

2019 Groundwater and Soil Vapour Monitoring Report Riverside Heavy Dry Waste Site NE and SE of Section 33-038-27 W4M



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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 Riverside Heavy Dry Waste Site (Riverside Heavy), located at 4240 Northland Drive within the NE and SE portions of Section 33-038-27 W4M, 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 Riverside Heavy site included conducting quarterly events of groundwater and vapour monitoring, annual groundwater and soil 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 three monitoring wells (MW-01 to MW-03). MW-01 and MW-03 are screened within the native sand and clay and MW-02 is screened within siltstone bedrock. The vapour monitoring network consists of one vapour monitoring well (VW-01) located at the west side of the site near the top of the hill between the site and adjacent development.

Based upon the results of the groundwater and 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 to the northeast. The average horizontal hydraulic gradient at the site was 0.08 m/m. This is consistent with observations made historically. Groundwater elevations in 2019 were consistent with the historical groundwater elevations from 2013.
- Groundwater parameters that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2019 included total dissolved solids (TDS), sodium, chloride, sulphate, and dissolved metals including aluminum, arsenic, barium, iron, manganese, and uranium. The measured concentrations of these parameters were generally consistent with previous results. Several parameters are interpreted to reflect natural groundwater quality; however, some leachate impact was evident at MW-02 (northeast) and MW-03 (east).
- Concentrations of benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbon (PHC) fractions F1 to F2, adsorbable organic halides (AOX), volatile fatty/carboxylic acids, and volatile organic compounds (VOCs) in 2019 were less than the analytical detection limits at all groundwater monitoring wells with the exception of PHC fraction F2 at MW-03, which was equal to the analytical detection limit (0.10 mg/L), but considerably less than the Tier 1 Guideline (1.1 mg/L).
- Concentrations of BTEX, hydrocarbons, and VOCs in soil vapour samples collected (VW-01 and duplicate) were less than the soil vapour screening criteria.
- Siloxanes were not detected in the soil vapour samples 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 vapour and groundwater monitoring program in 2019 and previous years, there are indications of residual impacts related to the former landfill operations at several monitoring well locations. The groundwater monitoring program identified that some leachate indicator parameter concentrations are elevated in groundwater at the cross-gradient and down-gradient monitoring well locations; however, the groundwater flow direction is well defined and inferred risks to receptors are limited. Therefore, continuing the groundwater monitoring and sampling program is not warranted.

Based on the results of the soil vapour samples, there is little indication that this pathway will pose a hazard to receptors. However, information regarding potential subsurface methane concentrations along the east portion of the site is limited; based on the indication of some leachate impact in the groundwater on the east portion of the site and evidence of anoxic conditions, additional vapour monitoring is considered warranted to confirm methane is not a concern.

Buried landfill waste remains beneath the site, therefore ongoing risk management is required. Risk management is recommended to include ongoing monitoring and administrative actions. These include the following:

- Ongoing Monitoring:
 - Conduct one additional year of quarterly monitoring at the site, including headspace methane measurements, headspace pressures and water levels at all groundwater and soil vapour probes, to confirm methane is not present at significant concentrations, in particular along the east portion of the site.
 - If preliminary monitoring results indicate either that the eastern groundwater wells are blinded (i.e. the well screen is completely submerged) or identify elevated methane, vapour-specific monitoring probes would be recommended for this portion of the site. If concerns with methane are not identified, then the program would be recommended to be stopped.
- 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.

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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 Riverside Heavy Dry Waste Site (Riverside Heavy), located at 4240 Northland Drive within the NE and SE portions of Section 33-038-27 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.

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:
 - Purging shallow monitoring wells and deep 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.
 - Collecting groundwater samples from each well and submitting the samples for laboratory chemical analyses.
- Conducting vapour sampling:
 - Collecting vapour samples into Summa canisters for analysis.
 - Collecting vapour samples for siloxanes analysis into thermal desorption (TD) tubes.
 - 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.

The report was completed under Tetra Tech's Limitations on the Use of this Document for conducting environmental 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).

1.2 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 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 Riverside Heavy site.

The objectives of the project were 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 environmental monitoring reports for each of the eight sites.

The eight pre-1972 landfill sites include:

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

Each site is summarized in a separate report and this report is focused on the Riverside Heavy 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 Section 33-038-27 W4M, at 4240 Northland Drive in Red Deer, Alberta. A general site location plan is shown on Figure 1. The site is zoned A2 – Environmental Preservation. The site is located on a large hill slope within the Riverside Industrial Park. Access to the site is from the Red Deer Fire Training Centre located east of site. The north and east boundary of the site is bounded by a Canadian National Railway right-of-way (ROW). South of the site consists of a natural area containing a slough and various shrubs and grasses. West of the site boundary are commercial buildings that were unoccupied at the time of the site activities. The site has mountain bike trails and is vegetated with a variety of natural grasses, shrubs, and trees. A general site plan and surrounding land use is shown on Figure 2.

2.2 Site History

Municipal records indicate that the waste disposal at the site occurred between 1991 and 2007 (approximately 16 years). This would indicate that the estimated age of the waste material would be approximately 13 to 29 years old. The findings from the Phase II Environmental Site Assessment (ESA) completed in 2014 (Tiamat 2014a) confirmed that the waste material at the site consisted of construction material (wires, plastics, brick, asphalt, concrete, glass, and wood) and municipal solid waste (MSW). The former landfill is closed and inactive.

Historical waste disposal was identified during the Phase II ESA to be situated beneath the east facing slope of the hill. The waste disposal of asphalt and concrete was used for slope stabilization. The western portion of the site is approximately 30 m higher than the eastern portion. Estimated waste areas are identified on Figure 2.

Results of the Phase II ESA conducted by Tiamat indicate that surface material of sod and loam was overlying the buried waste material. The sod and loam varied between 15 cm and 45 cm in depth. The MSW contained fill soil consisting of sand, silt, and clay, located below the sod to a depth of approximately 7.6 m below grade (mbg). Native clay was encountered underlying the MSW in the south and clay fill was underneath in the north, east, and west. Siltstone bedrock was encountered at MW-02 in the north.

The Phase II ESA (Tiamat 2014a) suggested mild strength constituents from leachate are present in the groundwater. Initial assessments of landfill gas (LFG) showed the concentrations of soil gas constituents to be low with no notable concern for the environmental quality of the subsurface soil vapour.

2.3 Historical Groundwater Monitoring and Investigation Summary

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

- Phase I Environmental Site Assessment, Historic Waste Disposal Site, Riverside Heavy Dry Waste Site, The City of Red Deer. September 24, 2013 (Tiamat 2013).
- Phase II Environmental Site Assessment, Historic Waste Disposal Site, Riverside Heavy Dry Waste Site, The City of Red Deer. February 26, 2014 (Tiamat 2014a).
- Environmental Risk Management Plan, Historic Waste Disposal Sites, Riverside Heavy Dry Waste Site, The City of Red Deer. November 25, 2014 (Tiamat 2014b).

Nine testholes (TH-01 to TH-09) were advanced in July 2013 as part of the Phase II ESA. One vapour well (VW-01) and three monitoring wells (MW-01, MW-02, and MW-03) were installed.

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

- Waste was encountered at several testholes across the site through the fill material.
- Groundwater analytical results showed concentrations of routine parameters and metals greater than the referenced Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines; AEP 2019a).
- Groundwater has been impacted by mild strength leachate constituents.
- Soil vapour analytical results showed trace amounts of volatile organic compounds (VOCs) and siloxanes at VW-01.

The recommendations of the program were as follows, as identified in the Phase II ESA (Tiamat 2014a):

- Continue to monitor groundwater elevations and soil vapour data quarterly for one hydrogeological cycle.
- If groundwater conditions on site change, the water quality at the slough should be monitored.
- Collect an additional set of soil vapour and groundwater analytical data, groundwater elevations, and volatile headspace measurements during the winter months to determine seasonal changes in soil vapour concentrations.
- Create a risk management plan (RMP) that outlines the environmental issues of the site and future land use.
- Review any available data to update the RMP.

The recommendations of the RMP completed by Tiamat (Tiamat 2014b) included 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 three monitoring wells (MW-01 to MW-03). MW-01 and MW-03 are screened within the native sand and clay and MW-02 is screened within siltstone bedrock. All monitoring wells were in good condition in 2019. Monitoring well completion details are summarized in Table 1.

The vapour monitoring network consists of one vapour monitoring well (VW-01) located at the west side of the site near the top of the hill. The vapour well was in good condition in 2019.

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 City and site are located within the Red Deer River drainage basin with principal drainage via the Red Deer River located east of the site. The Red Deer River has incised the uplands with gentle slopes to the east and west of the river in the vicinity of the site.

The geology in the river valley is characterized by fluvial surficial sediments deposited by the Red Deer River, overlying shale and sandstone bedrock of the Paskapoo Formation. The uplands at the west of the site comprise undivided ice-contact lacustrine and fluvial deposits, of gravel, sand, silt, clay, and local till. These deposits are described as being up to 25 m thick (Shetsen 1990). The fluvial deposits to the east comprise gravel, sand, with minor silt beds.

Key elements of the geological setting are presented below from Tiamat's 2013 Phase I Report (Tiamat 2013):

"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 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.

Terrace gravels hydraulically connected to the Red Deer River are a known resource of groundwater. 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.

The Tertiary bedrock consists of sequences of alternating shales and sandstones of the Paskapoo Formation. 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."

3.1.2 Local Geology

Based on the Phase II ESA results, Riverside Heavy consisted of fill material up to 7 m, consisting of a mixture of vegetation, clay, sand, and loam, overlying a native clay. Testholes with observed waste encountered debris up to a maximum depth of 10 m in the central portion of the site. Waste material was situated on top of a native clay and sand layer, overlying a siltstone bedrock at the bottom of the slope, located at 4.6 m depth at MW02. Bedrock was not encountered at the testholes on or at the top of the slope.

3.2 Hydrogeology

The following sections summarize the regional and local hydrogeology.

3.2.1 Regional Hydrogeology

The regional hydrogeology is most influenced by the presence of the river sediments situated within the valley along the Red Deer River and a bedrock valley trending north-northeast in the vicinity of the site.

Key elements of the hydrogeological setting are presented below 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." Mapping by the Alberta Geological Survey (Andriashek 2018) indicates that the valley is located approximately 1.4 km east of the site, however the width of the valley is not defined.

"The dominant type of near-surface groundwater in the Paskapoo Formation in the area of assessment is sodium bicarbonate. Notable concentrations of sodium sulphate 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.”

The regional groundwater flow is expected to follow the bedrock topography and will be influenced by the varying distribution of sediments in the river valley, which will have been deposited in various historical channels since filled in under varying depositional environments. Further, the river is in hydrologic connection with the adjacent sediments; therefore, seasonal changes in the river stage will affect the local groundwater flow patterns (magnitude and direction). In seasons of higher river flow, bank storage will occur whereas in seasons of lower flow (such as late summer/fall), the storage will be released.

3.2.2 Local Hydrogeology

The site slopes to the east and has greater than 30 m in elevation change from the top to the bottom. A slough exists at the south boundary of the site. The Red Deer River flows northwesterly in the area and is located approximately 700 m east of the site and 600 m north of the site. Shallow groundwater is assumed to flow towards the river.

3.3 Groundwater Resource Usage

A search of the Alberta Water Well Database for groundwater users within a 1 km radius of the site identified 23 groundwater wells; 5 of the wells are listed as domestic use, 1 is listed as domestic and stock use, 10 are listed as industrial use, 2 as “other”, and 5 are listed as unknown use (Alberta Environment and Parks [AEP] 2019b).

The nearest water well is located approximately 200 m southeast of the site. The well use is listed as other. The depths of water wells within a 1 km radius of the site range from 9 m to 195 m. 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 for 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 Guidelines (AEP 2019a).

A CSM was developed for the site. The CSM 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;
- Benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (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 A2 – Environmental Preservation District with adjacent natural areas on slopes to the north. Overall, the area is used as commercial/industrial land. The site has been classified as commercial/industrial land use for Tier 1 Guidelines comparison.

4.3 Grain Size Designation

The Tier 1 Guidelines are 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 (Tiamat 2014a). While the majority of soils encountered were fine-grained, some sand layers were noted; therefore, the results 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 commercial, 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 groundwater well was identified within 500 m of the site and was listed as other use. No potable groundwater wells were identified. Groundwater at the site is not presently used as drinking water.

4.4.1.3 Inhalation

The inhalation pathway considers the migration of volatile contaminants (e.g., BTEX, PHC 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 commercial/industrial, there is a potential for the infiltration of vapours into buildings and subsequent inhalation by the workers. 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 applicable to the site as the site is surrounded by residential and commercial land to the west and south, and parkland (golf course) to the north and east.

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). This pathway is 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 a slough located approximately 45 m south of the site. The Red Deer River is located approximately 650 m northeast of the site. The site is also located at an elevation higher than the slough and the river. 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, inhalation, and off-site migration by wind or water erosion pathways. The ecological receptor exposures applicable to the site include direct soil contact, FAL, and nutrient and energy cycling pathways.

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 (CCME) 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 (AEP 2019c) include human toxicity reference values (TRVs) for inhalation (Table A-7). 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 commercial land use is 0.2741 (AEP 2019c) based on 10 hours/day, 5 days/week, and 48 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

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 below 5% (the lower explosive limit) 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 no 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 Tier 1 Guidelines (AEP 2019a) under commercial/industrial land uses for coarse-grained soils.

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 (CCME 2014) under commercial land use for coarse-grained soils.

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, June 25, September 19, and December 3. Groundwater sampling was conducted on December 3, 2019.

5.1 Field Program

Groundwater monitoring consisted of measuring combustible vapour concentrations (CVCs) and VOCs in monitoring well headspaces, 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 Hydrocarbon Surveyor II (RKI) calibrated to hexane and isobutylene and operated in 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 three monitoring wells (MW-01, MW-02, and MW-03). 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 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 F1-F2.
- VOCs.
- Total Kjeldahl nitrogen (TKN).
- Routine and dissolved metals.
- Dissolved organic carbon (DOC).
- Ammonia.
- Phosphorus.
- Adsorbable organic halides (AOX).
- 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, June 25, September 19, 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 noting the position of the sampling labcock. 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, or until readings stabilized. VW-01 is a small diameter soil gas probe (25 mm well), which was purged directly with the GEM LFG analyzer.

After purging, gas composition measurements for methane, carbon dioxide, oxygen, balance gas, and hydrogen sulphide were recorded using the GEM analyzer. Upon 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 screened 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 as 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 the soil vapour probe 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 the soil vapour probe monitoring location.
- Sampling 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. 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 tightened back on the canister.
- Canisters, flow controllers, and pressure gauges were placed in the original shipping container and returned to the laboratory under 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. A duplicate sample was 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 is summarized below:

- VOCs;
- 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 Riverside Heavy and discussions of these results.

7.1 Groundwater Well Headspace Monitoring

Tetra Tech monitored three groundwater monitoring wells during each monitoring event for measurements of well headspace including, CVCs and VOCs using an RKI Eagle 2 calibrated to hexane and isobutylene and operated in methane elimination mode. The results of well headspace monitoring at vapour-specific monitoring wells are provided in Section 7.5.

In May 2019 and June 2019, all CVC concentrations were non-detectable at the monitoring wells. In September 2019, concentrations ranged from non-detectable at most monitoring wells to 65 parts per million (ppm) at MW-03. In December 2019, CVCs were 5 ppm at all monitoring wells.

In May 2019, June 2019, and September 2019, VOCs were non-detectable at all monitoring wells. In December 2019, concentrations ranged from non-detectable at most wells to 12 ppm at MW-03.

The concentrations of CVCs and VOCs measured at MW-03 are not interpreted to represent a concern.

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. These figures show groundwater elevations in 2013 and 2019. Overall, groundwater elevations in 2019 were consistent at all monitoring wells with the elevations from 2013. Slight seasonal fluctuations were observed in 2019.

In 2019, the average depths to groundwater in the monitoring wells were 5.03 mbg in May, 4.91 mbg in June, 5.27 mbg in September, and 5.14 mbg in December. The contoured elevations for the monitoring wells suggest the groundwater flow was to the northeast in 2019, which is consistent with the inferred flow direction in 2013.

The inferred groundwater flow directions are shown on Figure 4 to Figure 7. The average horizontal gradient in 2019 was 0.08 m/m.

7.3 Groundwater Field Parameters

Field measurements for temperature, pH, and EC in December 2019 are shown in Table 2. The results of the field tests are summarized in this section.

Groundwater temperatures ranged from 5.85°C (MW-03) to 5.96°C (MW-02).

Field pH values ranged from 6.88 (MW-02) to 7.08 (MW-01) in 2019. The field pH was less than the laboratory pH at all wells. The difference between the 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 1,026 µS/cm (MW-01) to 2,023 µS/cm (MW-02). The field EC results were less than the laboratory measured EC results, which may be due to limitations of the field equipment.

7.4 Laboratory Results

The groundwater analytical data for 2019 is summarized in Table 2. The 2019 laboratory analytical reports are included in Appendix D.

Background Groundwater Quality

MW-01 is located up-gradient of the site and is interpreted to represent background groundwater quality. Concentrations of TDS, sulphate, dissolved arsenic, dissolved iron, and dissolved manganese were greater than the Tier 1 Guidelines in 2019. The concentrations of sulphate and dissolved manganese were also greater than the current Alberta Tier 1 Guidelines in 2013. These concentrations are interpreted to be related to natural groundwater quality and not related to historical landfill operations.

The concentrations of BTEX, PHC fractions F1 and F2, and VOCs were less than the laboratory analytical detection limits in 2013 and 2019.

Routine Water Chemistry Parameters

In 2019, TDS concentrations ranged from 1,220 mg/L (MW-03) to 2,240 mg/L (MW-02). TDS concentrations at all monitoring wells in 2019 were greater than the Tier 1 Guidelines (500 mg/L). Field TDS concentrations from 2013 were in the same order of magnitude as the TDS concentrations measured in 2019. TDS concentrations were not analyzed in laboratory samples in 2013.

Sodium concentrations at the site were greater than the referenced guideline of 200 mg/L at monitoring well MW-02 (256 mg/L), which is consistent with historical results.

Sulphate concentrations at the site were greater than the referenced guideline (429 mg/L) at MW-01 and MW-02. Sulphate concentrations ranged from 2.1 mg/L at MW-03 to 624 mg/L at MW-02, which is consistent with concentrations measured in 2013.

Elevated TDS, sodium, and sulphate concentrations often occur in groundwater as a result of the dissolution of naturally occurring salts in the glacial tills of Alberta, and do not necessarily indicate groundwater quality impact related to the former landfill operations. The exception is likely monitoring well MW-02 where the sodium

concentration exceeded the guideline and a chloride concentration of 429 mg/L was measured. Chloride is often considered a useful parameter to assess groundwater quality impacts associated with landfills, as chloride is generally present in elevated concentrations in leachate, and due to the mobile and conservative (non-reactive) nature of the ion. Chloride concentrations in 2019 ranged from less than the analytical detection limit at up-gradient well MW-01 to 429 mg/L at MW-02 in December and were greater than the guidelines at both MW-02 and MW-03. In 2013, chloride concentrations at up-gradient well MW-01 were low (4.7 mg/L) but concentrations exceeded the Tier 1 Guidelines at MW-02 and MW-03 (both 360 mg/L).

Concentrations of ammonia were less than the calculated Tier 1 Guidelines at all monitoring wells. Concentrations were 0.810 mg-N/L and 0.327 mg-N/L at MW-01 and MW-02, respectively. The concentration at MW-03 was an order of magnitude greater (4.80 mg-N/L). Ammonia is used as a leachate indicator parameter and is often elevated in groundwater if there is impact from MSW landfill leachate. As discussed below, the groundwater at MW-03 is more deeply anoxic which is reflected by the higher ammonia concentrations. Concentrations were consistent with results obtained in 2013.

Dissolved Metals

Dissolved aluminum concentrations were greater than the guideline at MW-02 (0.0636 mg/L) and at MW-03 (0.0987 mg/L). Concentrations in 2019 were greater than in 2013, but within the same order of magnitude. The elevated aluminum concentration suggests incomplete filtering of these sample occurred. The two samples with dissolved aluminum exceedances also exhibit the greatest DOC concentrations and published information suggests elevated DOC may act as a colloidal carrier and influence filtration rates. The interpreted inadequate filtration at MW-02 and MW-03 implies that dissolved metal concentrations in these samples may not be a proper reflection of the in-situ groundwater quality.

Concentrations of dissolved arsenic were greater than the Tier 1 Guidelines at MW-01 and MW-03 in 2019. The concentrations of dissolved arsenic at MW-01 (interpreted up-gradient) are likely correlated to the presence of dissolved iron and, because chloride concentrations at the well are also low (less than 2.5 mg/L), may not necessarily be related to former landfill activities. At MW-03, groundwater conditions are deeper anoxic with higher dissolved iron concentrations and associated higher arsenic concentration.

The concentration of dissolved barium at MW-03 in December 2019 (1.09 mg/L) was marginally greater than the Tier 1 Guidelines (1.0 mg/L). Concentrations of dissolved barium at this well have increased from the concentration measured in 2013 (0.72 mg/L). Tetra Tech interprets this dissolved barium concentration to be related to the low sulphate concentration measured in the groundwater at this well. As barium sulphate has a low solubility, more barium will be released into solution when sulphate concentrations are low. The measured barium concentration is not considered an environmental concern.

Iron and manganese are redox-sensitive parameters that 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 at all monitoring wells during the 2019 sampling event, including at up-gradient monitoring well MW-01. Manganese and iron also naturally occur in groundwater under anaerobic conditions and concentrations of these parameters do not necessarily indicate an adverse impact on groundwater quality. However, the dissolved iron concentration at MW-03 (26.7 mg/L), in conjunction with low sulphate and an ammonia concentration of 4.8 mg-N/L, suggest that the anoxic conditions are related to landfill leachate.

A dissolved uranium concentration greater than the Tier 1 Guidelines (0.015 mg/L) was measured at MW-02 (0.0338 mg/L) in December 2019. The concentration of dissolved uranium in 2013 at MW-02 was also greater than

the current guideline. The dissolved uranium concentrations were consistent with the 2013 results and may be naturally occurring.

Organic Parameters

Concentrations of BTEX and PHC fractions F1 to F2 were less than the analytical detection limits at all locations with the exception of PHC fraction F2 at MW-03, which was equal to the analytical detection limit (0.10 mg/L). The DOC concentration at MW-03 was also 33.6 mg/L in 2019, which was greater than the concentrations at up-gradient monitoring well MW-01 (4.6 mg/L) and MW-02 (16.9 mg/L). As stated above, MW-03 exhibits inferred anoxic conditions, possibly due to leachate impact, which may explain the trace concentration of PHC fraction F2.

In 2019, concentrations of AOX, volatile fatty/carboxylic acids, and VOCs were less than the analytical detection limits at all monitoring wells, which was consistent with historical results.

7.5 Soil Vapour Monitoring Results

The soil vapour monitoring results are presented in Table 3.

Pressures at VW-01 were negligible during all monitoring events in 2019. Concentrations of methane were less than the instrument detection limit during all events in 2019. Concentrations of carbon dioxide, oxygen, and balance gas were consistent between the four monitoring events. The vapour well was dry in 2019 indicating the well was not blinded in groundwater.

7.6 Vapour Analytical Results

The attached 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 D.

BTEX and PHC fractions F1 and F2 (parameters with a TRV for inhalation) were compared against the screening criteria for commercial land use, 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 samples VW-01 and its duplicate (19DUP01). However, soil vapour concentrations were between 290 and 319,000 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

The concentration of methane in the sample collected from VW-01 in December 2019 was less than the laboratory analytical detection limit (0.05% vol), which is consistent with the vapour monitoring results.

Siloxanes do not have TRV values for inhalation and were, therefore, not compared against the vapour screening criteria. Concentrations of siloxanes in sample VW-01 were not detected greater 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 commercial land use, coarse-grained soil. Several parameters were detected greater than the analytical detection limits in samples VW-01 and 19DUP01. However, the soil vapour concentrations were between 1,300 and 113,000 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

7.7 Quality Assurance/Quality Control

7.7.1 Methods

Tetra Tech's 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 soil vapour sample; and
- Documenting field procedures and sampling activities.

7.7.2 Results

The QA/QC results for vapours 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:

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

Where:

V₁ = Parent Sample

V₂ = 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.

