	0.2	ND
Methane	ppm	4.1	ND
n-Butane	ppm	0.41	ND
n-Pentane	ppm	0.2	ND
Propane	ppm	0.2	ND
Propene	ppm	0.2	ND
Propyne	ppm	0.41	ND
Volatile Organic Compounds			
Dichlorodifluoromethane (FREON 12)	ppbv	0.20	0.74
1,2-Dichlorotetrafluoroethane	ppbv	0.17	ND
Chloromethane	ppbv	0.30	0.92
Vinyl chloride	ppbv	0.18	ND
Chloroethane	ppbv	0.30	ND
1,3-Butadiene	ppbv	0.50	ND
Trichlorofluoromethane (FREON 11)	ppbv	0.20	0.31
Ethanol (ethyl alcohol)	ppbv	2.3	104
Trichlorotrifluoroethane	ppbv	0.15	0.18
2-propanol	ppbv	3.0	ND
2-Propanone	ppbv	0.80	26
Methyl ethyl ketone (MEK) (2-Butanone)	ppbv	3.0	ND
Methyl isobutyl ketone	ppbv	3.2	ND
Methyl butyl ketone (MBK) (2-Hexanone)	ppbv	2.0	ND
Methyl t-butyl ether (MTBE)	ppbv	0.20	ND
Ethyl acetate	ppbv	2.2	ND
1,1-Dichloroethylene	ppbv	0.25	ND
cis-1,2-Dichloroethylene	ppbv	0.19	ND
trans-1,2-Dichloroethylene	ppbv	0.20	ND
Methylene chloride(Dichloromethane)	ppbv	0.80	ND
Chloroform	ppbv	0.15	0.24
Carbon tetrachloride	ppbv	0.30	ND
1,1-Dichloroethane	ppbv	0.20	ND
1,2-Dichloroethane	ppbv	0.20	ND
Ethylene dibromide	ppbv	0.17	ND
1,1,1-Trichloroethane	ppbv	0.30	ND
1,1,2-Trichloroethane	ppbv	0.15	ND
1,1,2,2-Tetrachloroethane	ppbv	0.20	ND
cis-1,3-Dichloropropene	ppbv	0.18	ND
trans-1,3-Dichloropropene	ppbv	0.17	ND
1,2-Dichloropropane	ppbv	0.40	ND
Bromomethane	ppbv	0.18	ND
Bromoform	ppbv	0.20	ND
Bromodichloromethane	ppbv	0.20	ND
Dibromochloromethane	ppbv	0.20	ND
Trichloroethylene (TCE)	ppbv	0.30	ND
Tetrachloroethylene (PCE)	ppbv	0.20	ND
Benzene	ppbv	0.18	2.42
Toluene	ppbv	0.20	7.53
Ethylbenzene	ppbv	0.20	0.94
p+m-xylene	ppbv	0.37	4.38
o-xylene	ppbv	0.20	1.5
Styrene	ppbv	0.20	0.21
4-ethyltoluene	ppbv	2.2	ND
1,3,5-Trimethylbenzene	ppbv	0.50	ND
1,2,4-Trimethylbenzene	ppbv	0.50	0.58
Chlorobenzene	ppbv	0.20	ND
Benzyl chloride	ppbv	1.0	ND
1,3-Dichlorobenzene	ppbv	0.40	ND
1,4-Dichlorobenzene	ppbv	0.40	ND
1,2-Dichlorobenzene	ppbv	0.40	ND
1,2,4-Trichlorobenzene	ppbv	2.0	ND
Hexachlorobutadiene	ppbv	3.0	ND
Hexane	ppbv	0.30	1.99
Heptane	ppbv	0.30	1.88
Cyclohexane	ppbv	0.20	0.36
Tetrahydrofuran	ppbv	0.40	4.46
1,4-Dioxane	ppbv	2.0	ND
Xylene (Total)	ppbv	0.60	5.88
Vinyl bromide	ppbv	0.20	ND
Propene	ppbv	0.30	ND
2,2,4-Trimethylpentane	ppbv	0.20	0.41
Carbon disulfide	ppbv	0.50	8.70
Vinyl acetate	ppbv	0.20	ND

Notes:

- 1) Results are from sampling performed on Saturday, August 17, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) - - No value established in the detection limit and reference criteria.
- 4) For further information, the reader should refer to the laboratory report in Appendix A.

Table 5D
Analytcs Results - Soil Vapour - Siloxanes

Parameter	Detection Limit		VW-01	
	mg/m ³	ppm	08/17/2013	
			mg/m ³	ppm
Trimethylsilyl Fluoride	--	--	0.0007	0.0002
Tetramethylsilane	0.0001	0.0001	ND	ND
Methoxytrimethylsilane	0.0018	0.0004	ND	ND
Ethoxytrimethylsilane	0.0017	0.0004	ND	ND
Trimethylsilanol	--	--	0.0394	0.0107
Isopropoxytrimethylsilane	0.0007	0.0001	ND	ND
Trimethoxymethyl Silane #	--	--	ND	ND
Hexamethyl Disiloxane - L2	--	--	0.0005	0.0001
Propoxytrimethylsilane	0.002	0.0004	ND	ND
1-Methylbutoxytrimethylsilane *	--	--	ND	ND
Butoxytrimethylsilane *	--	--	ND	ND
Trimethoxyvinyl Silane #	--	--	ND	ND
Hexamethyl Cyclotrisiloxane - D3	--	--	0.0074	0.0008
Octamethyl Trisiloxane - L3	0.0001	0.0001	ND	ND
Triethoxyvinyl Silane #	--	--	ND	ND
Triethoxyethyl Silane #	--	--	ND	ND
Octamethyl Cyclotetrasiloxane - D4	--	--	0.0071	0.0006
Decamethyl Tetrasiloxane - L4	0.0002	0.0001	ND	ND
Tetraethylsilicate #	--	--	ND	ND
Decamethyl Cyclopentasiloxane - D5	--	--	0.0160	0.0011
Dodecamethyl Pentasiloxane - L5	0.0017	0.0006	ND	ND
Dodecamethyl Cyclohexasiloxane - D6	--	--	0.1747	0.0096
Sum	--	--	0.2541	0.0245

Notes:

- 1) Soil vapour samples collected on Saturday, August 17, 2013.
- 2) ND - Not Detected, less than the limit of method detection.
- 3) -- No value established in the detection limit and reference criteria.
- 4) V=200 mL, where V is volume of air/gas sampled.
- 5) * - Semiquantitative (response factor set at 5).
- 6) # - Unstable, poor detectability, commercial standards tested.
- 7) For further information, the reader should refer to the laboratory report in Appendix A.