Several duplicate RPDs were greater than 20%; the differences are assumed to be based on the duplicate collection methods, which involve two separate flow regulators for the Summa canisters, which may lead to different flow rates into the canister at times; these effects are accentuated at the low concentrations measured. 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, cumulative 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.

The cumulative risk level for carcinogens in sample VW-01 and its duplicate was between 3.1×10^{-8} and 3.4×10^{-8} , which are less than the target risk level of 1×10^{-5} . The cumulative hazard level for non-carcinogens identified in sample VW-01 and its duplicate, was 0.001, which is less than the target hazard level of 1. Table 7 summarizes the soil properties used for 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 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 in any of the samples collected.

9.0 EVALUATION OF SITE CONDITIONS

9.1 Summary of Site Conditions

Based on the evaluation of 2019 and historical groundwater quality data (Appendix F) for the site, some leachate impact is evident at MW-02 (northeast) and MW-03 (east), based on measured concentrations of typical leachate indicator parameters like ammonia and chloride. However, there is no evidence that there are significant groundwater quality concerns related to the former landfill operations at Riverside Heavy. The previous Phase II ESA recommended sampling the slough on-site if groundwater conditions changed. Groundwater conditions at the site in 2019 were overall consistent with conditions in 2013, and there was no evidence of significant concerns. As such, collection of surface water samples from the slough is not recommended.

The soil vapour monitoring results at vapour monitoring well VW-01 indicate that concentrations of methane were less than the instrument detection limit during all monitoring events in 2019. However, there are no vapour wells near the eastern portion of the site and therefore no measurements of subsurface methane concentrations are available. Based on the indication of some leachate impact on the east portion of the site and evidence of anoxic conditions, additional vapour monitoring is considered warranted in this area of the site to confirm methane is not a concern. We note that measurements of VOCs and CVCs in groundwater monitoring well headspaces did not identify significantly elevated levels at any of the wells, and that the nearest commercial building on the east side is at a distance of more than 100 m.

Based on the above, and on the continued presence of buried landfill waste at the site, ongoing risk management measures are recommended as outlined below.

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 567 (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, toluene, ethylbenzene, chloromethane, and chloroform) 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 XCG¹. 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 .

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.

¹ XCG Consulting Limited, 2018. Vapour Intrusion Assessment and Environmental Monitoring Report, prepared for the City of Red Deer's Montfort Landfill.

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 individual hazard quotient calculated for the site was 0.0008 (vs the individual target hazard level of 0.2) and the greatest estimated cancer risk was 3.4×10^{-8} (vs target Risk of 1.0×10^{-5}). While development at the site is not currently proposed, for illustrative purposes, based on these hazard quotients and cancer risk levels 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. Similarly, with cumulative risks and hazard quotients the same conclusion can be drawn. The 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 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 to the northeast. The average horizontal hydraulic gradient at the site is 0.08 m/m. This is consistent with observations made historically. The groundwater elevations in 2019 were consistent with the historical groundwater elevations from 2013.
- Groundwater parameters that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2019 included TDS, sodium, chloride, sulphate, and dissolved metals including aluminum, arsenic, barium, iron, manganese, and uranium. The measured concentrations of these parameters were generally consistent with previous results. Several parameters are interpreted to reflect natural groundwater quality; however, some leachate impact is evident at MW-02 (northeast) and MW-03 (east).
- Concentrations of BTEX, PHC fractions F1 to F2, AOX, volatile fatty/carboxylic acids, and VOCs in groundwater in 2019 were less than the analytical detection limits at all monitoring wells with the exception of PHC fraction F2 at MW-03, which was equal to the analytical detection limit (0.10 mg/L), but considerably less than the Tier 1 Guideline (1.1 mg/L).

- Concentrations of BTEX, hydrocarbons, and VOCs in soil vapour samples collected (VW-01 and duplicate) were less than the soil vapour screening criteria.
- Siloxanes were not detected in the soil vapour samples 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 vapour and groundwater monitoring program in 2019 and previous years, there are indications of residual impacts related to the former landfill operations at several monitoring well locations. The groundwater monitoring program identified that some leachate indicator parameter concentrations are elevated in groundwater at the cross-gradient and down-gradient monitoring well locations; however, the groundwater flow direction is well defined and inferred risks to receptors are limited. Therefore, continuing the groundwater monitoring and sampling program is not warranted.

Based on the results of the soil vapour samples, there is little indication that this pathway will pose a hazard to receptors. However, information regarding potential subsurface methane concentrations along the east portion of the site is limited; based on the indication of some leachate impact in the groundwater on the east portion of the site and evidence of anoxic conditions, additional vapour monitoring is considered warranted to confirm methane is not a concern.

Buried landfill waste remains beneath the site, therefore ongoing risk management is required. Risk management is recommended to include ongoing monitoring and administrative actions. These include the following:

- Ongoing Monitoring:
 - Conduct one additional year of quarterly monitoring at the site, including headspace methane measurements, headspace pressures and water levels at all groundwater and soil vapour probes, to confirm methane is not present at significant concentrations, in particular along the east portion of the site.
 - If preliminary monitoring results indicate either that the eastern groundwater wells are blinded (i.e. the well screen is completely submerged) or identify elevated methane, vapour-specific monitoring probes would be recommended for this portion of the site. If concerns with methane are not identified, then the program would be recommended to be stopped.
- 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.

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.

FILE: 704-SWM.SWOP04071-01.007
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Table 1: Groundwater Elevations

Monitoring Well		MW-01	MW-02	MW-03
Total Drilled Depth (m)		14.9	6.1	6.1
Top of Screened Interval (mbg)		11.9	3.1	1.5
Bottom of Screened Interval (mbg)		14.9	6.1	6.1
Stick up (m)		0.75	0.74	0.73
Ground Elevation (m)		871.81	848.56	847.73
TPC Elevation (m)		872.56	849.29	848.47
Depth to Groundwater (mBTPC)	Aug-13	9.63	3.99	1.90
	May-19	10.53	4.81	1.96
	Jun-19	10.43	4.44	2.08
	Sep-19	10.49	4.85	2.70
	Dec-19	10.37	4.85	2.43
Groundwater Elevation (m)	Aug-13	862.93	845.31	846.56
	May-19	862.03	844.48	846.50
	Jun-19	862.13	844.86	846.39
	Sep-19	862.07	844.45	845.77
	Dec-19	862.19	844.45	846.04
Combustible Vapour Concentrations* (CVCs) (ppm)	May-19	ND	ND	ND
	Jun-19	ND	ND	ND
	Sep-19	ND	ND	65
	Dec-19	5	5	5
Volatile Organic Compounds* (VOCs) (ppm)	May-19	ND	ND	ND
	Jun-19	ND	ND	ND
	Sep-19	ND	ND	ND
	Dec-19	ND	ND	12

Notes:

mbg - Metres below grade.

mBTPC - Metres below top of plastic pipe casing.

ppm - Parts per million

*- Measured using an RKI Eagle II calibrated to hexane and isobutylene and 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
			Sample Date	3-Dec-2019	3-Dec-2019	3-Dec-2019
			Lab Report Number	L2393425	L2393425	L2393425
			Laboratory ID	L2393425-1	L2393425-2	L2393425-3
Field Testing						
Field Temperature	°C	-	5.87	5.96	5.85	
Field Electric Conductivity	µS/cm	-	1,026	2,023	1,461	
Field pH	pH Units	6.5 to 8.5	7.08	6.88	7.05	
Routine						
pH	pH Units	6.5 to 8.5	7.75	7.54	7.86	
Electrical Conductivity (EC)	µS/cm	-	1,690	3,100	2,080	
Total Dissolved Solids (TDS)	mg/L	500	1,260	2,240	1,220	
Hardness as CaCO ₃	mg/L	-	712	1,530	866	
Alkalinity (total as CaCO ₃)	mg/L	-	592	681	854	
Bicarbonate	mg/L	-	722	831	1,040	
Carbonate	mg/L	-	<5.0	<5.0	<5.0	
Hydroxide	mg/L	-	<5.0	<5.0	<5.0	
Calcium	mg/L	-	206	370	177	
Magnesium	mg/L	-	48.0	146	103	
Potassium	mg/L	-	5.97	9.06	10.1	
Sodium	mg/L	200	141	256	147	
Chloride	mg/L	120	<2.5	429	271	
Fluoride	mg/L	1.5	<0.10	<0.10	0.13	
Phosphorus (P) - Total	mg/L	-	0.769	0.109	1.16	
Sulphate	mg/L	429 ³	499	624	2.1	
Ionic Balance	N/A	-	92.6	108	98.2	
Nutrients						
Ammonia as N	mg/L	9.67 to 15.5 ⁶	0.810	0.327	4.80	
Nitrate (as NO ₃ -N)	mg/L	3	<0.10	<0.10	<0.10	
Nitrite (as NO ₂ -N)	mg/L	0.020 to 0.20 ⁴	<u><0.050</u>	<u><0.050</u>	<u><0.050</u>	
Nitrate and Nitrite (as N)	mg/L	-	<0.11	<0.11	<0.11	
Total Kjeldahl Nitrogen (TKN)	mg/L	-	1.61	0.85	7.1	
Carbon						
Dissolved Organic Carbon (DOC)	mg/L	-	4.6	16.9	33.1	
Dissolved Metals						
Aluminum	mg/L	0.05 ⁵	0.0056	0.0636	0.0987	
Antimony	mg/L	0.006	<0.00050	<0.00050	<0.00050	
Arsenic	mg/L	0.005	0.0148	0.00096	0.0272	
Barium	mg/L	1	0.0591	0.0432	1.09	
Boron	mg/L	1.5	0.287	0.122	0.09	
Cadmium	mg/L	0.00037 ³	0.000179	0.000238	0.000056	
Chromium	mg/L	0.05	<0.00050	<0.00050	<0.00050	
Copper	mg/L	0.007	0.0068	<0.0010	0.0068	
Iron	mg/L	0.3	1.92	0.801	27.6	
Lead	mg/L	0.007 ³	0.00025	<0.00025	0.00056	
Manganese	mg/L	0.05	1.33	0.832	1.40	
Mercury	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	
Nickel	mg/L	0.274 to 0.524 ³	0.0049	0.0128	0.0087	
Selenium	mg/L	0.002	<0.00025	0.00030	0.00037	
Silver	mg/L	0.0001	<0.000050	<0.000050	<0.000050	
Uranium	mg/L	0.015	0.00471	0.0338	0.00273	
Zinc	mg/L	0.03	<0.0050	<0.0050	0.0052	
Organics						
AOX	mg/L	-	ND	ND	ND	
Hydrocarbons						
Benzene	mg/L	0.005	<0.00050	<0.00050	<0.00050	
Toluene	mg/L	0.021	<0.00050	<0.00050	<0.00050	
Ethylbenzene	mg/L	0.0016	<0.00050	<0.00050	<0.00050	
Xylenes (m & p)	mg/L	-	<0.00050	<0.00050	<0.00050	
Xylene (o)	mg/L	-	<0.00050	<0.00050	<0.00050	
Xylenes Total	mg/L	0.02	<0.00071	<0.00071	<0.00071	
Styrene	mg/L	0.072	<0.00050	<0.00050	<0.00050	
F1 (C ₆ -C ₁₀)	mg/L	-	<0.10	<0.10	<0.10	
F1 (C ₆ -C ₁₀) - BTEX	mg/L	2.2	<0.10	<0.10	<0.10	
F2 (C ₁₀ -C ₁₆)	mg/L	1.1	<0.10	<0.10	0.10	
Volatile Fatty/Carboxylic Acids						
Acetic Acid	mg/L	-	<10	<10	<10	
Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	
Formic Acid	mg/L	-	<50	<50	<50	
Hexanoic Acid	mg/L	-	<1.0	<1.0	<1.0	
iso-Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	
Isovaleric acid	mg/L	-	<1.0	<1.0	<1.0	
Proponic Acid	mg/L	-	<5.0	<5.0	<5.0	
Valeric Acid	mg/L	-	<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 Commercial/Industrial 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 712 mg/L to 1,530 mg/L.

⁴ Guideline varies with chloride. Values shown based on site chloride range of <2.5 mg/L to 429 mg/L.

⁵ Guideline varies with pH. Values shown based on site pH range of 6.88 to 7.08.

⁶ Guideline varies with pH and temperature. Values shown based on pH range of 6.88 to 7.08 and temperature range of 5.85°C to 5.96°C.

"-" No applicable guideline.

"ND" Non-detected.

BOLD - Greater than Tier 1 Guideline.

Italic - Detection limit greater than Tier 1 Guideline.

N/A - Not applicable.

Table 2: Groundwater Analytical Results

Parameter	Unit	Tier 1 Guideline ^{1,2}	Location Code	MW-01	MW-02	MW-03
			Sample Date	3-Dec-2019	3-Dec-2019	3-Dec-2019
			Lab Report Number	L2393425	L2393425	L2393425
			Laboratory ID	L2393425-1	L2393425-2	L2393425-3
Volatile Organic Compounds (VOCs)						
Bromobenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
Bromochloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	
Bromodichloromethane	mg/L	-	<0.00050	<0.00050	<0.00050	
Bromoform	mg/L	-	<0.00050	<0.00050	<0.00050	
Bromomethane	mg/L	-	<0.0010	<0.0010	<0.0010	
n-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
sec-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
tert-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
Carbon tetrachloride	mg/L	0.002	<0.00050	<0.00050	<0.00050	
Chlorobenzene	mg/L	0.0013	<0.00050	<0.00050	<0.00050	
Chloroethane	mg/L	-	<0.0010	<0.0010	<0.0010	
Chloroform	mg/L	0.018	<0.00050	<0.00050	<0.00050	
Chloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	
2-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	
4-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	
Dibromochloromethane	mg/L	0.19	<0.00050	<0.00050	<0.00050	
1,2-Dibromo-3-chloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	
1,2-Dibromoethane	mg/L	-	<0.00050	<0.00050	<0.00050	
Dibromomethane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,2-Dichlorobenzene	mg/L	0.0007	<0.00050	<0.00050	<0.00050	
1,3-Dichlorobenzene	mg/L	-	<0.00050	<0.00050	<0.00050	
1,4-Dichlorobenzene	mg/L	0.001	<0.00050	<0.00050	<0.00050	
1,1-Dichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,2-Dichloroethane	mg/L	0.005	<0.0010	<0.0010	<0.0010	
1,1-Dichloroethene	mg/L	0.014	<0.00050	<0.00050	<0.00050	
1,2-Dichloroethene (cis)	mg/L	-	<0.0010	<0.0010	<0.0010	
1,2-Dichloroethene (trans)	mg/L	-	<0.00050	<0.00050	<0.00050	
Dichlorodifluoromethane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,2-Dichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,3-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	
2,2-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	
1,1-Dichloropropene	mg/L	-	<0.0010	<0.0010	<0.0010	
1,3-Dichloropropene [cis]	mg/L	-	<0.00050	<0.00050	<0.00050	
1,3-Dichloropropene [trans]	mg/L	-	<0.0010	<0.0010	<0.0010	
Hexachlorobutadiene	mg/L	0.0013	<0.0010	<0.0010	<0.0010	
p-Isopropyltoluene	mg/L	-	<0.0010	<0.0010	<0.0010	
Methylene Chloride	mg/L	0.05	<0.0010	<0.0010	<0.0010	
iso-Propylbenzene (cumene)	mg/L	-	<0.0010	<0.0010	<0.0010	
n-Propylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
1,1,1,2-Tetrachloroethane	mg/L	-	<0.0010	<0.0010	<0.0010	
1,1,2,2-Tetrachloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	
Tetrachloroethene	mg/L	0.01	<0.00050	<0.00050	<0.00050	
1,2,3-Trichlorobenzene	mg/L	0.008	<0.0010	<0.0010	<0.0010	
1,2,4-Trichlorobenzene	mg/L	0.015	<0.0010	<0.0010	<0.0010	
1,1,1-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,1,2-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	
Trichloroethene	mg/L	0.005	<0.00050	<0.00050	<0.00050	
Trichlorofluoromethane	mg/L	-	<0.0010	<0.0010	<0.0010	
1,2,3-Trichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	
1,2,4-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
1,3,5-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	
Vinyl chloride	mg/L	0.002	<0.00050	<0.00050	<0.00050	

Notes:

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⁶ Guideline varies with pH and temperature. Values shown based on pH range of 6.88 to 7.08 and temperature range of 5.85°C to 5.96°C.

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Italic - Detection limit greater than Tier 1 Guideline.

N/A - Not applicable.

Table 3: 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	0.0
CO ₂ (%)	7.0	6.7	6.5	7.0	9.3
O ₂ (%)	14.2	11.9	12.3	12.9	11.1
Balance (% v/v)	78.8	81.5	81.2	80.1	79.4
Static Water Level (mbtoc) ³		Dry	Dry	Dry	Dry
Depth to Bottom (m)	7.30	4.60	4.59	4.58	4.71
Stick up (m)		0.70	0.70	0.79	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 Guidelines - Commercial Coarse-Grained	VW-01	
				VW-01	19DUP01
				3-Dec-2019	3-Dec-2019
				L2393615	L2393615
				L2393615-1/ L2393615-3	L2393615-2
Parameter	Unit	$\mu\text{g}/\text{m}^3$			
Field Tests					
Air Volume	L		0.06	-	
Initial Pressure	in Hg		-9.6	-7.8	
Aliphatic/Aromatic PHC Sub-Fractionation					
Aliphatics (C ₆ -C ₈)	$\mu\text{g}/\text{m}^3$	7,208,479	57	79	
Aliphatics (>C ₈ -C ₁₀)	$\mu\text{g}/\text{m}^3$	391,765	48	48	
Aliphatics (>C ₁₀ -C ₁₂)	$\mu\text{g}/\text{m}^3$	391,765	23	21	
Aliphatics (>C ₁₂ -C ₁₆)	$\mu\text{g}/\text{m}^3$	391,765	<30	<30	
Aromatics (>C ₈ -C ₁₀)	$\mu\text{g}/\text{m}^3$	7,835	<15	<15	
Aromatics (>C ₁₀ -C ₁₂)	$\mu\text{g}/\text{m}^3$	78,353	<15	<15	
Aromatics (>C ₁₂ -C ₁₆)	$\mu\text{g}/\text{m}^3$	78,353	<30	<30	
Linear & Cyclic Methyl Siloxanes					
Hexamethylcyclotrisiloxane, D3(CVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Octamethylcyclotetrasiloxane, D4(CVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Decamethylcyclopentasiloxane, D5(CVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Dodecamethylcyclohexasiloxane, D6(CVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Hexamethyldisiloxane, MM(LVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Octamethyltrisiloxane, MDM(LVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Decamethyltetrasiloxane, MD2M(LVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Dodecamethylpentasiloxane, MD3M(LVMS)	$\mu\text{g}/\text{m}^3$	NG	<170	-	
Hydrocarbons					
Benzene	$\mu\text{g}/\text{m}^3$	711	2.17	2.43	
Toluene	$\mu\text{g}/\text{m}^3$	1,252,764	6.20	6.35	
Ethylbenzene	$\mu\text{g}/\text{m}^3$	343,100	<0.87	<0.87	
Xylenes (m & p)	$\mu\text{g}/\text{m}^3$	NG	2.7	2.7	
Xylene (o)	$\mu\text{g}/\text{m}^3$	NG	1.01	1.00	
Xylenes Total	$\mu\text{g}/\text{m}^3$	63,009	3.7	3.7	
Styrene	$\mu\text{g}/\text{m}^3$	32,070	<0.85	<0.85	
F1 (C ₆ -C ₁₀)	$\mu\text{g}/\text{m}^3$	8,440,843	92	109	
F2 (C ₁₀ -C ₁₆)	$\mu\text{g}/\text{m}^3$	510,777	33	24	
Alcohols					
Isopropanol	$\mu\text{g}/\text{m}^3$	63,317	2.6	<2.5	
High Level Fixed Gases					
Nitrogen	%	NG	76.4	74.8	
Oxygen	%	NG	20.2	20.2	
Carbon Dioxide	%	NG	0.674	0.702	
Carbon Monoxide	%	NG	<0.050	<0.050	
Methane	%	NG	<0.050	<0.050	
Polycyclic Aromatic Hydrocarbons (PAHs)					
Naphthalene	$\mu\text{g}/\text{m}^3$	1,108	<2.6	<2.6	
Hydrocarbon Gases (C₁-C₅)					
Methane	%	NG	0.00026	0.00026	
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	

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 Table 6 to Table 9 for further information.

NG - No applicable guideline

BOLD - Greater than Guideline

Table 4: Soil Vapour Analytical Results

		Location Code Field ID Sample Date Lab Report Number Laboratory ID	Generic Soil Vapour Guidelines - Commercial Coarse-Grained	VW-01	
				VW-01	19DUP01
				3-Dec-2019	3-Dec-2019
				L2393615	L2393615
				L2393615-1/ L2393615-3	L2393615-2
Parameter	Unit	µg/m ³			
Volatile Organic Compounds (VOCs)					
1,1,1-Trichloroethane	µg/m ³	16,967,811	<1.1	<1.1	
1,1,1,2-Tetrachloroethane	µg/m ³	162	<1.4	<1.4	
1,1,2-Trichloroethane	µg/m ³	610	<1.1	<1.1	
1,1-Dichloroethane	µg/m ³	6,146	<0.81	<0.81	
1,1-Dichloroethene	µg/m ³	65,376	<0.79	<0.79	
1,2,4-Trichlorobenzene	µg/m ³	4,930	<1.5	<1.5	
1,2,4-Trimethylbenzene	µg/m ³	21,926	<0.98	<0.98	
1,2-Dibromoethane	µg/m ³	5,410	<1.5	<1.5	
1,2-Dichlorobenzene	µg/m ³	70,313	<1.2	<1.2	
1,2-Dichloroethane	µg/m ³	348	<0.81	<0.81	
1,2-Dichloroethene (cis)	µg/m ³	2,415	<0.79	<0.79	
1,2-Dichloroethene (trans)	µg/m ³	2,443	<0.79	<0.79	
1,2-Dichloropropane	µg/m ³	1,356	<0.92	<0.92	
1,2-Dichlorotetrafluoroethane	µg/m ³	5,691,447	<1.4	<1.4	
1,3,5-Trimethylbenzene	µg/m ³	22,022	<0.98	<0.98	
1,3-Butadiene	µg/m ³	262	<0.44	<0.44	
1,3-Dichlorobenzene	µg/m ³	913	<1.2	<1.2	
1,3-Dichloropropene [cis]	µg/m ³	490	<0.91	<0.91	
1,3-Dichloropropene [trans]	µg/m ³	2,141	<0.91	<0.91	
1,4-Dichlorobenzene	µg/m ³	913	<1.2	<1.2	
1,4-Dioxane	µg/m ³	1,586	<0.72	<0.72	
1-Methyl-4 ethyl benzene	µg/m ³	143,229	<0.98	<0.98	
2-Butanone (MEK)	µg/m ³	1,680,480	2.23	5.26	
2-Hexanone (MBK)	µg/m ³	10,484	<4.1	<4.1	
4-Methyl-2-pentanone (MIBK)	µg/m ³	1,029	<0.82	<0.82	
Acetone	µg/m ³	9,433,603	19.8	58.2	
Allyl chloride	µg/m ³	324	<0.63	<0.63	
Benzyl chloride	µg/m ³	343	<1.0	<1.0	
Bromodichloromethane	µg/m ³	379	<1.3	<1.3	
Bromoform	µg/m ³	19,108	<2.1	<2.1	
Bromomethane	µg/m ³	1,729	<0.78	<0.78	
Carbon disulfide	µg/m ³	221,172	1.66	170	
Carbon tetrachloride	µg/m ³	1,616	<1.3	<1.3	
Chlorobenzene	µg/m ³	3,458	<0.92	<0.92	
Chloroethane	µg/m ³	315,959	<0.53	<0.53	
Chloroform	µg/m ³	393	<0.98	<0.98	
Chloromethane	µg/m ³	27,333	1.13	1.0	
Cyclohexane	µg/m ³	2,022,099	<0.69	<0.69	
Dibromochloromethane	µg/m ³	43,273	<1.7	<1.7	
Dichlorodifluoromethane	µg/m ³	35,554	2.30	1.94	
Ethyl acetate	µg/m ³	24,887	<0.72	<0.72	
Freon 113	µg/m ³	2,199,564	<1.5	<1.5	
Heptane	µg/m ³	143,229	1.76	1.7	
Hexachlorobutadiene	µg/m ³	674	<2.1	<2.1	
Hexane	µg/m ³	197,588	2.05	1.84	
Isooctane	µg/m ³	146,973	1.30	1.16	
iso-Propylbenzene (cumene)	µg/m ³	143,229	<0.98	<0.98	
Methyl t-Butyl Ether (MTBE)	µg/m ³	11,731	<0.72	<0.72	
Methylene Chloride	µg/m ³	190,826	<0.69	<0.69	
Propene	µg/m ³	936,937	<0.34	<0.34	
Tetrachloroethene	µg/m ³	38,149	<1.4	<1.4	
Tetrahydrofuran	µg/m ³	628,403	<0.63	<0.59	
Trichloroethene	µg/m ³	2,196	<1.1	<1.1	
Trichlorofluoromethane	µg/m ³	346,158	<1.1	<1.1	
Vinyl acetate	µg/m ³	66,330	<1.8	5.0	
Vinyl bromide (bromoethene)	µg/m ³	956	<0.87	<0.87	
Vinyl chloride	µg/m ³	2,043	<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 Table 6 to Table 9 for further information.

NG - No applicable guideline

BOLD - Greater than Guideline

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	L2393615	L2393615	
			Laboratory ID	L2393615-1/ L2393615-3	L2393615-2	
Field Tests						
Air Volume	L	0.01	0.06	-	-	
Initial Pressure	in Hg	-30	-9.6	-7.8	-	
Aliphatic/Aromatic PHC Sub-Fractionation						
Aliphatics (C ₆ -C ₈)	µg/m ³	15	57	79	39	
Aliphatics (>C ₈ -C ₁₀)	µg/m ³	15	48	48	0	
Aliphatics (>C ₁₀ -C ₁₂)	µg/m ³	15	23	21	-	
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 & 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	2.17	2.43	-	
Toluene	µg/m ³	0.75	6.20	6.35	2	
Ethylbenzene	µg/m ³	0.87	<0.87	<0.87	-	
Xylenes (m & p)	µg/m ³	1.7	2.7	2.7	0	
Xylene (o)	µg/m ³	0.87	1.01	1.00	-	
Xylenes Total	µg/m ³	2	3.7	3.7	0	
Styrene	µg/m ³	0.85	<0.85	<0.85	-	
F1 (C ₆ -C ₁₀)	µg/m ³	15	92	109	18	
F2 (C ₁₀ -C ₁₆)	µg/m ³	15	33	24	-	
Alcohols						
Isopropanol	µg/m ³	2.5	2.6	<2.5	-	
High Level Fixed Gases						
Nitrogen	%	1	76.4	74.8	2	
Oxygen	%	0.1	20.2	20.2	0	
Carbon Dioxide	%	0.05	0.674	0.702	4	
Carbon Monoxide	%	0.05	<0.050	<0.050	-	
Methane	%	0.0001	<0.050	<0.050	-	
Polycyclic Aromatic Hydrocarbons (PAHs)						
Naphthalene	µg/m ³	2.6	<2.6	<2.6	-	
Hydrocarbon Gases (C₁-C₆)						
Methane	%	0.0001	0.00026	0.00026	0	
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	-	
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	2.23	5.26	81	
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	5.9	19.8	58.2	98	
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	3.1	1.66	170	196	
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	1.13	1.0	-	
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	2.30	1.94	-	
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 $RPD(\%) = \frac{|V1-V2|}{[(V1+V2)/2]} * 100$ 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

		Field ID	VW-01	19DUP01	RPD (%)	
			Sample Date	3-Dec-2019		3-Dec-2019
			Lab Report Number	L2393615		L2393615
			Laboratory ID	L2393615-1/ L2393615-3		L2393615-2
Parameter	Unit	RDL				
Volatile Organic Compounds (VOCs)						
Heptane	µg/m ³	0.82	1.76	1.70	-	
Hexachlorobutadiene	µg/m ³	2.1	<2.1	<2.1	-	
Hexane	µg/m ³	0.7	2.05	1.84	-	
Isooctane	µg/m ³	0.93	1.30	1.16	-	
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	-	
Propene	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	<0.63	<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	5.0	-	
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.

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 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.

cm^2 Square centimetre.

g/cm^3 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	Commercial Land Use
L _B	Building length	cm	2,000
W _B	Building width	cm	1,500
A _B	Building area exposed to soil, including basement wall area	cm ²	3.60E+06
H _B	Building height	cm	300
L _{crack}	Thickness of the foundation	cm	11.25
A _{crack}	Area of cracks through which contaminant vapours enter the building	cm ²	1846
ACH	Air exchanges per hour	h ⁻¹	0.9

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	Commercial Land Use			
	Units	Coarse-Grained	Units	Coarse-Grained
Benzene		0.71		711
Toluene		1,253		1,252,764
Ethylbenzene		343		343,100
Xylenes		63		63,009
PHC F1		8,441		8,440,843
PHC F2		511		510,777
Naphthalene		1.11		1,108
1,1,1-Trichloroethane		16,968		16,967,811
1,1,2,2-Tetrachloroethane		0.16		162
1,1,2-Trichloroethane		0.61		610
1,1-Dichloroethane		6.15		6,146
1,1-Dichloroethene		65		65,376
1,2,4-Trichlorobenzene		4.93		4,930
1,2,4-Trimethylbenzene		22		21,926
1,2-Dibromoethane		5.41		5,410
1,2-Dichlorobenzene		70		70,313
1,2-Dichloroethane		0.35		348
1,2-Dichloroethene (cis)		2.41		2,415
1,2-Dichloroethene (trans)		2.44		2,443
1,2-Dichloropropane		1.36		1,356
1,3,5-Trimethylbenzene		22		22,022
1,3-Butadiene		0.26		262
1,3-Dichlorobenzene		0.91		913
1,3-Dichloropropene [cis]		0.49		490
1,3-Dichloropropene [trans]		2.14		2,141
1,4-Dichlorobenzene		0.91		913
1,4-Dioxane		1.59		1,586
1-Methyl-4 ethyl benzene		143		143,229
2-Butanone (MEK)		1,680		1,680,480
2-Hexanone (MBK)		10		10,484
4-Methyl-2-pentanone (MIBK)		1.03		1,029
Acetone		9,434		9,433,603
Allyl chloride	mg/m ³	0.32	µg/m ³	324
Benzyl chloride		0.34		343
Bromodichloromethane		0.38		379
Bromoform		19		19,108
Bromomethane		1.73		1,729
Carbon disulfide		221		221,172
Carbon tetrachloride		1.62		1,616
Chlorobenzene		3.46		3,458
Chloroethane		316		315,959
Chloroform		0.39		393
Chloromethane		27		27,333
Cyclohexane		2,022		2,022,099
Dibromochloromethane		43		43,273
Dichlorodifluoromethane		36		35,554
Ethyl acetate		25		24,887
Freon 113		2,200		2,199,564
Freon 114		5,691		5,691,447
Heptane		143		143,229
Hexachlorobutadiene		0.67		674
Hexane		198		197,588
Isooctane		147		146,973
iso-Propylbenzene (cumene)		143		143,229
Isopropanol		63		63,317
Methyl t-Butyl Ether (MTBE)		12		11,731
Methylene Chloride		191		190,826
Propylene		937		936,937
Styrene		32		32,070
Tetrachloroethene		38		38,149
Tetrahydrofuran		628		628,403
Trichloroethene		2.20		2,196
Trichlorofluoromethane		346		346,158
Vinyl acetate		66		66,330
Vinyl bromide (bromoethene)		0.96		956
Vinyl chloride		2.04		2,043

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 (µg/m ³)		Comparisons of Soil Vapour Measurements to Soil Vapour Criteria			
			VW-01	19DUP-01	Estimated Cancer Risk ^b		Estimated Hazard Quotients ^c	
					VW-01	19DUP-01	VW-01	19DUP-01
Benzene	µg/m ³	711	2.17	2.43	3.1E-08	3.4E-08	--	--
Toluene	µg/m ³	1,252,764	6.20	6.35	-	-	4.95E-06	5.07E-06
Xylenes Total	µg/m ³	63,009	3.7	3.7	-	-	5.87E-05	5.87E-05
F1 (C ₆ -C ₁₀)	µg/m ³	8,440,843	92	109	-	-	1.09E-05	1.29E-05
F2 (C ₁₀ -C ₁₆)	µg/m ³	510,777	33	24	-	-	6.46E-05	4.70E-05
Aliphatics (C ₆ -C ₈)	µg/m ³	7,208,479	57	79	-	-	7.91E-06	1.10E-05
Aliphatics (>C ₈ -C ₁₀)	µg/m ³	391,765	48	48	-	-	1.23E-04	1.23E-04
Aliphatics (>C ₁₀ -C ₁₂)	µg/m ³	391,765	23	21	-	-	5.87E-05	5.36E-05
Isopropanol	µg/m ³	63,317	2.6	<2.5	-	-	4.11E-05	ND
2-Butanone (MEK)	µg/m ³	1,680,480	2.23	5.26	-	-	1.33E-06	3.13E-06
Acetone	µg/m ³	9,433,603	19.8	58.2	-	-	2.10E-06	6.17E-06
Carbon disulfide	µg/m ³	221,172	1.66	170	-	-	7.51E-06	7.69E-04
Chloromethane	µg/m ³	27,333	1.13	1.0	-	-	4.13E-05	3.66E-05
Dichlorodifluoromethane	µg/m ³	35,554	2.30	1.94	-	-	6.47E-05	5.46E-05
Heptane	µg/m ³	143,229	1.76	1.7	-	-	1.23E-05	1.19E-05
Hexane	µg/m ³	197,588	2.05	1.84	-	-	1.04E-05	9.31E-06
Isooctane	µg/m ³	146,973	1.30	1.16	-	-	8.85E-06	7.89E-06
Vinyl acetate	µg/m ³	66,330	<1.8	5.0	-	-	ND	7.54E-05
Cumulative Risk and Hazard Index ^d					3.1E-08	3.4E-08	0.001	0.001
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.

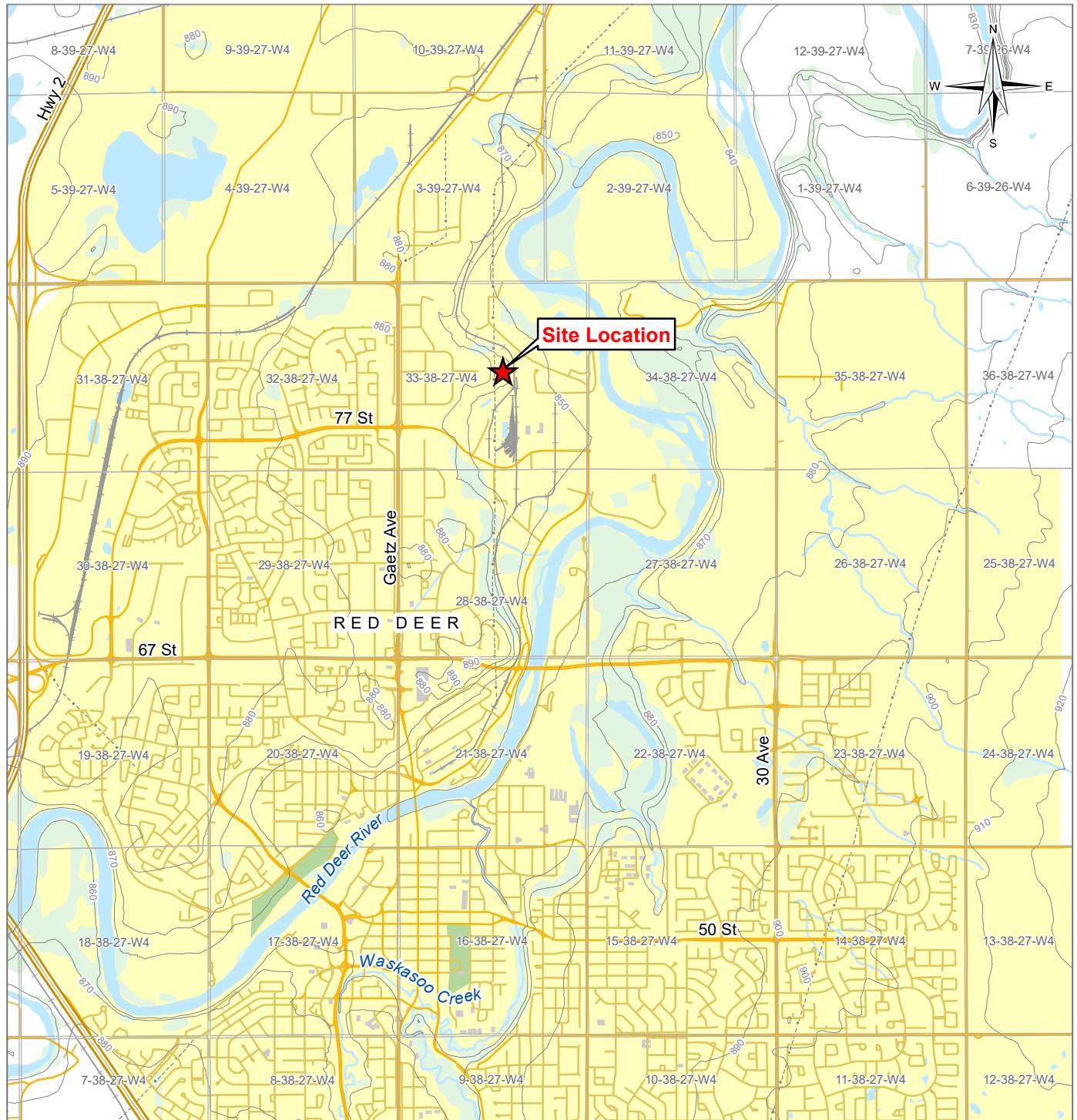
^b Estimated cancer risk = (soil vapour concentration/cancer soil vapour screening level) x 10^{-5} .

^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 Location
- 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 RIVERSIDE HEAVY DRY WASTE

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 Ti-EDM	DWN MRV	CKD SL	APVD MR	REV 0	TETRA TECH
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007				

Figure 1

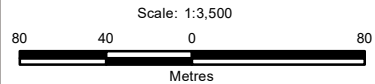


LEGEND

- Monitoring Well
- Vapour Well
- Historic Waste Disposal (Provided by Tiamat, 2014)
- Municipal Sanitary Waste Area (Provided by Tiamat, 2014)
- Site Boundary
- 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



PROJECTION
 3TM 114

DATUM
 NAD83

FILE NO.
 SWOP04071-01_Figure2_LandUse.mxd

CLIENT

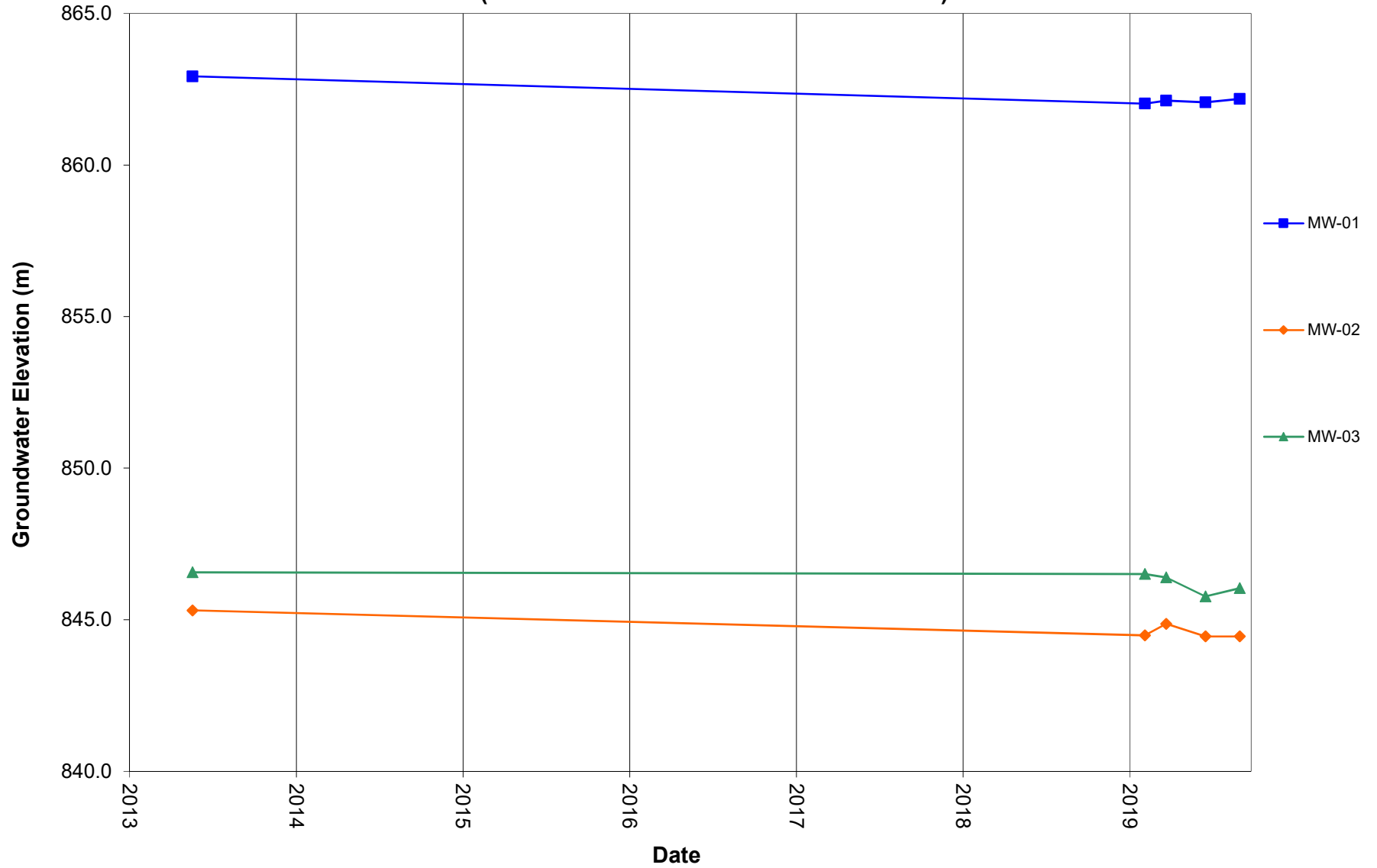
2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RIVERSIDE HEAVY DRY WASTE

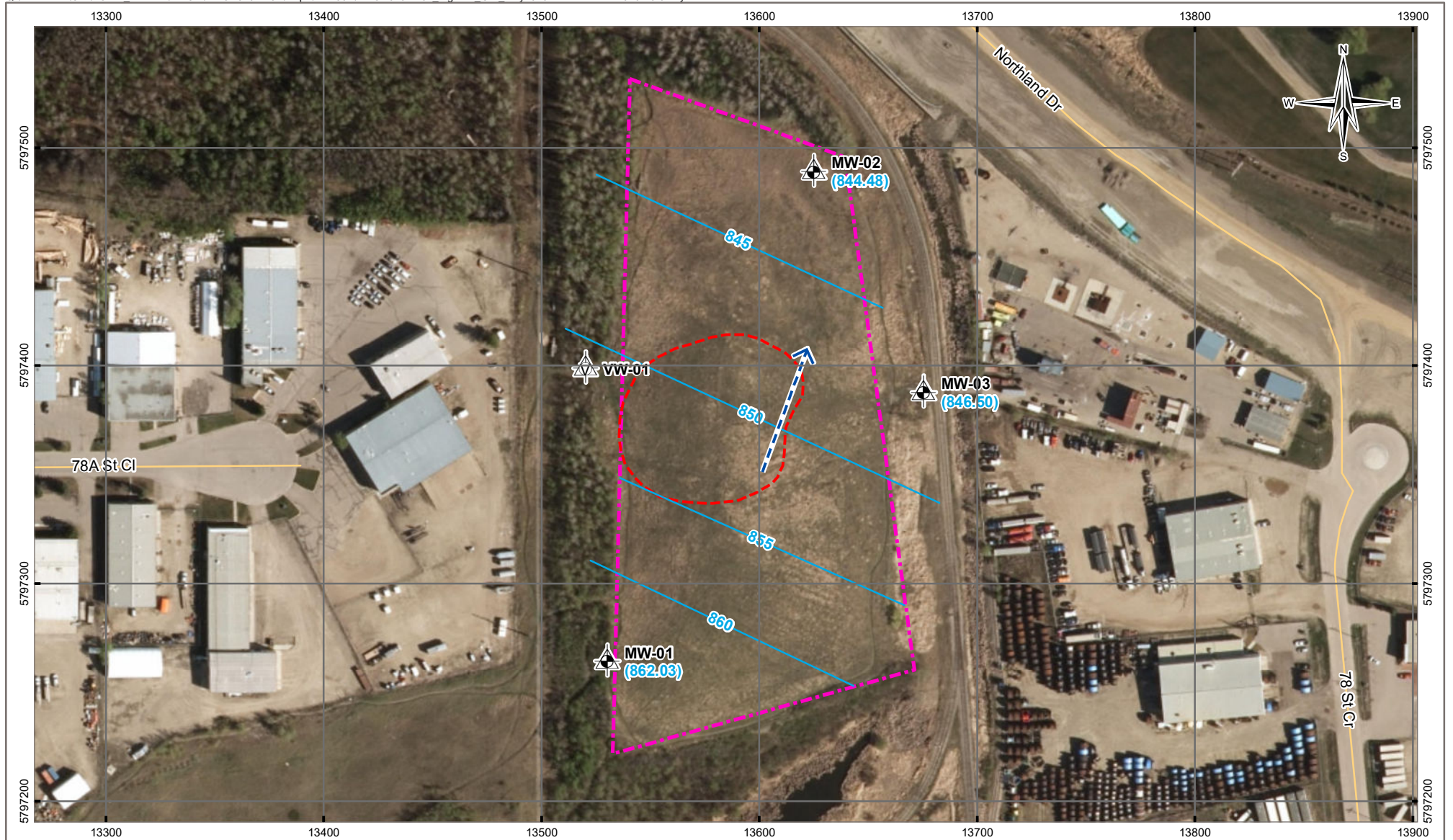
Site Plan and Surrounding Land Use

OFFICE TL-EDM	DWN MRV MRV	CKD SL SL	APVD MR MR	REV 0
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007			






Figure 2




**FIGURE 3
HISTORICAL GROUNDWATER ELEVATIONS
(GROUNDWATER MONITORING WELLS)**





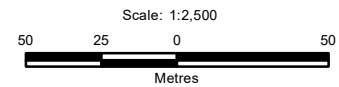
LEGEND


-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (8XX.XX) Groundwater Elevation (masl)

-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Municipal Sanitary Waste Area (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

STATUS
 ISSUED FOR USE



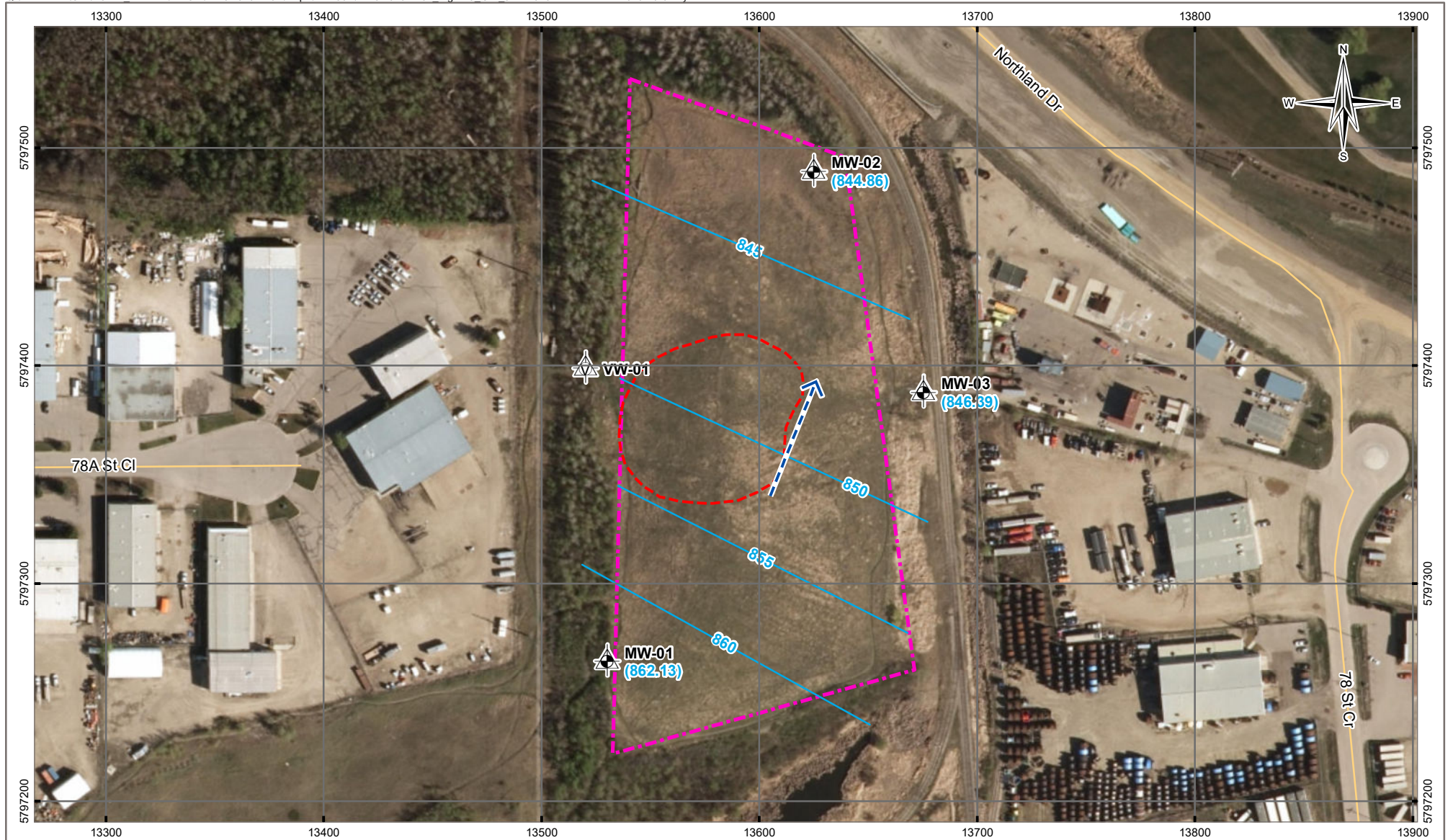
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CLIENT  Red Deer	
 TETRA TECH	

**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 RIVERSIDE HEAVY DRY WASTE**






**Groundwater Elevation Contours
 May 2019**




OFFICE TI-EDM	DWN MRV	CKD SL	APVD MR	REV 0
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007			

Figure 4



LEGEND

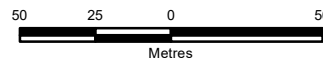
-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (8XX.XX) Groundwater Elevation (masl)

-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Municipal Sanitary Waste Area (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

STATUS
 ISSUED FOR USE

Scale: 1:2,500



PROJECTION
 3TM 114

DATUM
 NAD83

FILE NO.
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CLIENT

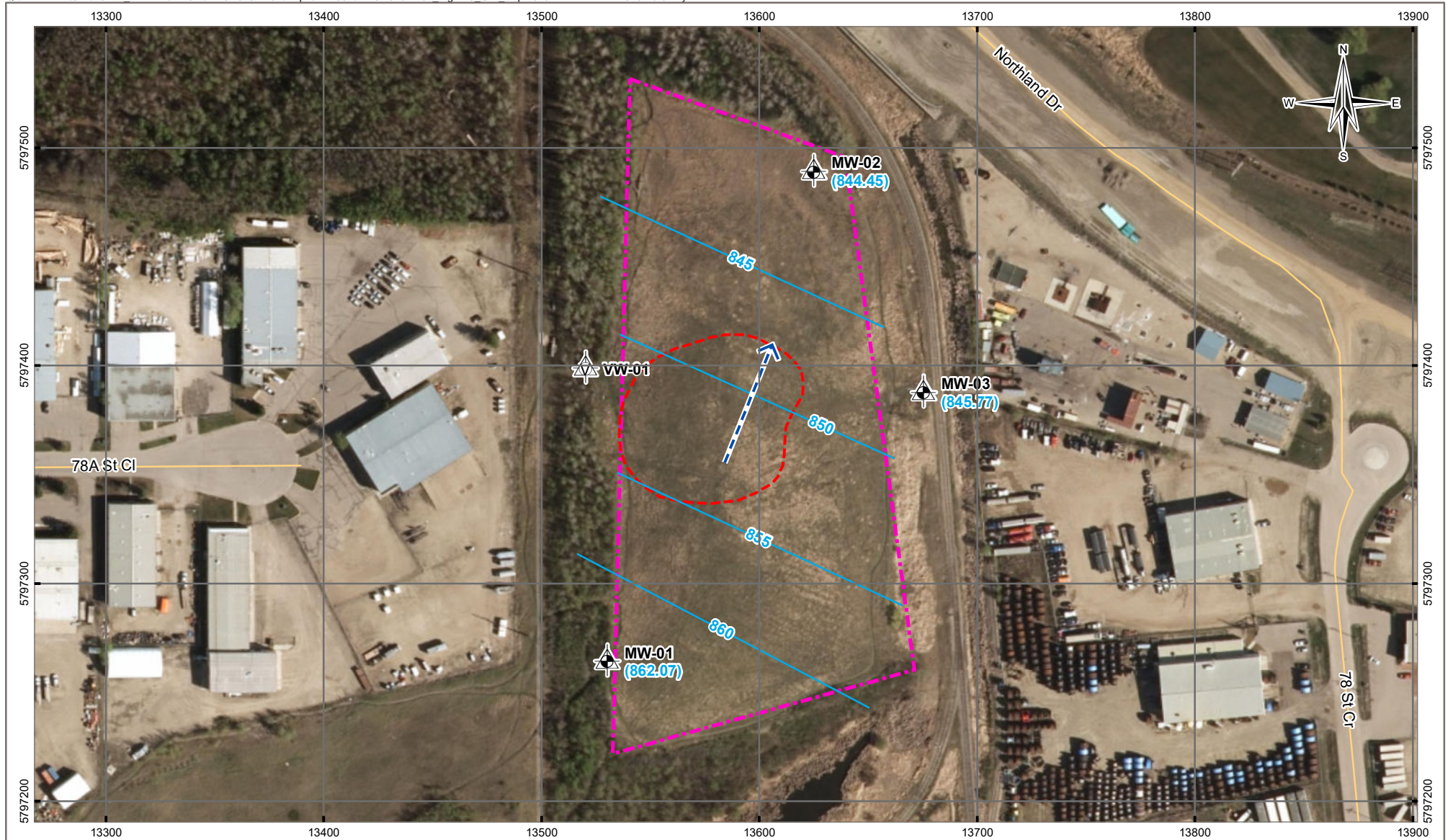



**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 RIVERSIDE HEAVY DRY WASTE**






**Groundwater Elevation Contours
 June 2019**




OFFICE TI-EDM	DWN MRV	CKD SL	APVD MR	REV 0
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007			

Figure 5



LEGEND

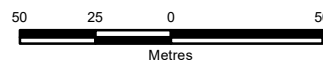
-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (8XX.XX) Groundwater Elevation (masl)

-  Historic Waste Disposal (Provided by Tiamat, 2014)
-  Municipal Sanitary Waste Area (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

STATUS
 ISSUED FOR USE

Scale: 1:2,500



PROJECTION
 3TM 114

DATUM
 NAD83

FILE NO.
 SWOP04071-01_Figure6_GW_Sept2019.mxd

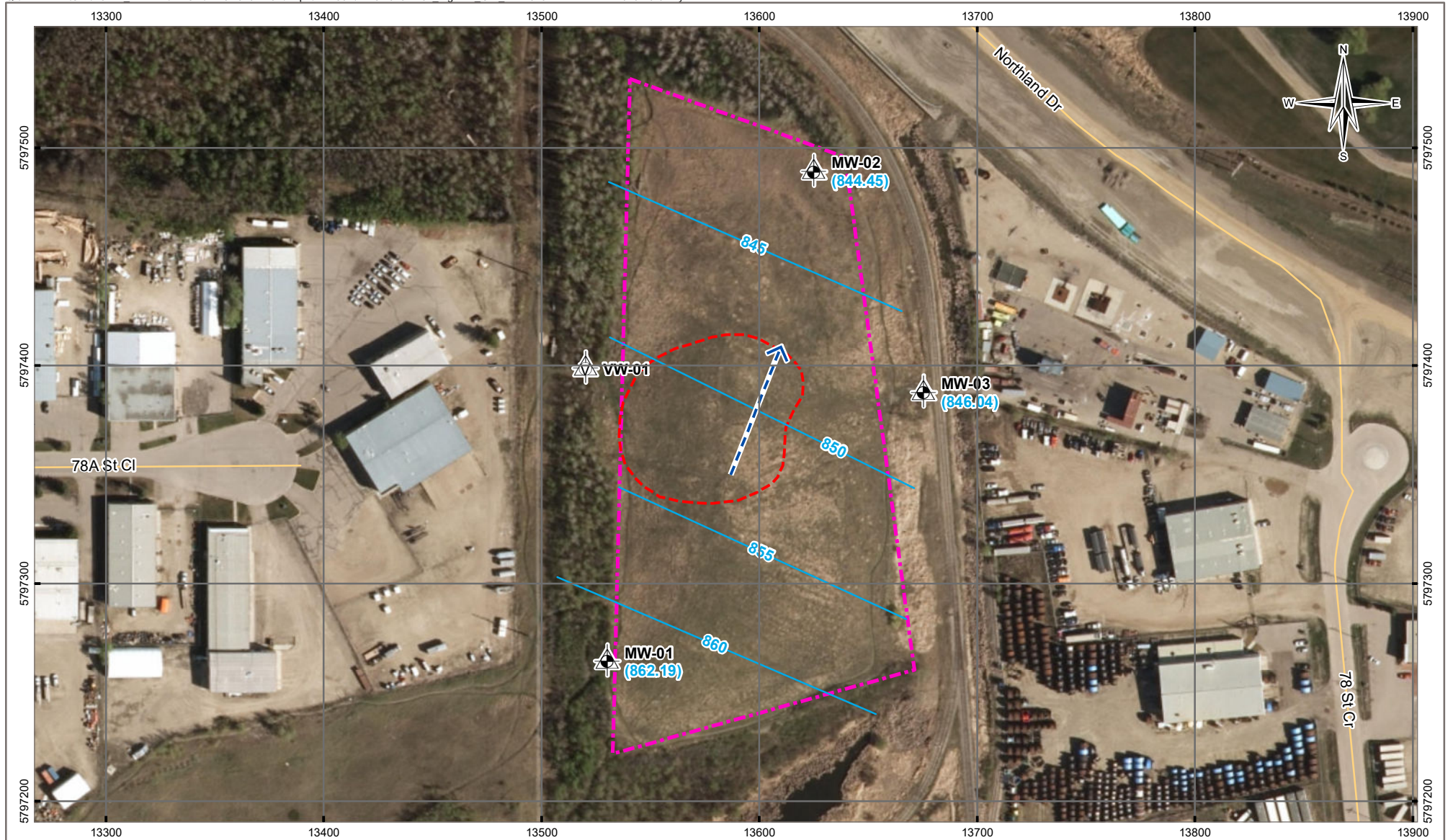


**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 RIVERSIDE HEAVY DRY WASTE**






**Groundwater Elevation Contours
 September 2019**




OFFICE TI-EDM	DWN MRV	CKD SL	APVD MR	REV 0
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007			

Figure 6



LEGEND

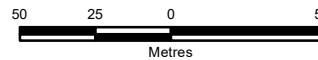
-  Monitoring Well
-  Vapour Well
-  Inferred Direction of Groundwater Flow
-  Interpreted Groundwater Elevation Contour
-  (8XX.XX) Groundwater Elevation (masl)

-  Historic Waste Disposal
(Provided by Tiamat, 2014)
-  Municipal Sanitary Waste Area
(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

STATUS
 ISSUED FOR USE

Scale: 1:2,500



PROJECTION
 3TM 114

FILE NO.
 SWOP04071-01_Figure7_GW_Dec2019.mxd

DATUM
 NAD83



**2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT
 RIVERSIDE HEAVY DRY WASTE**

**Groundwater Elevation Contours
 December 2019**

OFFICE TL-EDM	DWN MRV	CKD SL	APVD MR	REV 0
DATE October 1, 2020	PROJECT NO. SWM.SWOP04071-01.007			

Figure 7

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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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.

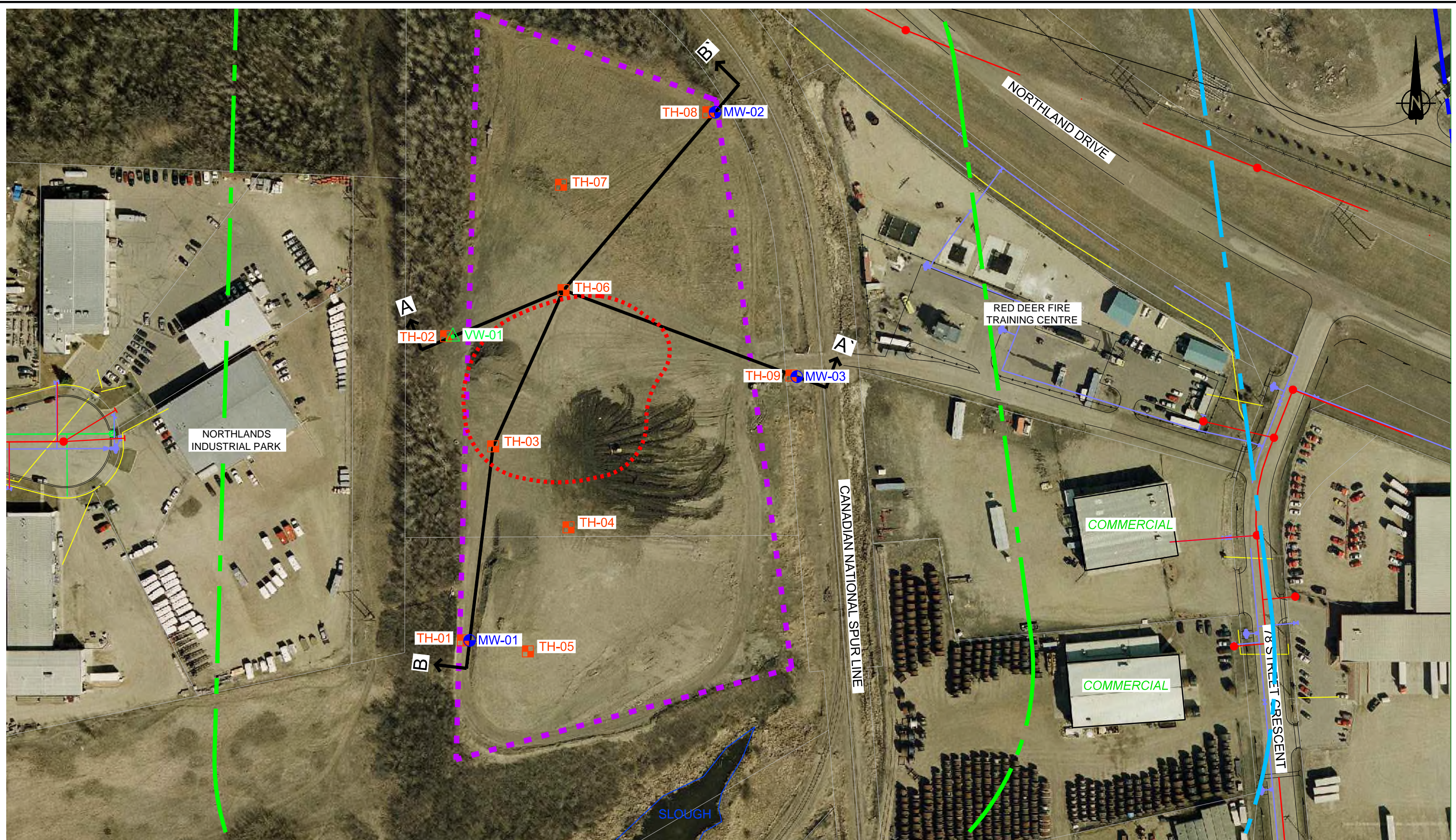
TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 NOTIFICATION OF AUTHORITIES

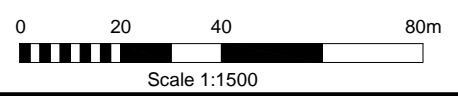
In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

APPENDIX B

CROSS-SECTIONS (TIAMAT 2014A)



SOURCE
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PERMISSION FROM THE CITY OF RED DEER.



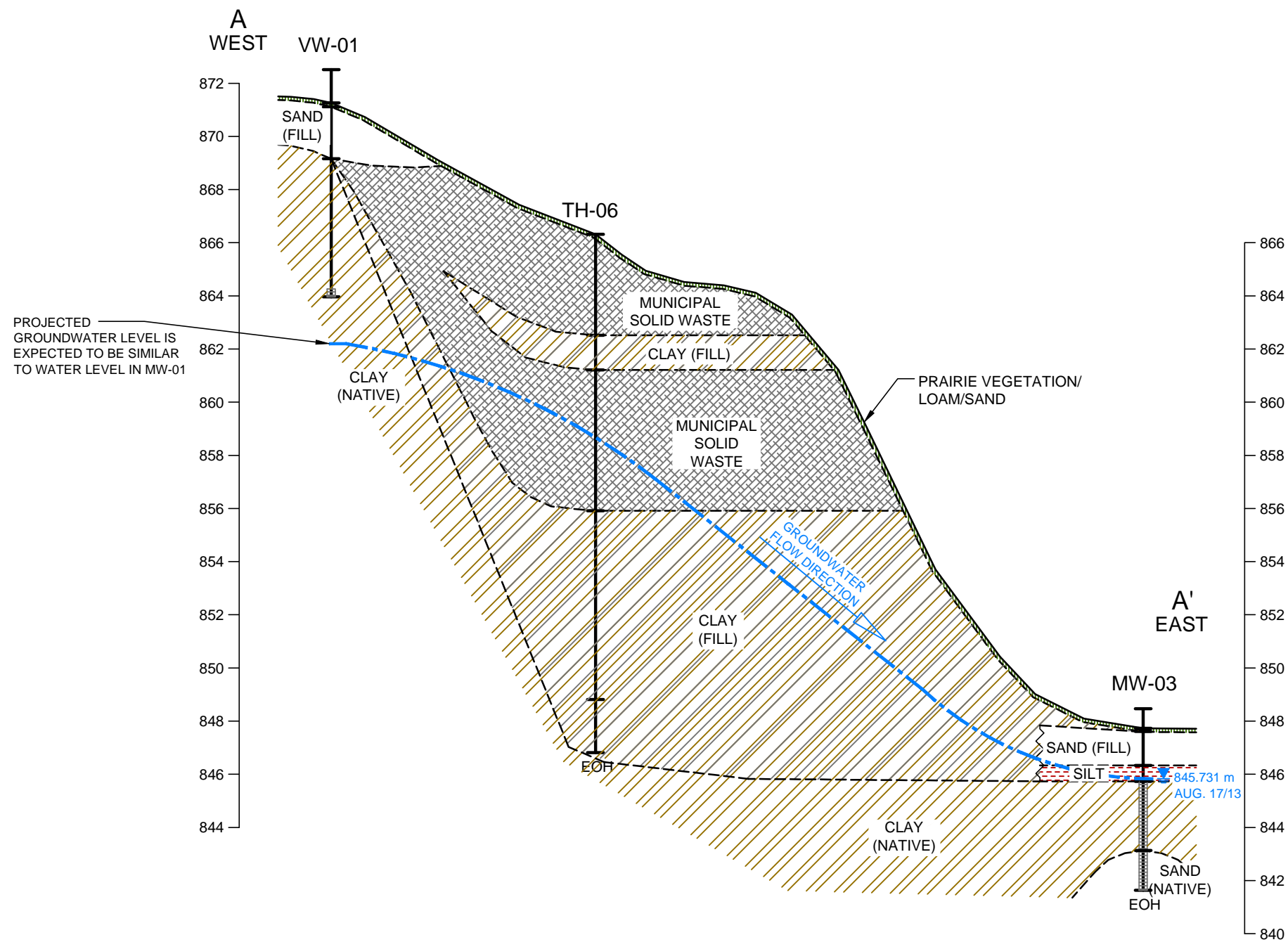
PHASE II TEST LOCATIONS
 MW-## GROUNDWATER MONITORING WELL (3)
 TH-## TESTHOLE (9)
 VW-## SOIL VAPOUR MONITORING WELL (2)

LEGEND
 - - - - - HISTORIC WASTE DISPOSAL
 MUNICIPAL SANITARY WASTE AREA
 ——— LOT BOUNDARY
 ——— CROSS SECTION LOCATION
 ——— ELECTRICAL
 ——— SANITARY
 ——— STORM
 ——— WATER

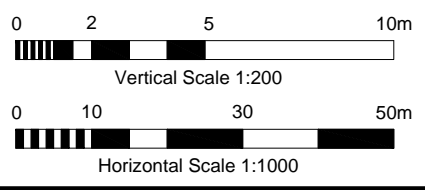
NOTE:
LOCATION OF BURIED UTILITIES ARE APPROXIMATE,
ACTUAL LOCATIONS OF THE SHALLOW UTILITIES
AND ANY OTHER UTILITIES SHOULD BE VERIFIED
PRIOR TO ANY GROUND DISTURBANCE ACTIVITY.

CLIENT:	THE CITY OF RED DEER
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE RIVERSIDE HEAVY DRY WASTE
TITLE:	SITE PLAN SHOWING INTERPRETED EXTENT OF WASTE

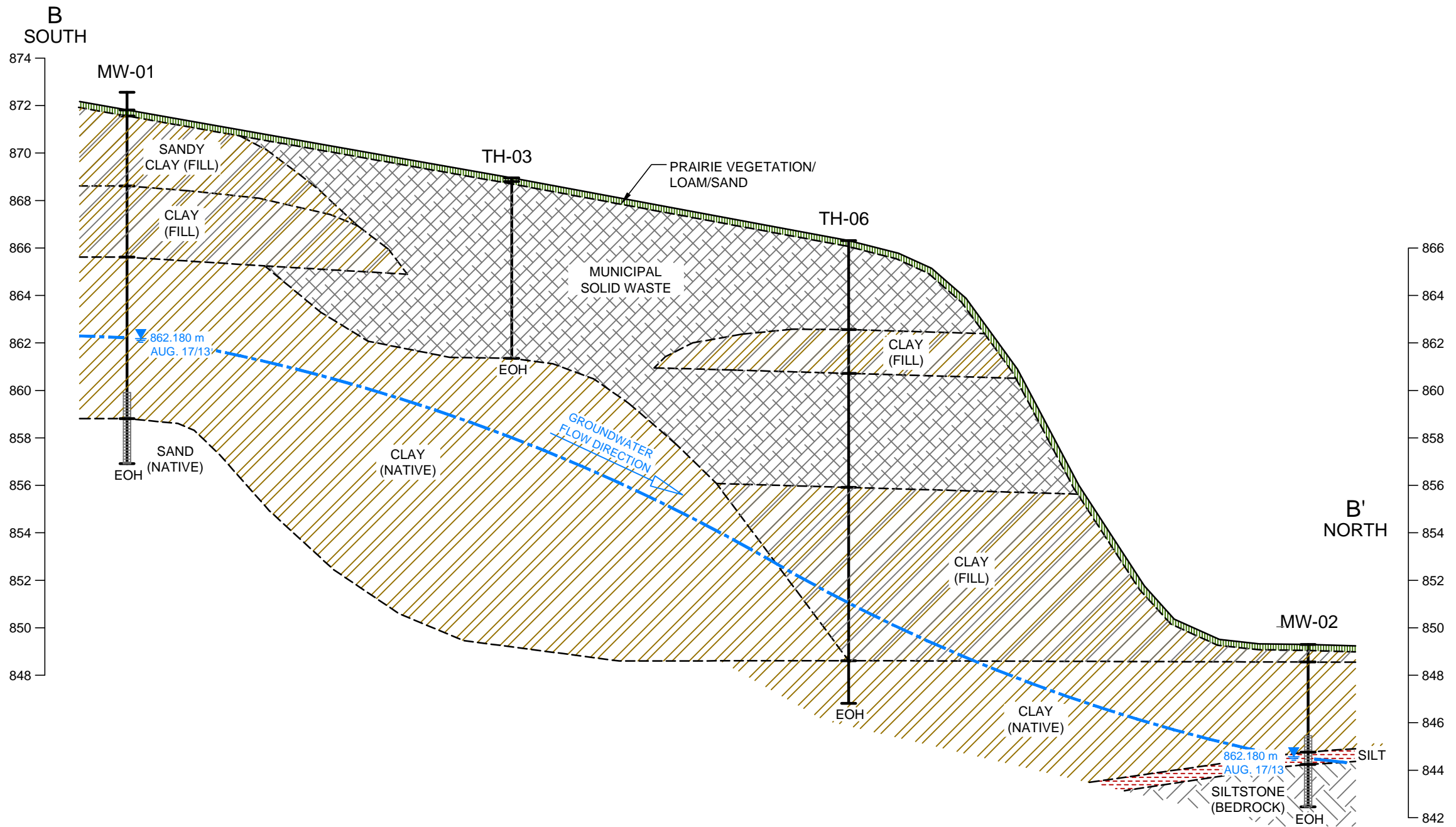
Tiamat Environmental Consultants Ltd.	
SCALE: 1 : 1500	DATE: JUNE 10/14
DRAWN BY: LCH	CHECKED BY: LTM
PROJECT NO.: 12-435	CAD FILE NO.: ERP v1.00.dwg
FIGURE NO.:	FIGURE 2



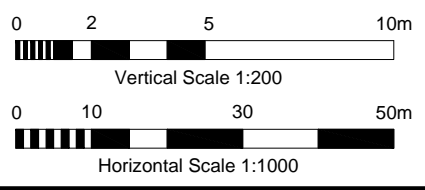
NOTE:
 THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.



CLIENT:	THE CITY OF RED DEER			
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE RIVERSIDE HEAVY DRY WASTE			
TITLE:	CROSS SECTION A - A'			SCALE: AS SHOWN
		DATE: June 10/14	PROJECT NO.: 12-435	FIGURE NO.: FIGURE 3A
	DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP Sections v1.00	



NOTE:
 THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.



CLIENT:	THE CITY OF RED DEER			
PROJECT:	ENVIRONMENTAL RISK MANAGEMENT PLAN HISTORIC WASTE DISPOSAL SITE RIVERSIDE HEAVY DRY WASTE			
TITLE:	CROSS SECTION B - B'			SCALE: AS SHOWN
		DATE: June 10/14	PROJECT NO.: 12-435	FIGURE NO.:
	DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP Sections v1.00	FIGURE 3B

APPENDIX C

WATER WELL DATA



Reconnaissance Report

[View in Metric](#)

[Export to Excel](#)

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)
96778	SE	33	38	27	4	FORRESTER DRILLING	1967-01-01	353.00	New Well	Unknown		25		CAN GENERAL TRANSIT CO LT	51.22		
96778	SE	33	38	27	4	FORRESTER DRILLING	1967-01-01	353.00	New Well	Unknown		25	30	CAN GENERAL TRANSIT CO LT	46.47		
96778	SE	33	38	27	4	FORRESTER DRILLING	1967-01-01	353.00	New Well	Unknown		25	36	CAN GENERAL TRANSIT CO LT	46.47		
96779	SE	33	38	27	4	FORRESTER DRILLING	1964-03-30	120.00	New Well	Domestic & Stock	1	9		HERMARY, ALBERT	40.60	22.00	7.00
96780	SE	33	38	27	4	FORRESTER DRILLING	1977-10-07	165.00	New Well	Industrial		11		BURNCO INDUSTRIES LTD	38.00	30.00	7.00
96781	2	33	38	27	4	UNKNOWN DRILLER	1953-06-20	605.00	Structure Test Hole	Industrial							0.00
96782	7	33	38	27	4	HI-RATE DRILLING COMPANY LTD.	1969-11-19	200.00	New Well	Other		27	24	RED DEER, CITY OF	37.64	11.00	
96783	SW	33	38	27	4	UNKNOWN DRILLER		195.00	Chemistry	Domestic	1			LONGACRE, L.E.	80.00		0.00
96784	SW	33	38	27	4	UNKNOWN DRILLER		120.00	Chemistry	Domestic	1			CONTENT PARK	16.00		0.00
96785	SW	33	38	27	4	FORRESTER DRILLING	1984-08-03	315.00	New Well	Industrial		41		LEE TOOL CO LTD			8.63
96786	5	33	38	27	4	HI-RATE DRILLING 1985 LTD.	1969-11-18	285.00	New Well	Other		22	22	RED DEER, CITY OF	127.39	11.00	
96787	5	33	38	27	4	UNKNOWN DRILLER	1953-06-05	684.00	Structure Test Hole	Industrial							0.00
96788	NW	33	38	27	4	FORRESTER DRILLING	1975-08-13	250.00	New Well	Domestic		16		UNION FAMILY FARMSTEAD/KUHNEN	115.00	20.00	6.63
96789	NW	33	38	27	4	COMFORT DRLG	1964-04-01	255.00	New Well	Industrial		6	1	NORTHLAND TRAILER HOMES	50.00	15.00	7.00
96790	NW	33	38	27	4	FORRESTER DRILLING	1958-04-01	240.00	New Well	Industrial		13		GALLOWAY, LARRY	110.00	10.00	7.00
96790	NW	33	38	27	4	ALBERTA EAGLE DRILLING LTD.		240.00	Existing Well- Decommissioned	Unknown		1		UNKNOWN	122.00		7.00
96791	NW	33	38	27	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic				SUNTRY RV			0.00
96792	14	33	38	27	4	MID-WEST WATER WELLS LTD.	1985-09-03	120.00	New Well	Industrial		5		GEO PROBE# RIG WELL	28.00	40.00	5.50
96793	15	33	38	27	4	UNKNOWNDRILLINGCOMP11		640.00	Existing Well- Decommissioned	Unknown	2	1		RED DEER, CITY OF			
96793	15	33	38	27	4	UNKNOWN DRILLER	1952-11-16	640.00	Structure Test Hole	Industrial							0.00

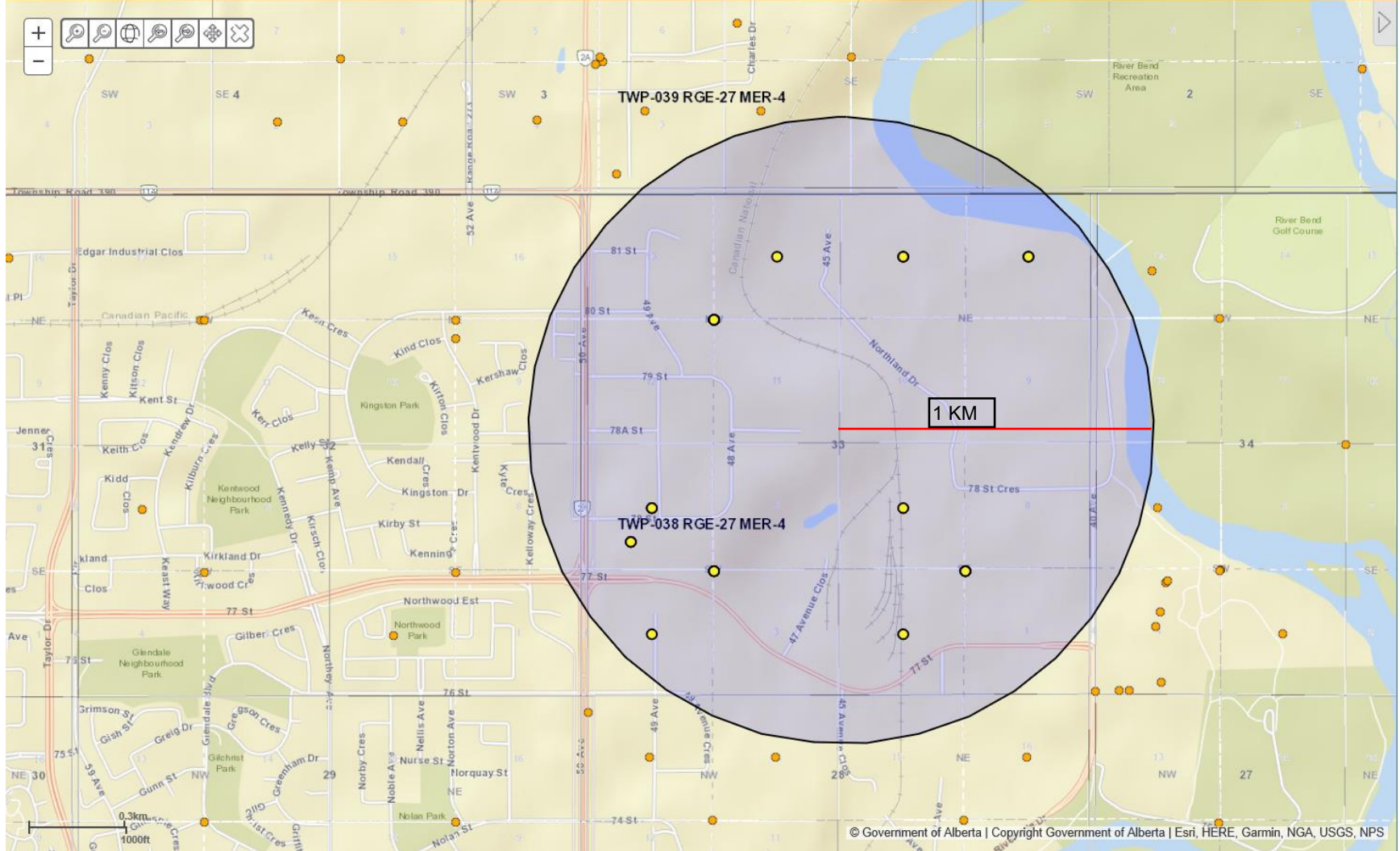


Reconnaissance Report

[View in Metric](#)

[Export to Excel](#)

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)
96794	16	33	38	27	4	UNKNOWNDRILLINGCOMP11		29.00	Existing Well- Decommissioned	Unknown		1		RED DEER, CITY OF			
96794	16	33	38	27	4	FORRESTER DRILLING	1961-04-17	29.00	Test Hole	Unknown		2		RCA # TH1, SITE 5			0.00
242198	4	33	38	27	4	UNKNOWN DRILLER		195.00	Chemistry	Domestic	1			LONGACRE, LOUIS			0.00
288614	6	33	37	27	4	ALKEN BASIN DRILLING LTD.	1997-05-24	240.00	New Well	Industrial		19	9	QUADRO HLDG LTD	61.00	60.00	5.50
288614	6	33	37	27	4	ALBERTA EAGLE DRILLING LTD.		240.00	Existing Well- Decommissioned	Unknown		1		WOODY'S R V WORLD			
288647	NW	33	38	27	4	ALKEN BASIN DRILLING LTD.	1998-05-05	500.00	Test Hole	Industrial		26		ALTA SUB SURFACE TOOLS INC			9.00



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: 19-DEC-19 13:43 (MT)
Version: FINAL

Client Phone: 403-203-3355

Certificate of Analysis

Lab Work Order #: L2393425
Project P.O. #: SWM.SWOP04071-01.007
Job Reference: SWM.SWOP04071-01.007
C of C Numbers: Heavy Dry Waste Site
Legal Site Desc:

Inayat Dhaliwal
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

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
L2393425-1 MW-01							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:50							
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	17-DEC-19	R4944846
Surrogate: 2-Bromobenzotrifluoride	60.6		60-140	%	16-DEC-19	17-DEC-19	R4944846
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		13-DEC-19	R4944123
F1-BTEX	<0.10		0.10	mg/L		13-DEC-19	R4944123
Surrogate: 3,4-Dichlorotoluene	91.5		70-130	%		13-DEC-19	R4944123
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4945722
Ammonia, Total (as N)	0.81	DLHC	0.50	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	1.61		0.20	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.769	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)	<2.5	DLDS	2.5	mg/L		07-DEC-19	R4938288
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	0.0056	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	0.0148	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.0591	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.287	DLDS	0.050	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.000179	DLDS	0.000025	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	206	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	0.0068	DLDS	0.0010	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	1.92	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	48.0	DLDS	0.025	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	1.33	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.0049	DLDS	0.0025	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	5.97	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	141	DLDS	0.25	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.00471	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	<0.0050	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
L2393425-1 MW-01							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:50							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	<0.10	DLDS	0.10	mg/L		07-DEC-19	R4938288
Ion Balance Calculation							
Ion Balance	92.6			%		16-DEC-19	
TDS (Calculated)	1260			mg/L		16-DEC-19	
Hardness (as CaCO3)	712			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.10	DLDS	0.10	mg/L		07-DEC-19	R4938288
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.11		0.11	mg/L		09-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLDS	0.050	mg/L		07-DEC-19	R4938288
Sulfate in Water by IC							
Sulfate (SO4)	499	DLDS	1.5	mg/L		07-DEC-19	R4938288
pH, Conductivity and Total Alkalinity							
pH	7.75		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	1690		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	722		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)	592		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	12-DEC-19	12-DEC-19	R4942751
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
2,2-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
2-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
4-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
p-Isopropyltoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Benzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromochloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromodichloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromoform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromomethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Carbon tetrachloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751

* 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
L2393425-1 MW-01							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:50							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,2-Dichloroethene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromochloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromomethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylbenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylene dibromide	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Hexachlorobutadiene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Isopropylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
m+p-Xylenes	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Methylene chloride	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Propylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
o-Xylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
sec-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Styrene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
tert-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Tetrachloroethylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Toluene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichlorofluoromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Vinyl chloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Surrogate: 1,4-Difluorobenzene	98.6		70-130	%	12-DEC-19	12-DEC-19	R4942751
Surrogate: 4-Bromofluorobenzene	76.9		70-130	%	12-DEC-19	12-DEC-19	R4942751

* 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
L2393425-2 MW-02							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:25							
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	17-DEC-19	R4944846
Surrogate: 2-Bromobenzotrifluoride	74.6		60-140	%	16-DEC-19	17-DEC-19	R4944846
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		13-DEC-19	R4944123
F1-BTEX	<0.10		0.10	mg/L		13-DEC-19	R4944123
Surrogate: 3,4-Dichlorotoluene	102.0		70-130	%		13-DEC-19	R4944123
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4945722
Ammonia, Total (as N)	0.327		0.050	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	16.9		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	0.85		0.20	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	0.109	DLHC	0.025	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)	429	DLDS	2.5	mg/L		07-DEC-19	R4938288
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	0.0636	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	0.00096	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	0.0432	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.122	DLDS	0.050	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.000238	DLDS	0.000025	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	370	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	0.801	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	146	DLDS	0.025	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	0.832	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.0128	DLDS	0.0025	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	9.06	DLDS	0.25	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	0.00030	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	256	DLDS	0.25	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.0338	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	<0.0050	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
L2393425-2 MW-02							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:25							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	<0.10	DLDS	0.10	mg/L		07-DEC-19	R4938288
Ion Balance Calculation							
Ion Balance	108			%		16-DEC-19	
TDS (Calculated)	2240			mg/L		16-DEC-19	
Hardness (as CaCO3)	1530			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.10	DLDS	0.10	mg/L		07-DEC-19	R4938288
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.11		0.11	mg/L		09-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLDS	0.050	mg/L		07-DEC-19	R4938288
Sulfate in Water by IC							
Sulfate (SO4)	624	DLDS	1.5	mg/L		07-DEC-19	R4938288
pH, Conductivity and Total Alkalinity							
pH	7.54		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	3100		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	831		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)	681		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	12-DEC-19	12-DEC-19	R4942751
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
2,2-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
2-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
4-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
p-Isopropyltoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Benzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromochloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromodichloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromoform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromomethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Carbon tetrachloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393425-2 MW-02							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:25							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,2-Dichloroethene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromochloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromomethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylbenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylene dibromide	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Hexachlorobutadiene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Isopropylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
m+p-Xylenes	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Methylene chloride	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Propylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
o-Xylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
sec-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Styrene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
tert-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Tetrachloroethylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Toluene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichlorofluoromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Vinyl chloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Surrogate: 1,4-Difluorobenzene	98.8		70-130	%	12-DEC-19	12-DEC-19	R4942751
Surrogate: 4-Bromofluorobenzene	78.5		70-130	%	12-DEC-19	12-DEC-19	R4942751

* 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
L2393425-3 MW-03							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:00							
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	17-DEC-19	R4944846
Surrogate: 2-Bromobenzotrifluoride	80.4		60-140	%	16-DEC-19	17-DEC-19	R4944846
F1 (C6-C10)							
F1(C6-C10)	<0.10		0.10	mg/L		13-DEC-19	R4944123
F1-BTEX	<0.10		0.10	mg/L		13-DEC-19	R4944123
Surrogate: 3,4-Dichlorotoluene	96.5		70-130	%		13-DEC-19	R4944123
Miscellaneous Parameters							
AOX	ND U		10	mg/L		12-DEC-19	R4945722
Ammonia, Total (as N)	4.80	DLHC	0.50	mg/L		16-DEC-19	R4943991
Dissolved Organic Carbon	33.1		1.0	mg/L		13-DEC-19	R4943327
Xylenes	<0.00071		0.00071	mg/L		16-DEC-19	
Total Kjeldahl Nitrogen	7.1	DLHC	1.0	mg/L		12-DEC-19	R4943090
Phosphorus (P)-Total	1.16	DLHC	0.10	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)	271	DLDS	2.5	mg/L		07-DEC-19	R4938288
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	0.0987	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	0.0272	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Barium (Ba)-Dissolved	1.09	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Boron (B)-Dissolved	0.090	DLDS	0.050	mg/L		09-DEC-19	R4937828
Cadmium (Cd)-Dissolved	0.000056	DLDS	0.000025	mg/L		09-DEC-19	R4937828
Calcium (Ca)-Dissolved	177	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	0.0068	DLDS	0.0010	mg/L		09-DEC-19	R4937828
Iron (Fe)-Dissolved	27.6	DLDS	0.050	mg/L		09-DEC-19	R4937828
Lead (Pb)-Dissolved	0.00056	DLDS	0.00025	mg/L		09-DEC-19	R4937828
Magnesium (Mg)-Dissolved	103	DLDS	0.025	mg/L		09-DEC-19	R4937828
Manganese (Mn)-Dissolved	1.40	DLDS	0.00050	mg/L		09-DEC-19	R4937828
Nickel (Ni)-Dissolved	0.0087	DLDS	0.0025	mg/L		09-DEC-19	R4937828
Potassium (K)-Dissolved	10.1	DLDS	0.25	mg/L		09-DEC-19	R4937828
Selenium (Se)-Dissolved	0.00037	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	147	DLDS	0.25	mg/L		09-DEC-19	R4937828
Uranium (U)-Dissolved	0.00273	DLDS	0.000050	mg/L		09-DEC-19	R4937828
Zinc (Zn)-Dissolved	0.0052	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
L2393425-3 MW-03							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:00							
Matrix: WATER							
Fluoride in Water by IC							
Fluoride (F)	0.13	DLDS	0.10	mg/L		07-DEC-19	R4938288
Ion Balance Calculation							
Ion Balance	98.2			%		16-DEC-19	
TDS (Calculated)	1220			mg/L		16-DEC-19	
Hardness (as CaCO3)	866			mg/L		16-DEC-19	
Nitrate in Water by IC							
Nitrate (as N)	<0.10	DLDS	0.10	mg/L		07-DEC-19	R4938288
Nitrate+Nitrite							
Nitrate and Nitrite (as N)	<0.11		0.11	mg/L		09-DEC-19	
Nitrite in Water by IC							
Nitrite (as N)	<0.050	DLDS	0.050	mg/L		07-DEC-19	R4938288
Sulfate in Water by IC							
Sulfate (SO4)	2.1	DLDS	1.5	mg/L		07-DEC-19	R4938288
pH, Conductivity and Total Alkalinity							
pH	7.86		0.10	pH		14-DEC-19	R4943994
Conductivity (EC)	2080		2.0	uS/cm		14-DEC-19	R4943994
Bicarbonate (HCO3)	1040		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)	854		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	12-DEC-19	12-DEC-19	R4942751
1,1,1-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2,2-Tetrachloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1,2-Trichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,1-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,3-Trichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trichlorobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2,4-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dibromo-3-chloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,2-Dichloropropane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3,5-Trimethylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
1,3-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
1,4-Dichlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
2,2-Dichloropropane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
2-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
4-Chlorotoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
p-Isopropyltoluene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Benzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromobenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromochloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromodichloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromoform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Bromomethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Carbon tetrachloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751

* 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
L2393425-3 MW-03							
Sampled By: Megan Rouse on 03-DEC-19 @ 12:00							
Matrix: WATER							
VOCs in Water							
Chlorobenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloroform	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Chloromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,2-Dichloroethene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
cis-1,3-Dichloropropene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromochloromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dibromomethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Dichlorodifluoromethane	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylbenzene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Ethylene dibromide	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Hexachlorobutadiene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Isopropylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
m+p-Xylenes	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Methylene chloride	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
n-Propylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
o-Xylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
sec-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Styrene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
tert-Butylbenzene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Tetrachloroethylene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Toluene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,2-Dichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
trans-1,3-Dichloropropene	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichloroethene	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Trichlorofluoromethane	<0.0010		0.0010	mg/L	12-DEC-19	12-DEC-19	R4942751
Vinyl chloride	<0.00050		0.00050	mg/L	12-DEC-19	12-DEC-19	R4942751
Surrogate: 1,4-Difluorobenzene	98.3		70-130	%	12-DEC-19	12-DEC-19	R4942751
Surrogate: 4-Bromofluorobenzene	78.7		70-130	%	12-DEC-19	12-DEC-19	R4942751

* 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:

Heavy Dry Waste Site

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

L2393425

Lab ID	Sample ID				Lab ID	Sample ID			
L2393425-1	MW-01				L2393425-2	MW-02			
Sample Date: 03-DEC-19					Sample Date: 03-DEC-19				
Matrix: WATER					Matrix: WATER				
	Result	UNITS	MEQ/L	MEQ %		Result	UNITS	MEQ/L	MEQ %
Ion Balance	92.6	%			Ion Balance	108	%		
Routine Anions					Routine Anions				
Bicarbonate	722	mg/L	11.83	28	Bicarbonate	831	mg/L	13.62	17
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	<2.5	mg/L	0	0	Chloride	429	mg/L	12.10	15
Sulfate	499	mg/L	10.39	24	Sulfate	624	mg/L	12.99	16
Nitrate+Nitrite-N		mg/L	0	0	Nitrate+Nitrite-N		mg/L	0	0
Anion Sum			22.22	52	Anion Sum			38.71	48
Routine Cations					Routine Cations				
Calcium	206	mg/L	10.28	24	Calcium	370	mg/L	18.46	23
Magnesium	48.0	mg/L	3.95	9	Magnesium	146	mg/L	12.02	15
Sodium	141	mg/L	6.13	14	Sodium	256	mg/L	11.14	14
Potassium	5.97	mg/L	0.15	0	Potassium	9.06	mg/L	0.23	0
Ammonium	0.81	mg/L	0.06	0	Ammonium	0.327	mg/L	0.02	0
Cation Sum			20.57	48	Cation Sum			41.87	52
L2393425-3	MW-03								
Sample Date: 03-DEC-19									
Matrix: WATER									
	Result	UNITS	MEQ/L	MEQ %					
Ion Balance	98.2	%							
Routine Anions									
Bicarbonate	1040	mg/L	17.04	35					
Carbonate	<5.0	mg/L	0	0					
Hydroxide	<5.0	mg/L	0	0					
Chloride	271	mg/L	7.64	16					
Sulfate	2.1	mg/L	0.04	0					
Nitrate+Nitrite-N		mg/L	0	0					
Anion Sum			24.74	50					
Routine Cations									
Calcium	177	mg/L	8.83	18					
Magnesium	103	mg/L	8.48	17					
Sodium	147	mg/L	6.39	13					
Potassium	10.1	mg/L	0.26	1					
Ammonium	4.80	mg/L	0.34	1					
Cation Sum			24.30	50					

ALS LABORATORY GROUP SOIL SALINITY CONVERSION

L2393425

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: L2393425

Report Date: 19-DEC-19

Page 1 of 15

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							
WG3242690-11	DUP	L2393425-3						
Dissolved Organic Carbon		33.1	35.4		mg/L	6.8	20	13-DEC-19
WG3242690-7	DUP	L2390727-1						
Dissolved Organic Carbon		12.7	11.3		mg/L	12	20	13-DEC-19
WG3242690-10	LCS							
Dissolved Organic Carbon			112.2		%		80-120	13-DEC-19
WG3242690-6	LCS							
Dissolved Organic Carbon			114.9		%		80-120	13-DEC-19
WG3242690-5	MB							
Dissolved Organic Carbon			<1.0		mg/L		1	13-DEC-19
WG3242690-9	MB							
Dissolved Organic Carbon			<1.0		mg/L		1	13-DEC-19
WG3242690-12	MS	L2393425-3						
Dissolved Organic Carbon			N/A	MS-B	%		-	13-DEC-19
WG3242690-8	MS	L2390727-1						
Dissolved Organic Carbon			95.2		%		70-130	13-DEC-19
CL-IC-N-CL		Water						
Batch	R4938288							
WG3238491-11	DUP	L2393349-3						
Chloride (Cl)		3.25	3.17		mg/L	2.7	20	07-DEC-19
WG3238491-10	LCS							
Chloride (Cl)			100.1		%		90-110	07-DEC-19
WG3238491-9	MB							
Chloride (Cl)			<0.50		mg/L		0.5	07-DEC-19
WG3238491-12	MS	L2393349-3						
Chloride (Cl)			112.2		%		75-125	07-DEC-19
F-IC-N-CL		Water						
Batch	R4938288							
WG3238491-11	DUP	L2393349-3						
Fluoride (F)		0.177	0.188		mg/L	5.7	20	07-DEC-19
WG3238491-10	LCS							
Fluoride (F)			104.9		%		90-110	07-DEC-19
WG3238491-9	MB							
Fluoride (F)			<0.020		mg/L		0.02	07-DEC-19
WG3238491-12	MS	L2393349-3						
Fluoride (F)			116.0		%		75-125	07-DEC-19
F1-HS-FID-CL		Water						



Quality Control Report

Workorder: L2393425

Report Date: 19-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
F1-HS-FID-CL	Water							
Batch	R4944123							
WG3243605-1 MB								
F1(C6-C10)			<0.10		mg/L		0.1	13-DEC-19
Surrogate: 3,4-Dichlorotoluene			125.7		%		70-130	13-DEC-19
F2-4-ME-FID-CL	Water							
Batch	R4944846							
WG3243467-1 MB								
F2: (C10-C16)			<0.10		mg/L		0.1	17-DEC-19
Surrogate: 2-Bromobenzotrifluoride			70.9		%		60-140	17-DEC-19
HG-D-CVAA-CL	Water							
Batch	R4943011							
WG3242289-6 LCS								
Mercury (Hg)-Dissolved			118.0		%		80-120	13-DEC-19
WG3242289-5 MB								
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	13-DEC-19
MET-D-CCMS-CL	Water							
Batch	R4937828							
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
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



Quality Control Report

Workorder: L2393425

Report Date: 19-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							
WG3238594-7	DUP	L2393428-4						
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
WG3238594-6	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
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
WG3238594-5	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



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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								
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
WG3238594-8 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**



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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
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
NO2-IC-N-CL								
Water								
Batch	R4938288							
WG3238491-10	LCS							
Nitrite (as N)			99.7		%		90-110	07-DEC-19
WG3238491-9	MB							
Nitrite (as N)			<0.010		mg/L		0.01	07-DEC-19
NO3-IC-N-CL								
Water								
Batch	R4938288							
WG3238491-10	LCS							
Nitrate (as N)			101.1		%		90-110	07-DEC-19
WG3238491-9	MB							
Nitrate (as N)			<0.020		mg/L		0.02	07-DEC-19
P-T-COL-CL								
Water								
Batch	R4943276							
WG3242072-10	LCS							
Phosphorus (P)-Total			92.6		%		80-120	13-DEC-19
WG3242072-9	MB							
Phosphorus (P)-Total			<0.0050		mg/L		0.005	13-DEC-19
PH/EC/ALK-CL								
Water								
Batch	R4943994							
WG3243425-11	LCS							
Conductivity (EC)			99.3		%		90-110	14-DEC-19
Alkalinity, Total (as CaCO3)			104.4		%		85-115	14-DEC-19
WG3243425-10	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								



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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
SO4-IC-N-CL		Water						
Batch	R4938288							
WG3238491-11	DUP	L2393349-3						
Sulfate (SO4)		50.1	49.8		mg/L	0.6	20	07-DEC-19
WG3238491-10	LCS							
Sulfate (SO4)			105.1		%		90-110	07-DEC-19
WG3238491-9	MB							
Sulfate (SO4)			<0.30		mg/L		0.3	07-DEC-19
WG3238491-12	MS	L2393349-3						
Sulfate (SO4)			113.5		%		75-125	07-DEC-19
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							
Total Kjeldahl Nitrogen			102.0		%		75-125	12-DEC-19
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



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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							
WG3243150-3	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
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



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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							
WG3243150-4 MS		L2393410-5						
Caproic (Hexanoic) Acid			97.3		%		70-130	13-DEC-19
VOC-HS-MS-CL								
	Water							
Batch	R4942751							
WG3242018-2 DUP		L2393184-1						
1,1,1,2-Tetrachloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1,1-Trichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1,2,2-Tetrachloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1,2-Trichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloropropene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,3-Trichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,3-Trichloropropane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,4-Trichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,4-Trimethylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dibromo-3-chloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichloropropane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3,5-Trimethylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,4-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
2,2-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
2-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
4-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
p-Isopropyltoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	12-DEC-19
Benzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromochloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromodichloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromoform		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-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	R4942751							
WG3242018-2	DUP	L2393184-1						
Bromomethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Carbon tetrachloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloroform		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
cis-1,2-Dichloroethene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
cis-1,3-Dichloropropene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dibromochloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dibromomethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dichlorodifluoromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Ethylbenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Ethylene dibromide		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Hexachlorobutadiene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Isopropylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
m+p-Xylenes		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Methylene chloride		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
n-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
n-Propylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
o-Xylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
sec-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Styrene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
tert-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Tetrachloroethylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Toluene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
trans-1,2-Dichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
trans-1,3-Dichloropropene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Trichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Trichlorofluoromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Vinyl chloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
WG3242018-3	DUP	L2393424-1						
1,1,1,2-Tetrachloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1,1-Trichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-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	R4942751							
WG3242018-3	DUP	L2393424-1						
1,1,2,2-Tetrachloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1,2-Trichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloroethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,1-Dichloropropene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,3-Trichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,3-Trichloropropane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,4-Trichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2,4-Trimethylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dibromo-3-chloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,2-Dichloropropane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3,5-Trimethylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
1,3-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
1,4-Dichlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
2,2-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
2-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
4-Chlorotoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
p-Isopropyltoluene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	12-DEC-19
Benzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromochloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromodichloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromoform		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Bromomethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Carbon tetrachloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chlorobenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloroform		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Chloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
cis-1,2-Dichloroethene		0.0084	0.0075		mg/L			12-DEC-19



Quality Control Report

Workorder: L2393425

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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	R4942751							
WG3242018-3	DUP	L2393424-1						
cis-1,2-Dichloroethene		0.0084	0.0075		mg/L	12	30	12-DEC-19
cis-1,3-Dichloropropene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dibromochloromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dibromomethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Dichlorodifluoromethane		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Ethylbenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Ethylene dibromide		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Hexachlorobutadiene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Isopropylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
m+p-Xylenes		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Methylene chloride		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
n-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
n-Propylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
o-Xylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
sec-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Styrene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
tert-Butylbenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Tetrachloroethylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Toluene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
trans-1,2-Dichloroethene		0.00067	0.00059		mg/L	13	30	12-DEC-19
trans-1,3-Dichloropropene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Trichloroethene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
Trichlorofluoromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	12-DEC-19
Vinyl chloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	12-DEC-19
WG3242018-1	MB							
1,1,1,2-Tetrachloroethane			<0.0010		mg/L		0.001	12-DEC-19
1,1,1-Trichloroethane			<0.00050		mg/L		0.0005	12-DEC-19
1,1,2,2-Tetrachloroethane			<0.00050		mg/L		0.0005	12-DEC-19
1,1,2-Trichloroethane			<0.00050		mg/L		0.0005	12-DEC-19
1,1-Dichloroethane			<0.00050		mg/L		0.0005	12-DEC-19
1,1-Dichloroethene			<0.00050		mg/L		0.0005	12-DEC-19
1,1-Dichloropropene			<0.0010		mg/L		0.001	12-DEC-19
1,2,3-Trichlorobenzene			<0.0010		mg/L		0.001	12-DEC-19



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
VOC-HS-MS-CL								
	Water							
Batch	R4942751							
WG3242018-1 MB								
1,2,3-Trichloropropane			<0.00050		mg/L		0.0005	12-DEC-19
1,2,4-Trichlorobenzene			<0.0010		mg/L		0.001	12-DEC-19
1,2,4-Trimethylbenzene			<0.0010		mg/L		0.001	12-DEC-19
1,2-Dibromo-3-chloropropane			<0.0010		mg/L		0.001	12-DEC-19
1,2-Dichlorobenzene			<0.00050		mg/L		0.0005	12-DEC-19
1,2-Dichloroethane			<0.0010		mg/L		0.001	12-DEC-19
1,2-Dichloropropane			<0.00050		mg/L		0.0005	12-DEC-19
1,3,5-Trimethylbenzene			<0.0010		mg/L		0.001	12-DEC-19
1,3-Dichlorobenzene			<0.00050		mg/L		0.0005	12-DEC-19
1,3-Dichloropropane			<0.0010		mg/L		0.001	12-DEC-19
1,4-Dichlorobenzene			<0.00050		mg/L		0.0005	12-DEC-19
2,2-Dichloropropane			<0.0010		mg/L		0.001	12-DEC-19
2-Chlorotoluene			<0.0010		mg/L		0.001	12-DEC-19
4-Chlorotoluene			<0.0010		mg/L		0.001	12-DEC-19
p-Isopropyltoluene			<0.0010		mg/L		0.001	12-DEC-19
Benzene			<0.00050		mg/L		0.0005	12-DEC-19
Bromobenzene			<0.0010		mg/L		0.001	12-DEC-19
Bromochloromethane			<0.0010		mg/L		0.001	12-DEC-19
Bromodichloromethane			<0.00050		mg/L		0.0005	12-DEC-19
Bromoform			<0.00050		mg/L		0.0005	12-DEC-19
Bromomethane			<0.0010		mg/L		0.001	12-DEC-19
Carbon tetrachloride			<0.00050		mg/L		0.0005	12-DEC-19
Chlorobenzene			<0.00050		mg/L		0.0005	12-DEC-19
Chloroethane			<0.0010		mg/L		0.001	12-DEC-19
Chloroform			<0.00050		mg/L		0.0005	12-DEC-19
Chloromethane			<0.0010		mg/L		0.001	12-DEC-19
cis-1,2-Dichloroethene			<0.0010		mg/L		0.001	12-DEC-19
cis-1,3-Dichloropropene			<0.00050		mg/L		0.0005	12-DEC-19
Dibromochloromethane			<0.00050		mg/L		0.0005	12-DEC-19
Dibromomethane			<0.00050		mg/L		0.0005	12-DEC-19
Dichlorodifluoromethane			<0.00050		mg/L		0.0005	12-DEC-19
Ethylbenzene			<0.00050		mg/L		0.0005	12-DEC-19
Ethylene dibromide			<0.00050		mg/L		0.0005	12-DEC-19



Quality Control Report

Workorder: L2393425

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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	R4942751							
WG3242018-1 MB								
Hexachlorobutadiene			<0.0010		mg/L		0.001	12-DEC-19
Isopropylbenzene			<0.0010		mg/L		0.001	12-DEC-19
m+p-Xylenes			<0.00050		mg/L		0.0005	12-DEC-19
Methylene chloride			<0.0010		mg/L		0.001	12-DEC-19
n-Butylbenzene			<0.0010		mg/L		0.001	12-DEC-19
n-Propylbenzene			<0.0010		mg/L		0.001	12-DEC-19
o-Xylene			<0.00050		mg/L		0.0005	12-DEC-19
sec-Butylbenzene			<0.0010		mg/L		0.001	12-DEC-19
Styrene			<0.00050		mg/L		0.0005	12-DEC-19
tert-Butylbenzene			<0.0010		mg/L		0.001	12-DEC-19
Tetrachloroethylene			<0.00050		mg/L		0.0005	12-DEC-19
Toluene			<0.00050		mg/L		0.0005	12-DEC-19
trans-1,2-Dichloroethene			<0.00050		mg/L		0.0005	12-DEC-19
trans-1,3-Dichloropropene			<0.0010		mg/L		0.001	12-DEC-19
Trichloroethene			<0.00050		mg/L		0.0005	12-DEC-19
Trichlorofluoromethane			<0.0010		mg/L		0.001	12-DEC-19
Vinyl chloride			<0.00050		mg/L		0.0005	12-DEC-19
Surrogate: 1,4-Difluorobenzene			100.5		%		70-130	12-DEC-19
Surrogate: 4-Bromofluorobenzene			88.1		%		70-130	12-DEC-19

Quality Control Report

Workorder: L2393425

Report Date: 19-DEC-19

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.

Quality Control Report

Workorder: L2393425

Report Date: 19-DEC-19

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

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Contact: Darby Madalena

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Anions and Nutrients							
Nitrate in Water by IC	1	03-DEC-19 12:50	07-DEC-19 15:08	3	4	days	EHTR
	2	03-DEC-19 12:25	07-DEC-19 15:08	3	4	days	EHTR
	3	03-DEC-19 12:00	07-DEC-19 15:08	3	4	days	EHTR
Nitrite in Water by IC	1	03-DEC-19 12:50	07-DEC-19 15:08	3	4	days	EHTR
	2	03-DEC-19 12:25	07-DEC-19 15:08	3	4	days	EHTR
	3	03-DEC-19 12:00	07-DEC-19 15:08	3	4	days	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2393425 were received on 06-DEC-19 16:50.

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 18, 2019

Service Request No:K1911634

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

Laboratory Results for: L2393425

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 **K1911634**.

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: L2393425
Sample Matrix: Water

Service Request: K1911634
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.

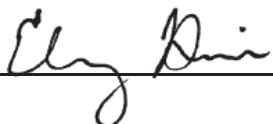
Sample Receipt:

Three 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

12/18/2019



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: L2393425

Service Request:K1911634

SAMPLE CROSS-REFERENCE

<u>SAMPLE #</u>	<u>CLIENT SAMPLE ID</u>	<u>DATE</u>	<u>TIME</u>
K1911634-001	L2393425-1	12/3/2019	
K1911634-002	L2393425-2	12/3/2019	
K1911634-003	L2393425-3	12/3/2019	



K1911634

L2393425

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# L2393425
ALS requires QC data to be provided with your final results.

Please see enclosed 3 sample(s) in 3 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED	Priority Flag
		DUE DATE	
L2393425-1 MW-01	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 3/ 2019	
		12/30/2019	
L2393425-2 MW-02	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 3/ 2019	
		12/30/2019	
L2393425-3 MW-03	Adsorbable Organic Halides (AOX-MISA-KL 1)	12/ 3/ 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]* Date Received: 12/12/19 1000

Verified By: _____ Date Verified: _____

Temperature: _____

Sample Integrity Issues: _____



Cooler Receipt and Preservation Form

Client ALS CANADA Service Request K19 11634

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	7772 0068 8607		

- 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
1317 South 13th Avenue, Kelso, WA 98626
Phone (360) 577-7222 Fax (360) 425-9096
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: L2393425/

Service Request: K1911634

Sample Name: L2393425-1
Lab Code: K1911634-001
Sample Matrix: Water

Date Collected: 12/3/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393425-2
Lab Code: K1911634-002
Sample Matrix: Water

Date Collected: 12/3/19
Date Received: 12/12/19

Analysis Method
1650C

Extracted/Digested By

Analyzed By
ESCHLOSS

Sample Name: L2393425-3
Lab Code: K1911634-003
Sample Matrix: Water

Date Collected: 12/3/19
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

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

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393425
Sample Matrix: Water
Sample Name: L2393425-1
Lab Code: K1911634-001

Service Request: K1911634
Date Collected: 12/03/19
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	12/16/19 10:15	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393425
Sample Matrix: Water
Sample Name: L2393425-2
Lab Code: K1911634-002

Service Request: K1911634
Date Collected: 12/03/19
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	12/16/19 10:15	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393425
Sample Matrix: Water
Sample Name: L2393425-3
Lab Code: K1911634-003

Service Request: K1911634
Date Collected: 12/03/19
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	1.0	100	12/16/19 10:15	



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

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: ALS Environmental - Canada
Project: L2393425
Sample Matrix: Water
Sample Name: Method Blank
Lab Code: K1911634-MB

Service Request: K1911634
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	12/16/19 10:15	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: ALS Environmental - Canada
Project: L2393425/
Sample Matrix: Water

Service Request: K1911634
Date Collected: NA
Date Received: NA
Date Analyzed: 12/16/2019
Analysis Lot: 663487

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	3.73	10.1	0.098
Percent Recovery A	103	101	98
Run B	3.73	10.3	
Percent Recovery B	103	103	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: ALS Environmental - Canada
Project: L2393425
Sample Matrix: Water

Service Request: K1911634
Date Collected: N/A
Date Received: N/A
Date Analyzed: 12/16/19
Date Extracted: NA

Duplicate Matrix Spike Summary
Halides, Adsorbable Organic (AOX)

Sample Name: Batch QC
Lab Code: KQ1918558-08
Analysis Method: 1650C
Prep Method: None

Units: mg/L
Basis: NA

Analyte Name	Sample Result	Matrix Spike KQ1918558-08MS			Duplicate Matrix Spike KQ1918558-08DMS			% Rec Limits	RPD	RPD Limit
		Result	Spike Amount	% Rec	Result	Spike Amount	% Rec			
Halides, Adsorbable Organic (AOX)	2.14	12.2	10.0	101	12.2	10.0	101	90-110	<1	20

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

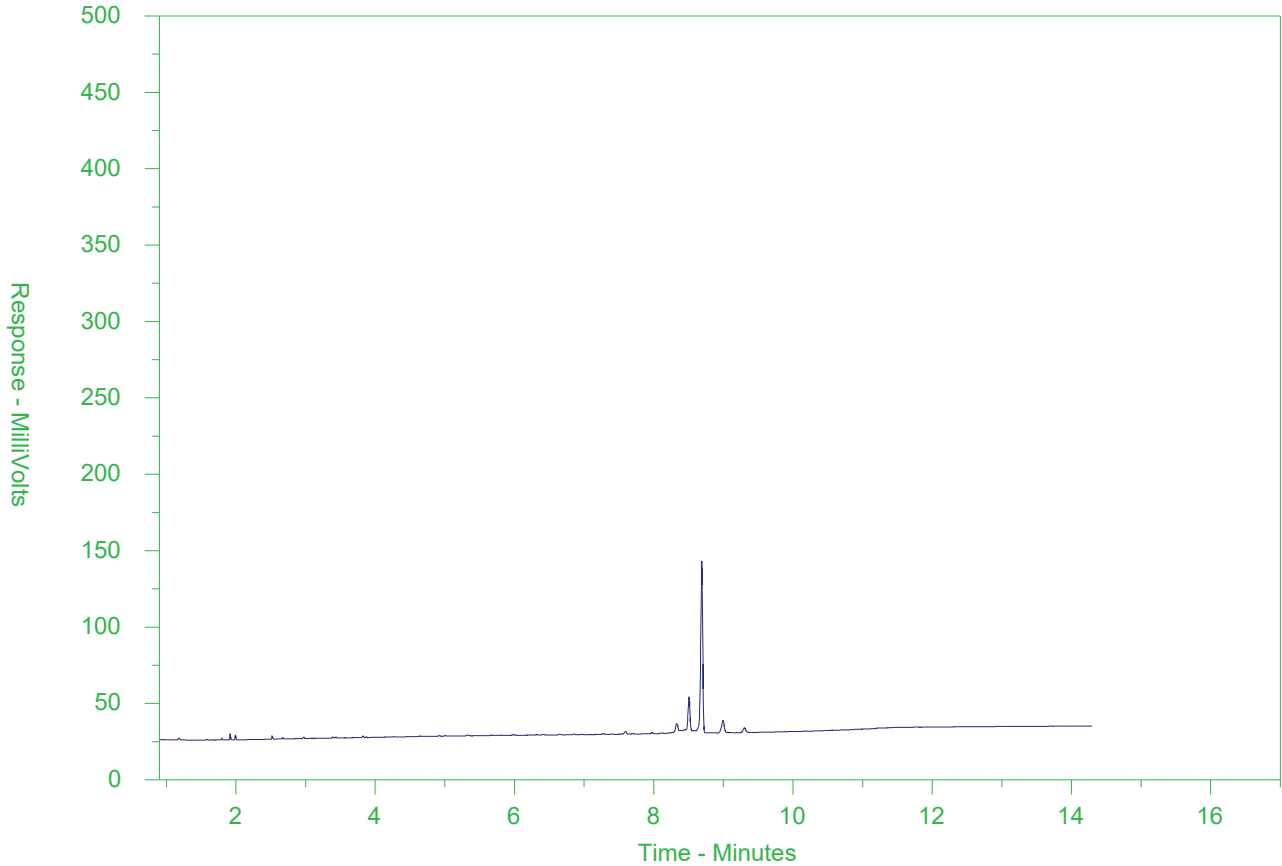
Results flagged with a pound (#) indicate the control criteria is not applicable.

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: L2393425-1
 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.

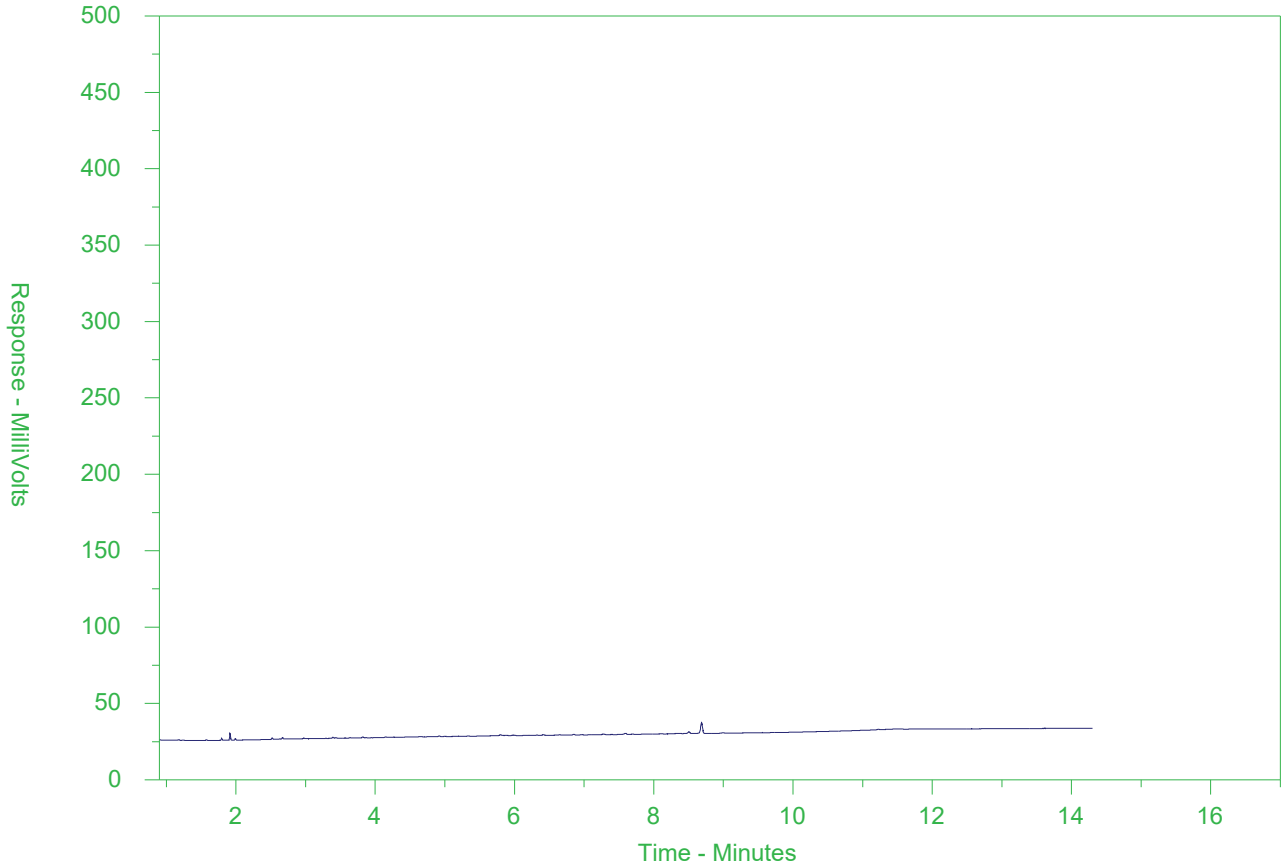
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

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: L2393425-2R
 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.

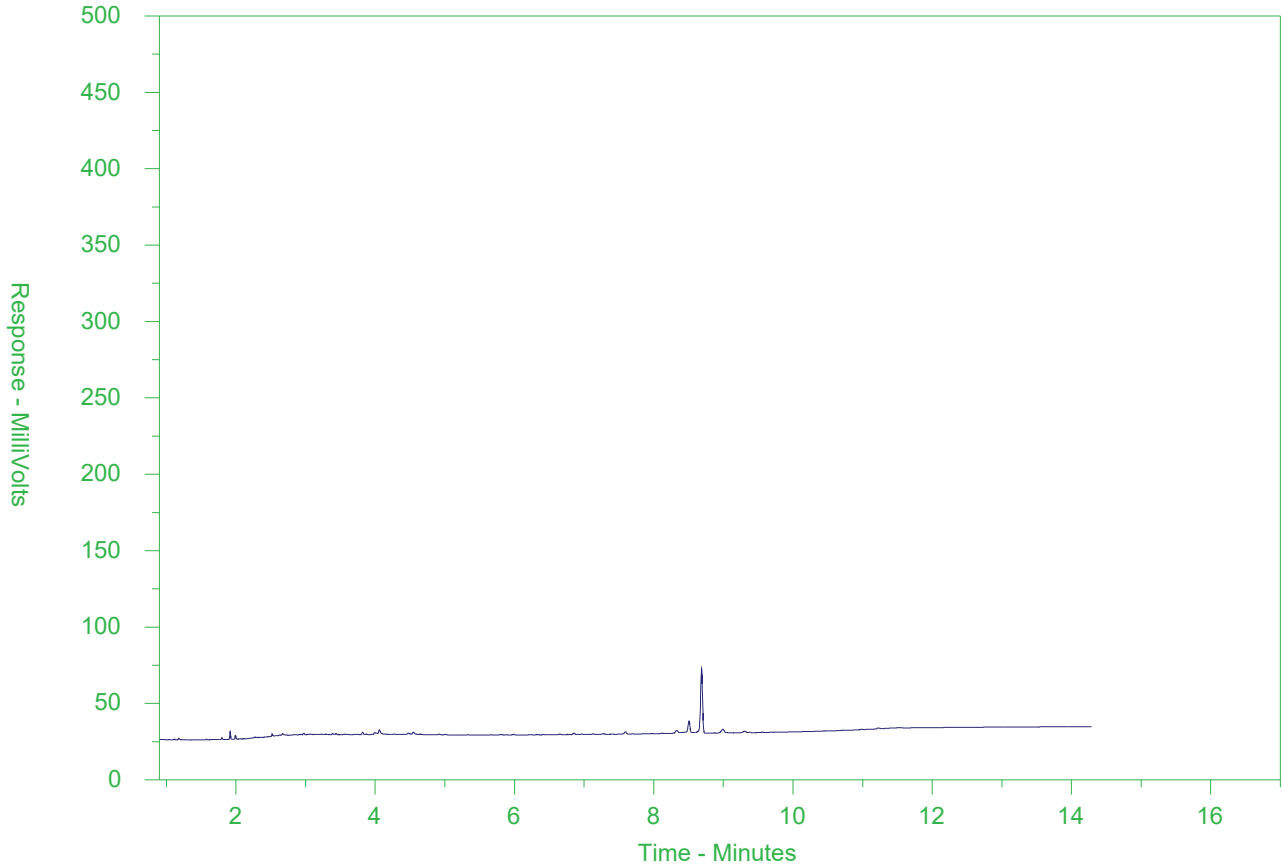
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the scale at left.

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: L2393425-3
 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.



L2393425-COFC

5

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES



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

COC #ORD Heavy Dry Waste Site

Environmental Division

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.SWOP04071-01.007														
Sample:		POI/AFE: SWM.SWOP04071-01.007														
Phone: Fax:		Legal Site Description:														
Lab Work Order # (lab use only)		Quote #: Q71650														
ALS Contact: Wendy Sears		Sampler (Initials): Megan Rouse														
Sample #	Sample Identification (This description will appear on the report)	Date dd-mmm-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
MW-01		03-Dec-19	1250	Water	X	X	X	X	X	X	X	X	X			1
MW-02		↓	1225	Water	X	X	X	X	X	X	X	X	X			1
MW-03		↓	1200	Water	X	X	X	X	X	X	X	X	X			1
Guidelines / Regulations					Special Instructions / Hazardous Details											
					metals + Hg + DOC FIP											
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: <i>Megza Rouse</i>	Date & Time: Dec 6/19/2008	Received By: <i>[Signature]</i>	Date & Time: <i>[Signature]</i>	Temperature: <i>[Signature]</i>	Sample Condition (lab use only)											
Relinquished By: <i>[Signature]</i>	Date & Time:	Received By: <i>[Signature]</i>	Date & Time:	Temperature: <i>[Signature]</i>	Samples Received in Good Condition? Y / N (If no provided details)											

[Large handwritten signature]



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

Date Received: 06-DEC-19
Report Date: 27-DEC-19 13:24 (MT)
Version: FINAL

Client Phone: 403-203-3355

Certificate of Analysis

Lab Work Order #: L2393615
Project P.O. #: SWM.SWOP04071-01.007
Job Reference: SWM.SWOP04071-01.007
C of C Numbers:
Legal Site Desc:

Inayat Dhaliwal
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393615-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 11:58							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	57		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>8-C10	48		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>10-C12	23		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>12-C16	<30		30	ug/m3		24-DEC-19	R4953507
Aromatic C>8-C10	<15		15	ug/m3		24-DEC-19	R4953507
Aromatic C>10-C12	<15		15	ug/m3		24-DEC-19	R4953507
Aromatic C>12-C16	<30		30	ug/m3		24-DEC-19	R4953507
Total F1 and F2 fractions (not corrected)							
F1 (C6-C10)	92		15	ug/m3		24-DEC-19	R4953507
F2 (C10-C16)	33		15	ug/m3		24-DEC-19	R4953507
Surrogate: 4-Bromofluorobenzene	97.8		50-150	%		24-DEC-19	R4953507
High Level Fixed Gases by TCD							
Nitrogen	76.4		1.0	%		13-DEC-19	R4944389
Oxygen	20.2		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	0.674		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		24-DEC-19	R4953168
Naphthalene	<0.50		0.50	ppb(V)		24-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.5		50-150	%		24-DEC-19	R4953168
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		24-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1-Dichloroethane	<0.81		0.81	ug/m3		24-DEC-19	R4953168
1,1-Dichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
1,1-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		24-DEC-19	R4953168
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dibromoethane	<1.5		1.5	ug/m3		24-DEC-19	R4953168
1,2-Dibromoethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		24-DEC-19	R4953168
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichloroethane	<0.81		0.81	ug/m3		24-DEC-19	R4953168
1,2-Dichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichloropropane	<0.92		0.92	ug/m3		24-DEC-19	R4953168
1,2-Dichloropropane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3-Butadiene	<0.44		0.44	ug/m3		24-DEC-19	R4953168
1,3-Butadiene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		24-DEC-19	R4953168
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		24-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
L2393615-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 11:58							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		24-DEC-19	R4953168
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,4-Dioxane	<0.72		0.72	ug/m3		24-DEC-19	R4953168
1,4-Dioxane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
2-Hexanone	<4.1		4.1	ug/m3		24-DEC-19	R4953168
2-Hexanone	<1.0		1.0	ppb(V)		24-DEC-19	R4953168
4-Ethyltoluene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
4-Ethyltoluene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Acetone	19.8	DLA	5.9	ug/m3		24-DEC-19	R4953168
Acetone	8.3	DLA	2.5	ppb(V)		24-DEC-19	R4953168
Allyl chloride	<0.63		0.63	ug/m3		24-DEC-19	R4953168
Allyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Benzene	2.17		0.64	ug/m3		24-DEC-19	R4953168
Benzene	0.68		0.20	ppb(V)		24-DEC-19	R4953168
Benzyl chloride	<1.0		1.0	ug/m3		24-DEC-19	R4953168
Benzyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromodichloromethane	<1.3		1.3	ug/m3		24-DEC-19	R4953168
Bromodichloromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromoform	<2.1		2.1	ug/m3		24-DEC-19	R4953168
Bromoform	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromomethane	<0.78		0.78	ug/m3		24-DEC-19	R4953168
Bromomethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Carbon Disulfide	1.66		0.62	ug/m3		24-DEC-19	R4953168
Carbon Disulfide	0.53		0.20	ppb(V)		24-DEC-19	R4953168
Carbon Tetrachloride	<1.3		1.3	ug/m3		24-DEC-19	R4953168
Carbon Tetrachloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chlorobenzene	<0.92		0.92	ug/m3		24-DEC-19	R4953168
Chlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloroethane	<0.53		0.53	ug/m3		24-DEC-19	R4953168
Chloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloroform	<0.98		0.98	ug/m3		24-DEC-19	R4953168
Chloroform	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloromethane	1.13		0.41	ug/m3		24-DEC-19	R4953168
Chloromethane	0.55		0.20	ppb(V)		24-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		24-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Cyclohexane	<0.69		0.69	ug/m3		24-DEC-19	R4953168
Cyclohexane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Dibromochloromethane	<1.7		1.7	ug/m3		24-DEC-19	R4953168
Dibromochloromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Dichlorodifluoromethane	2.30		0.99	ug/m3		24-DEC-19	R4953168
Dichlorodifluoromethane	0.47		0.20	ppb(V)		24-DEC-19	R4953168
Ethyl acetate	<0.72		0.72	ug/m3		24-DEC-19	R4953168
Ethyl acetate	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Ethylbenzene	<0.87		0.87	ug/m3		24-DEC-19	R4953168
Ethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Freon 113	<1.5		1.5	ug/m3		24-DEC-19	R4953168
Freon 113	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Freon 114	<1.4		1.4	ug/m3		24-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
L2393615-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 11:58							
Matrix: SG							
Canister EPA TO-15							
Freon 114	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Hexachlorobutadiene	<2.1		2.1	ug/m3		24-DEC-19	R4953168
Hexachlorobutadiene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Isooctane	1.30		0.93	ug/m3		24-DEC-19	R4953168
Isooctane	0.28		0.20	ppb(V)		24-DEC-19	R4953168
Isopropyl alcohol	2.6		2.5	ug/m3		24-DEC-19	R4953168
Isopropyl alcohol	1.1		1.0	ppb(V)		24-DEC-19	R4953168
Isopropylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
Isopropylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
m&p-Xylene	2.7		1.7	ug/m3		24-DEC-19	R4953168
m&p-Xylene	0.63		0.40	ppb(V)		24-DEC-19	R4953168
Methyl ethyl ketone	2.23		0.59	ug/m3		24-DEC-19	R4953168
Methyl ethyl ketone	0.76		0.20	ppb(V)		24-DEC-19	R4953168
Methyl isobutyl ketone	<0.82		0.82	ug/m3		24-DEC-19	R4953168
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Methylene chloride	<0.69		0.69	ug/m3		24-DEC-19	R4953168
Methylene chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
MTBE	<0.72		0.72	ug/m3		24-DEC-19	R4953168
MTBE	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
n-Heptane	1.76		0.82	ug/m3		24-DEC-19	R4953168
n-Heptane	0.43		0.20	ppb(V)		24-DEC-19	R4953168
n-Hexane	2.05		0.70	ug/m3		24-DEC-19	R4953168
n-Hexane	0.58		0.20	ppb(V)		24-DEC-19	R4953168
o-Xylene	1.01		0.87	ug/m3		24-DEC-19	R4953168
o-Xylene	0.23		0.20	ppb(V)		24-DEC-19	R4953168
Propylene	<0.34		0.34	ug/m3		24-DEC-19	R4953168
Propylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Styrene	<0.85		0.85	ug/m3		24-DEC-19	R4953168
Styrene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Tetrachloroethylene	<1.4		1.4	ug/m3		24-DEC-19	R4953168
Tetrachloroethylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Tetrahydrofuran	<0.63	DLQ	0.63	ug/m3		24-DEC-19	R4953168
Tetrahydrofuran	<0.21	DLQ	0.21	ppb(V)		24-DEC-19	R4953168
Toluene	6.20		0.75	ug/m3		24-DEC-19	R4953168
Toluene	1.65		0.20	ppb(V)		24-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		24-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Trichloroethylene	<1.1		1.1	ug/m3		24-DEC-19	R4953168
Trichloroethylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Trichlorofluoromethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
Trichlorofluoromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Vinyl acetate	<1.8		1.8	ug/m3		24-DEC-19	R4953168
Vinyl acetate	<0.50		0.50	ppb(V)		24-DEC-19	R4953168
Vinyl bromide	<0.87		0.87	ug/m3		24-DEC-19	R4953168
Vinyl bromide	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Vinyl chloride	<0.51		0.51	ug/m3		24-DEC-19	R4953168
Vinyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	96.5		50-150	%		24-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
L2393615-1 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 11:58							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	0.86		0.45	ppb(V)		24-DEC-19	
Xylenes (Total)	3.7		2.0	ug/m3		24-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.00026		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	-9.6		-30	in Hg	17-DEC-19	17-DEC-19	R4944737
Canister ID	01400-0031				17-DEC-19	17-DEC-19	R4944737
Regulator ID	PG67				17-DEC-19	17-DEC-19	R4944737
Batch Proof ID	191119.113				17-DEC-19	17-DEC-19	R4944737

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393615-2 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	79		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>8-C10	48		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>10-C12	21		15	ug/m3		24-DEC-19	R4953507
Aliphatic C>12-C16	<30		30	ug/m3		24-DEC-19	R4953507
Aromatic C>8-C10	<15		15	ug/m3		24-DEC-19	R4953507
Aromatic C>10-C12	<15		15	ug/m3		24-DEC-19	R4953507
Aromatic C>12-C16	<30		30	ug/m3		24-DEC-19	R4953507
Total F1 and F2 fractions (not corrected)							
F1 (C6-C10)	109		15	ug/m3		24-DEC-19	R4953507
F2 (C10-C16)	24		15	ug/m3		24-DEC-19	R4953507
Surrogate: 4-Bromofluorobenzene	100.3		50-150	%		24-DEC-19	R4953507
High Level Fixed Gases by TCD							
Nitrogen	74.8		1.0	%		13-DEC-19	R4944389
Oxygen	20.2		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	0.702		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		24-DEC-19	R4953168
Naphthalene	<0.50		0.50	ppb(V)		24-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	98.5		50-150	%		24-DEC-19	R4953168
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		24-DEC-19	R4953168
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1-Dichloroethane	<0.81		0.81	ug/m3		24-DEC-19	R4953168
1,1-Dichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,1-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
1,1-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		24-DEC-19	R4953168
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dibromoethane	<1.5		1.5	ug/m3		24-DEC-19	R4953168
1,2-Dibromoethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		24-DEC-19	R4953168
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichloroethane	<0.81		0.81	ug/m3		24-DEC-19	R4953168
1,2-Dichloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,2-Dichloropropane	<0.92		0.92	ug/m3		24-DEC-19	R4953168
1,2-Dichloropropane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3-Butadiene	<0.44		0.44	ug/m3		24-DEC-19	R4953168
1,3-Butadiene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		24-DEC-19	R4953168
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393615-2 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		24-DEC-19	R4953168
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
1,4-Dioxane	<0.72		0.72	ug/m3		24-DEC-19	R4953168
1,4-Dioxane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
2-Hexanone	<4.1		4.1	ug/m3		24-DEC-19	R4953168
2-Hexanone	<1.0		1.0	ppb(V)		24-DEC-19	R4953168
4-Ethyltoluene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
4-Ethyltoluene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Acetone	58.2	DLA	5.9	ug/m3		24-DEC-19	R4953168
Acetone	24.5	DLA	2.5	ppb(V)		24-DEC-19	R4953168
Allyl chloride	<0.63		0.63	ug/m3		24-DEC-19	R4953168
Allyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Benzene	2.43		0.64	ug/m3		24-DEC-19	R4953168
Benzene	0.76		0.20	ppb(V)		24-DEC-19	R4953168
Benzyl chloride	<1.0		1.0	ug/m3		24-DEC-19	R4953168
Benzyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromodichloromethane	<1.3		1.3	ug/m3		24-DEC-19	R4953168
Bromodichloromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromoform	<2.1		2.1	ug/m3		24-DEC-19	R4953168
Bromoform	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Bromomethane	<0.78		0.78	ug/m3		24-DEC-19	R4953168
Bromomethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Carbon Disulfide	170	DLA	3.1	ug/m3		24-DEC-19	R4953168
Carbon Disulfide	54.6	DLA	1.0	ppb(V)		24-DEC-19	R4953168
Carbon Tetrachloride	<1.3		1.3	ug/m3		24-DEC-19	R4953168
Carbon Tetrachloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chlorobenzene	<0.92		0.92	ug/m3		24-DEC-19	R4953168
Chlorobenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloroethane	<0.53		0.53	ug/m3		24-DEC-19	R4953168
Chloroethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloroform	<0.98		0.98	ug/m3		24-DEC-19	R4953168
Chloroform	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Chloromethane	1.00		0.41	ug/m3		24-DEC-19	R4953168
Chloromethane	0.48		0.20	ppb(V)		24-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		24-DEC-19	R4953168
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Cyclohexane	<0.69		0.69	ug/m3		24-DEC-19	R4953168
Cyclohexane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Dibromochloromethane	<1.7		1.7	ug/m3		24-DEC-19	R4953168
Dibromochloromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Dichlorodifluoromethane	1.94		0.99	ug/m3		24-DEC-19	R4953168
Dichlorodifluoromethane	0.39		0.20	ppb(V)		24-DEC-19	R4953168
Ethyl acetate	<0.72		0.72	ug/m3		24-DEC-19	R4953168
Ethyl acetate	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Ethylbenzene	<0.87		0.87	ug/m3		24-DEC-19	R4953168
Ethylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Freon 113	<1.5		1.5	ug/m3		24-DEC-19	R4953168
Freon 113	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Freon 114	<1.4		1.4	ug/m3		24-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
L2393615-2 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)		24-DEC-19	R4953168
Hexachlorobutadiene	<2.1		2.1	ug/m3		24-DEC-19	R4953168
Hexachlorobutadiene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Isooctane	1.16		0.93	ug/m3		24-DEC-19	R4953168
Isooctane	0.25		0.20	ppb(V)		24-DEC-19	R4953168
Isopropyl alcohol	<2.5		2.5	ug/m3		24-DEC-19	R4953168
Isopropyl alcohol	<1.0		1.0	ppb(V)		24-DEC-19	R4953168
Isopropylbenzene	<0.98		0.98	ug/m3		24-DEC-19	R4953168
Isopropylbenzene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
m&p-Xylene	2.7		1.7	ug/m3		24-DEC-19	R4953168
m&p-Xylene	0.62		0.40	ppb(V)		24-DEC-19	R4953168
Methyl ethyl ketone	5.26		0.59	ug/m3		24-DEC-19	R4953168
Methyl ethyl ketone	1.78		0.20	ppb(V)		24-DEC-19	R4953168
Methyl isobutyl ketone	<0.82		0.82	ug/m3		24-DEC-19	R4953168
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Methylene chloride	<0.69		0.69	ug/m3		24-DEC-19	R4953168
Methylene chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
MTBE	<0.72		0.72	ug/m3		24-DEC-19	R4953168
MTBE	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
n-Heptane	1.70		0.82	ug/m3		24-DEC-19	R4953168
n-Heptane	0.42		0.20	ppb(V)		24-DEC-19	R4953168
n-Hexane	1.84		0.70	ug/m3		24-DEC-19	R4953168
n-Hexane	0.52		0.20	ppb(V)		24-DEC-19	R4953168
o-Xylene	1.00		0.87	ug/m3		24-DEC-19	R4953168
o-Xylene	0.23		0.20	ppb(V)		24-DEC-19	R4953168
Propylene	<0.34		0.34	ug/m3		24-DEC-19	R4953168
Propylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Styrene	<0.85		0.85	ug/m3		24-DEC-19	R4953168
Styrene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Tetrachloroethylene	<1.4		1.4	ug/m3		24-DEC-19	R4953168
Tetrachloroethylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Tetrahydrofuran	<0.59		0.59	ug/m3		24-DEC-19	R4953168
Tetrahydrofuran	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Toluene	6.35		0.75	ug/m3		24-DEC-19	R4953168
Toluene	1.68		0.20	ppb(V)		24-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		24-DEC-19	R4953168
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		24-DEC-19	R4953168
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Trichloroethylene	<1.1		1.1	ug/m3		24-DEC-19	R4953168
Trichloroethylene	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Trichlorofluoromethane	<1.1		1.1	ug/m3		24-DEC-19	R4953168
Trichlorofluoromethane	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Vinyl acetate	5.0	AI	1.8	ug/m3		24-DEC-19	R4953168
Vinyl acetate	1.42	AI	0.50	ppb(V)		24-DEC-19	R4953168
Vinyl bromide	<0.87		0.87	ug/m3		24-DEC-19	R4953168
Vinyl bromide	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Vinyl chloride	<0.51		0.51	ug/m3		24-DEC-19	R4953168
Vinyl chloride	<0.20		0.20	ppb(V)		24-DEC-19	R4953168
Surrogate: 4-Bromofluorobenzene	98.5		50-150	%		24-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
L2393615-2 19DUP01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 12:00							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	0.85		0.45	ppb(V)		24-DEC-19	
Xylenes (Total)	3.7		2.0	ug/m3		24-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.00026		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	-7.8		-30	in Hg	17-DEC-19	17-DEC-19	R4944737
Canister ID	01400-0390				17-DEC-19	17-DEC-19	R4944737
Regulator ID	PG67				17-DEC-19	17-DEC-19	R4944737
Batch Proof ID	191119.103				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
L2393615-3 VW-01							
Sampled By: MEGAN ROUSE on 03-DEC-19 @ 14:25							
Matrix: SG							
Miscellaneous Parameters							
Air volume	.06			L		19-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	99.3		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150552SVI					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

Sample Parameter Qualifier Key:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit adjusted for required dilution
DLQ	Detection Limit raised due to co-eluting interference. GCMS qualifier ion ratio did not meet acceptance criteria.

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

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.

BTEX+NAPH-GCMS-WT	Canister	BTEX and Naphthalene	EPA TO-15
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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.

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.

C1-C5-FID-WT	Canister	Select list of 7 C1-C5 hydrocarbon gases	EPA Method 3C & ASTM D1946
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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.

Canister samples will be retained for 7 calendar days after final report. If you require longer canister storage time, please contact your account manager.

CAN-DATA-WT	Canister	Canister Information	EPA TO-15
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Batch Proof ID, Canister ID, Pressure on Receipt, Regulator ID.

F1-F2-GCMS-WT	Canister	Total F1and F2 fractions (not corrected)	EPATO-15
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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.

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.

FIXED GASES-TCD-WT	Canister	High Level Fixed Gases by TCD	EPA Method 3C & ASTM D1946
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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).

Oxygen is not separated from Argon.

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.

SILOXANES-GCMS-WT	Tube	Linear & Cyclic Methyl Siloxanes	EPA TO-17
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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.

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.

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.

TO15-GCMS-WT	Canister	Canister EPA TO-15	EPA TO-15
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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.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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.			
XYLENES-SUM-CALC-WT	Canister	Sum of Xylene Isomer Concentrations	CALCULATION

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

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

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

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 Routine Water Chemistry Report

L2393615

Lab ID	Sample ID			Lab ID	Sample ID		

ALS LABORATORY GROUP SOIL SALINITY CONVERSION

L2393615

Lab ID	Sample ID				Lab ID	Sample ID			
<p>"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."</p>									



Quality Control Report

Workorder: L2393615

Report Date: 27-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
ALIPH/AROM-GCMS-WT		Canister						
Batch	R4953507							
WG3249117-4	DUP	L2393610-1						
Aliphatic C6-C8		22	20		ug/m3	9.3	50	24-DEC-19
Aliphatic C>8-C10		33	19	J	ug/m3	14	30	24-DEC-19
Aliphatic C>10-C12		27	30		ug/m3	11	50	24-DEC-19
Aliphatic C>12-C16		<30	<30	RPD-NA	ug/m3	N/A	50	24-DEC-19
Aromatic C>8-C10		<15	<15	RPD-NA	ug/m3	N/A	50	24-DEC-19
Aromatic C>10-C12		<15	<15	RPD-NA	ug/m3	N/A	50	24-DEC-19
Aromatic C>12-C16		<30	<30	RPD-NA	ug/m3	N/A	50	24-DEC-19
WG3249117-2	LCS							
Aliphatic C6-C8			119.6		%		50-150	24-DEC-19
Aliphatic C>8-C10			102.6		%		50-150	24-DEC-19
Aliphatic C>10-C12			119.0		%		50-150	24-DEC-19
Aliphatic C>12-C16			134.7		%		50-150	24-DEC-19
Aromatic C>8-C10			106.5		%		50-150	24-DEC-19
Aromatic C>10-C12			103.2		%		50-150	24-DEC-19
Aromatic C>12-C16			87.9		%		50-150	24-DEC-19
WG3249117-3	LCSD	WG3249117-2						
Aliphatic C6-C8		119.6	129.2		%	7.8	50	24-DEC-19
Aliphatic C>8-C10		102.6	110.5		%	7.4	50	24-DEC-19
Aliphatic C>10-C12		119.0	123.4		%	3.7	50	24-DEC-19
Aliphatic C>12-C16		134.7	140.6		%	4.3	50	24-DEC-19
Aromatic C>8-C10		106.5	112.3		%	5.3	50	24-DEC-19
Aromatic C>10-C12		103.2	108.0		%	4.6	50	24-DEC-19
Aromatic C>12-C16		87.9	97.7		%	11	50	24-DEC-19
WG3249117-1	MB							
Aliphatic C6-C8			<15		ug/m3		15	24-DEC-19
Aliphatic C>8-C10			<15		ug/m3		15	24-DEC-19
Aliphatic C>10-C12			<15		ug/m3		15	24-DEC-19
Aliphatic C>12-C16			<30		ug/m3		30	24-DEC-19
Aromatic C>8-C10			<15		ug/m3		15	24-DEC-19
Aromatic C>10-C12			<15		ug/m3		15	24-DEC-19
Aromatic C>12-C16			<30		ug/m3		30	24-DEC-19

BTEX+NAPH-GCMS-WT **Canister**



Quality Control Report

Workorder: L2393615

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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
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
C1-C5-FID-WT		Canister						
Batch	R4944650							
WG3239341-8	DUP	L2393610-2						
Methane		0.00040	0.00030	J	%	0.00010	0.0002	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
WG3239341-5	LCS							
Methane			80.6		%		70-130	10-DEC-19
Ethane			90.2		%		70-130	10-DEC-19
Ethene			86.2		%		70-130	10-DEC-19
Propane			90.0		%		70-130	10-DEC-19
Propene			98.8		%		70-130	10-DEC-19
Butane			90.8		%		70-130	10-DEC-19
Pentane			93.7		%		70-130	10-DEC-19
WG3239341-6	LCSD	WG3239341-5						
Methane		80.6	80.4		%	0.3	50	10-DEC-19
Ethane		90.2	90.3		%	0.1	50	10-DEC-19
Ethene		86.2	85.8		%	0.5	50	10-DEC-19
Propane		90.0	89.5		%	0.5	50	10-DEC-19
Propene		98.8	98.2		%	0.6	50	10-DEC-19
Butane		90.8	90.5		%	0.3	50	10-DEC-19
Pentane		93.7	93.1		%	0.6	50	10-DEC-19



Quality Control Report

Workorder: L2393615

Report Date: 27-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							
WG3239341-7	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
F1-F2-GCMS-WT	Canister							
Batch	R4953507							
WG3249117-4	DUP	L2393610-1						
F1 (C6-C10)		53	47		ug/m3	11	50	24-DEC-19
F2 (C10-C16)		61	69		ug/m3	13	50	24-DEC-19
WG3249117-2	LCS							
F1 (C6-C10)			107.6		%		50-150	24-DEC-19
WG3249117-3	LCSD	WG3249117-2						
F1 (C6-C10)		107.6	107.7		%	0.1	50	24-DEC-19
WG3249117-1	MB							
F1 (C6-C10)			<15		ug/m3		15	24-DEC-19
F2 (C10-C16)			<15		ug/m3		15	24-DEC-19
Surrogate: 4-Bromofluorobenzene			94.3		%		50-150	24-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



Quality Control Report

Workorder: L2393615

Report Date: 27-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
FIXED GASES-TCD-WT		Canister						
Batch	R4944389							
WG3236065-5	LCS							
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						
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



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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						
1,4-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	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		ppb(V)			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							
WG3247636-4	DUP	L2393586-1						
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							
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



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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							
1,4-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
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



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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							
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
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



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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						
1,4-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		%	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		%			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						
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
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



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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							
1,4-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
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



Quality Control Report

Workorder: L2393615

Report Date: 27-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							
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						
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



Quality Control Report

Workorder: L2393615

Report Date: 27-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
SILOXANES-GCMS-WT								
	Tube							
Batch	R4945277							
WG3242059-3	LCSD	WG3242059-2						
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

Quality Control Report

Workorder: L2393615

Report Date: 27-DEC-19

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

Page 14 of 14

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-Dichloroethene	<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



L2393615-COFC

60 NORTHLAND R
WATERLOO, ON N.

Phone: (519) 886-6910

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

10 day (regular)

Rush 5 day (50%)

Rush 3 day (100%)

Rush 2 day (200%)

Rush 1 day (300%) - Enquire

COMPANY NAME: Tetra Tech Canada Inc.
 OFFICE: 110, 140 Quarry Park Blvd SE, Calgary, AB T2C 3G3
 PROJECT MANAGER: Darby Madalena
 PROJECT #: SWM.SWOP04071-01.007
 PHONE: 403-723-6867 FAX: 403-203-3301
 ACCOUNT #: (Red Deer Motors)
 QUOTATION # Q71650 PO # SWM.SWOP04071-01.007

SAMPLE TYPE/REGULATION
 Reg 419/05 Soil Vapor Intrusion
 OTHER Please List _____

REPORT FORMAT/DISTRIBUTION
 EMAIL _____ FAX _____ BOTH _____
 SELECT: PDF _____ DIGITAL _____ BOTH _____
 EMAIL 1 _____
 EMAIL 2 _____

SAMPLING INFORMATION					Matrix Type	SAMPLE DESCRIPTION TO APPEAR ON REPORT	TUBE AIR VOLUME - L	CT-C5-FID-WT	FIXED GASES-TCD-WT	TO15,F12SFRA+NAP-WT	siloxanes- GMS-WT	STARTING PRESSURE - Pre-Sampling (°Hg)	ENDING PRESSURE - Post Sampling (°Hg)	COLLECTION TIME (HRS)	Field Conditions (Rain/Wind/Dust/Odour) Field PID Reading	LAB ID
Date (dd-mmm-yy)	Time (24hr) (hh:mm)	Canister or Tube ID# (e.g. 060000-XXXX or G0XXXXXX SVI)	Regulator Serial # CS1200-XXXX or GXX	Sample Date/Time												
03-Dec-19	1158	144	PG-67	SG	VW-01	1.4	x	x	x			27	2	2		
03-Dec-19	-	6371	PG-67	SG	19DUP01	1.4	x	x	x			27	2	2		
03-Dec-19	1425	G01505523V1	-	SG	VW-01	-				x		/	/	/		

ANALYSIS REQUEST

TUBE AIR VOLUME - L: 1.4 m³

CT-C5-FID-WT

FIXED GASES-TCD-WT

TO15,F12SFRA+NAP-WT

siloxanes-
GMS-WT

STARTING PRESSURE - Pre-Sampling (°Hg)

ENDING PRESSURE - Post Sampling (°Hg)

COLLECTION TIME (HRS)

All rush work requires lab approval before sample submission

SUBMISSION #:

ENTERED BY:

DATE/TIME ENTERED:

BIN #:

SPECIAL INSTRUCTIONS/COMMENTS

SAMPLED BY: *Hosna Rouse*
 RELINQUISHED BY: *[Signature]*

Matrix Type

Soil Gas Vapour = SG Indoor Air = IA
 Ambient Air = AA Industrial Hygiene = IH

DATE & TIME: *Dec 3 1500*
 RECEIVED BY: *[Signature]*
 DATE & TIME: *12/6/19 1600*
 RECEIVED AT LAB BY: *[Signature]*

SAMPLE CONDITION AS RECEIVED

FROZEN
 COLD
 COOLING INITIATED
 AMBIENT

OBSERVATIONS: Yes No
 If yes add SIF:

MEAN TEMP: *2*
 INIT: *[Signature]*

Notes

1. Quote number must be provided to ensure proper pricing

2. TAT may vary dependent on complexity of analysis and lab workload at time of submission. Please contact the lab to confirm TATs.

3. Any known or suspected hazard relating to a sample must be noted on the chain of custody in comments section.

REV4-2012

APPENDIX E

HISTORICAL ANALYTICAL RESULTS

Table 1
Soil Vapour and Groundwater Monitoring Well Elevations

Test Location	Well Depth (m)	Elevations				Screen Length (m)
		Ground (m)	Top of Pipe (m)	Screen Interval		
				From	To	
MW-01	14.9	871.813	872.559	856.913	859.913	3.0
MW-02	6.1	848.556	849.294	842.456	845.456	3.0
MW-03	6.1	847.734	848.466	841.634	846.234	4.6
VW-01	7.3	871.261	NA	863.961	864.261	0.3
TH-03	NA	868.951	NA	NA	NA	NA
TH-04	NA	868.686	NA	NA	NA	NA
TH-05	NA	869.951	NA	NA	NA	NA
TH-06	NA	866.315	NA	NA	NA	NA
TH-07	NA	863.026	NA	NA	NA	NA

Notes:

- 1) Geodetic elevations are determined from multiple datums, ASCM Nos. 36574, 170910 and 124339.
- 2) MW - Monitoring Well.
- 3) VW - Soil Vapour Well.
- 4) TH- Testhole.
- 5) NA - Not Applicable.

Table 2
Site Monitoring Results

Test Location	Elevation		Groundwater Elevation (m)		Headspace Vapour			
	Ground (m)	Top of Pipe (m)	08/17/2013		08/17/2013		Combustible	Volatile
			Combustible	Volatile	Combustible	Volatile		
MW-01	871.813	872.559	862.180		1,100	30		
MW-02	848.556	849.294	844.568		20	1		
MW-03	847.734	848.466	845.831		230	ND		
VW-01	871.261	NA	--	--	185	3		

Notes:

- 1) Measurement of combustible and volatile vapours by RKI Eagle 2.
Combustible vapour sensor calibrated to hexane and photoionization detector calibrated to isobutylene.
- 2) NA - Not Applicable.
- 3) ND - Not Detected, less than the limit of instrument detection.
- 4) -- No value established.

Table 3A
Analytical Results - Soil - Drill Cuttings (Soil Bag)

Parameter	Detection Limit	Soil Bag			Class II Landfill Acceptance Criteria
		1 of 3	2 of 3	3 of 3	
pH	0.10	8.42	7.90	7.74	2-12.5
Flash Point (°C)	30.0	>75	>75	>75	>61
Paint Filter Test	-	PASS	PASS	PASS	PASS
Total Carbon by Combustion	0.1	3.5	2.8	1.8	--
Total Organic Carbon	0.10	0.86	1.99	0.84	--
<u>TCLP Hydrocarbons</u>					
Benzene	0.0050	ND	ND	ND	0.5
Toluene	0.0050	ND	ND	ND	0.5
Ethylbenzene	0.0050	ND	ND	ND	0.5
Xylenes	0.0050	ND	ND	ND	0.5
<u>TCLP Leachable Metals</u>					
Antimony (Sb)	5.0	ND	ND	ND	500
Arsenic (As)	0.20	ND	ND	ND	5
Barium (Ba)	5.0	ND	ND	ND	100
Beryllium (Be)	0.50	ND	ND	ND	5
Boron (B)	5.0	ND	ND	ND	500
Cadmium (Cd)	0.050	ND	ND	ND	1
Chromium (Cr)	0.50	ND	ND	ND	5
Cobalt (Co)	5.0	ND	ND	ND	100
Copper (Cu)	5.0	ND	ND	ND	100
Iron (Fe)	5.0	ND	ND	ND	1,000
Lead (Pb)	0.50	ND	ND	ND	5
Mercury (Hg)	0.010	ND	ND	ND	0.2
Nickel (Ni)	0.50	ND	ND	ND	5
Selenium (Se)	0.20	ND	ND	ND	1
Silver (Ag)	0.50	ND	ND	ND	5
Thallium (Tl)	0.50	ND	ND	ND	5
Uranium (U)	1.0	ND	ND	ND	2
Vanadium (V)	5.0	ND	ND	ND	100
Zinc (Zn)	5.0	ND	ND	ND	500
Zirconium (Zr)	5.0	ND	ND	ND	500

Notes:

- 1) Class II Landfill Acceptance Criteria - per Table 2, Part 4 Schedule to the Alberta User Guide for Waste Managers 3/95. Applicable waste screening for The City of Red Deer Class II Waste Management Facility.
- 2) All units are mg/L unless otherwise stated.
- 3) ND - Not Detected, less than the limit of method detection.
- 4) -- No value established.
- 5) Soil bags were sampled on Friday, June 28, Saturday, June 29 and Wednesday, July 10, 2013.
- 6) For further information, refer to the specific laboratory report in Appendix A.

Table 3B
Analytical Results - Soil - General Indices and Heavy Metals

Parameter	Unit	Detection Limit	TH-01	TH-03	TH-06	TH-06	TH-08	TH-09	Tier 1 Guideline
			@ 13.1 m	@ 5.5 m	@ 12.8 - 13.4 m	@ 17.7 m	@ 4.6 m	@ 4.6 m	
			12/07/13			07/13/2013			
Chloride (Cl)	mg/kg	3.7 - 16	ND	29	ND	ND	20	26	--
Nitrate-N	mg/kg	0.19 - 0.80	ND	ND	ND	ND	ND	ND	--
Nitrite-N	mg/kg	0.19 - 0.80	ND	ND	ND	ND	ND	ND	--
Metals									
Antimony (Sb)	mg/kg	0.20	ND	0.36	0.33	0.40	0.68	0.58	40
Arsenic (As)	mg/kg	0.20	1.86	5.85	15.90	6.54	9.24	6.98	26
Barium (Ba)	mg/kg	5.0	54.4	223	93.5	213	728	315	2,000
Beryllium (Be)	mg/kg	1.0	ND	ND	ND	ND	ND	ND	8
Cadmium (Cd)	mg/kg	0.50	ND	ND	ND	ND	ND	ND	22
Chromium (Cr)	mg/kg	0.50	5.76	18.6	19.6	18.6	23.2	30.2	87
Cobalt (Co)	mg/kg	1.0	2.2	7.3	7.6	7.4	6.7	9.9	300
Copper (Cu)	mg/kg	2.0	3.7	16.4	10.2	15.8	17.7	23.0	91
Lead (Pb)	mg/kg	5.0	ND	8.4	7.4	8.7	10.9	11.2	260
Mercury (Hg)	mg/kg	0.050	ND	ND	ND	ND	ND	ND	24
Molybdenum (Mo)	mg/kg	1.0	ND	ND	ND	1.1	7	4.9	40
Nickel (Ni)	mg/kg	2.0	5.7	21.1	22.8	20.2	23.9	32.1	50
Selenium (Se)	mg/kg	0.50	ND	ND	ND	ND	ND	ND	2.9
Silver (Ag)	mg/kg	1.0	ND	ND	ND	ND	ND	ND	40
Thallium (Tl)	mg/kg	0.50	ND	ND	ND	ND	ND	ND	1.0
Tin (Sn)	mg/kg	2.0	ND	ND	ND	ND	ND	ND	300
Uranium (U)	mg/kg	2.0	ND	ND	ND	ND	ND	ND	33
Vanadium (V)	mg/kg	1.0	8.4	29.2	21.9	31.1	30.5	39.1	130
Zinc (Zn)	mg/kg	10	15	58	65	56	67	76	360
Hexavalent Chromium	mg/kg	0.10	ND	ND	ND	ND	ND	ND	1.4
Boron (B), Hot Water Ext	mg/kg	0.10	0.21	0.12	0.22	0.87	0.42	0.62	2

Notes:

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

Table 3C
Analytical Results - Soil - VOCs

Parameter	Detection Limit	TH-01	TH-03	TH-06	TH-06	TH-08	TH-09	Tier 1 Guideline
		@ 13.1 m	@ 5.5 m	@ 12.8 - 13.4 m	@ 17.7 m	@ 4.6 m	@ 4.6 m	
Hydrocarbons								
F1 (C ₆ -C ₁₀)	10	ND	ND	ND	ND	ND	ND	270
F2 (C ₁₀ -C ₁₆)	25	ND	ND	ND	ND	ND	ND	260
F3 (C ₁₆ -C ₃₄)	50	ND	ND	ND	271	ND	ND	1,700
F4 (C ₃₄ -C ₅₀)	50	ND	ND	ND	148	ND	ND	3,300
Total Hydrocarbons (C ₇ -C ₅₀)	50	ND	ND	ND	419	ND	ND	--
Volatile Organic Compounds								
Benzene	0.0050	ND	ND	ND	ND	ND	ND	0.078
Bromobenzene	0.010	ND	ND	ND	ND	ND	ND	--
Bromochloromethane	0.010	ND	ND	ND	ND	ND	ND	--
Bromodichloromethane	0.010	ND	ND	ND	ND	ND	ND	--
Bromoform	0.010	ND	ND	ND	ND	ND	ND	--
Bromomethane	0.10	ND	ND	ND	ND	ND	ND	--
n-Butylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
sec-Butylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
tert-Butylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
Carbon tetrachloride	0.010	ND	ND	ND	ND	ND	ND	0.0068
Chlorobenzene	0.010	ND	ND	ND	ND	ND	ND	0.22
Dibromochloromethane	0.010	ND	ND	ND	ND	ND	ND	1.5
Chloroethane	0.10	ND	ND	ND	ND	ND	ND	--
Chloroform	0.010	ND	ND	ND	ND	ND	ND	0.003
Chloromethane	0.10	ND	ND	ND	ND	ND	ND	--
2-Chlorotoluene	0.010	ND	ND	ND	ND	ND	ND	--
4-Chlorotoluene	0.010	ND	ND	ND	ND	ND	ND	--
1,2-Dibromo-3-chloropropane	0.010	ND	ND	ND	ND	ND	ND	--
1,2-Dibromoethane	0.010	ND	ND	ND	ND	ND	ND	--
Dibromomethane	0.010	ND	ND	ND	ND	ND	ND	--
1,2-Dichlorobenzene	0.010	ND	ND	ND	ND	ND	ND	0.18
1,3-Dichlorobenzene	0.010	ND	ND	ND	ND	ND	ND	--
1,4-Dichlorobenzene	0.010	ND	ND	ND	ND	ND	ND	0.098
Dichlorodifluoromethane	0.010	ND	ND	ND	ND	ND	ND	--
1,1-Dichloroethane	0.010	ND	ND	ND	ND	ND	ND	--
1,2-Dichloroethane	0.010	ND	ND	ND	ND	ND	ND	0.033
1,1-Dichloroethene	0.010	ND	ND	ND	ND	ND	ND	0.24
cis-1,2-Dichloroethene	0.010	ND	ND	ND	ND	ND	ND	--
trans-1,2-Dichloroethene	0.010	ND	ND	ND	ND	ND	ND	--
Methylene chloride	0.010	ND	ND	ND	ND	ND	0.039	0.095
1,2-Dichloropropane	0.010	ND	ND	ND	ND	ND	ND	--
1,3-Dichloropropane	0.010	ND	ND	ND	ND	ND	ND	--
2,2-Dichloropropane	0.010	ND	ND	ND	ND	ND	ND	--
1,1-Dichloropropene	0.010	ND	ND	ND	ND	ND	ND	--
cis-1,3-Dichloropropene	0.010	ND	ND	ND	ND	ND	ND	--
trans-1,3-Dichloropropene	0.010	ND	ND	ND	ND	ND	ND	--
Ethylbenzene	0.015	ND	ND	ND	ND	ND	ND	0.21
Hexachlorobutadiene	0.010	ND	ND	ND	ND	ND	ND	0.031
Isopropylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
p-Isopropyltoluene	0.010	ND	ND	ND	ND	ND	ND	--
n-Propylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
Styrene	0.050	ND	ND	ND	ND	ND	ND	0.80
1,1,1,2-Tetrachloroethane	0.010	ND	ND	ND	ND	ND	ND	--
1,1,2,2-Tetrachloroethane	0.050	ND	ND	ND	ND	ND	ND	--
Tetrachloroethene	0.010	ND	ND	ND	ND	ND	ND	0.77
Toluene	0.050	ND	ND	ND	ND	ND	ND	0.49
1,2,3-Trichlorobenzene	0.010	ND	ND	ND	ND	ND	ND	0.31
1,2,4-Trichlorobenzene	0.010	ND	ND	ND	ND	ND	ND	0.93
1,1,1-Trichloroethane	0.010	ND	ND	ND	ND	ND	ND	--
1,1,2-Trichloroethane	0.010	ND	ND	ND	ND	ND	ND	--
Trichloroethene	0.010	ND	ND	ND	ND	ND	ND	0.081
Trichlorofluoromethane	0.010	ND	ND	ND	ND	ND	ND	--
1,2,3-Trichloropropane	0.020	ND	ND	ND	ND	ND	ND	--
1,2,4-Trimethylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
1,3,5-Trimethylbenzene	0.010	ND	ND	ND	ND	ND	ND	--
Vinyl chloride	0.20	ND	ND	ND	ND	ND	ND	0.0043
Xylenes	0.10	ND	ND	ND	ND	ND	ND	28

Notes:

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

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Phase II ESA - Riverside Heavy Dry Waste Site
Historic Waste Disposal Sites, The City of Red Deer

Table 4A
Groundwater Indices 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	7.91	1,239	7.6	2.6	1,202.50	-12.5
MW-02	7.50	2,021	7.3	1.83	1,976.00	+33.7
MW-03	6.99	1,909	11.9	0.81	1,644.50	-106.7

Notes:

- 1) Measurement of groundwater indices by YSI Pro Plus multimeter.
- 2) Wells sampled on Saturday, August 17, 2013.

Table 4B
Analytic Results - Groundwater - General Water Quality

Parameter	Unit	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
			08/17/2013			
<u>General Water Quality</u>						
Biochemical Oxygen Demand	mg/L	2.0	3.5	2	4.3	--
Total Chemical Oxygen Demand	mg/L	5.0 - 50.0	100	310	460	--
Conductivity	µS/cm	1.0	1,900	3,200	2,700	--
pH	Unitless	NA	7.71	6.78	7.55	6.5-8.5
Total Organic Carbon (C)	mg/L	0.50 - 2.5	14	20	46	--
Dissolved Cadmium (Cd)	µg/L	0.0050 - 0.013	0.087	0.12	0.039	--
Total Cadmium (Cd)	µg/L	0.0050 - 0.013	0.60	5.5	5.0	0.060*
Alkalinity (CaCO ₃)	mg/L	0.50	570	550	860	--
Bicarbonate (HCO ₃)	mg/L	0.50	690	670	1,100	--
Carbonate (CO ₃)	mg/L	0.50	ND	ND	ND	--
Hydroxide (OH)	mg/L	0.50	ND	ND	ND	--
Sulphate (SO ₄)	mg/L	1.0 - 5.0	510	690	ND	--
Chloride (Cl)	mg/L	1.0 - 5.0	4.7	360	360	--
Total Ammonia (N)	mg/L	0.050 - 0.50	0.64	0.76	4.6	1.37*
Total Phosphorus (P)	mg/L	0.030 - 0.15	0.54	6.2	4.8	--
Total Nitrogen (N)	mg/L	0.050	1.1	4.1	6.4	--
Total Kjeldahl Nitrogen	mg/L	0.050 - 0.50	0.98	4.1	6.3	--
Nitrite (NO ₂)	mg/L	0.0030	0.010	ND	0.0090	--
Nitrate (NO ₃)	mg/L	0.0030	0.067	0.030	0.11	--
Nitrate plus Nitrite (N)	mg/L	0.0030	0.077	0.030	0.12	--
<u>Trace Organics</u>						
Acetic Acid	mg/L	50	ND	ND	ND	--
Formic Acid	mg/L	50	ND	ND	ND	--
Propionic Acid	mg/L	50	ND	ND	ND	--
Adsorbable Organic Halogen	mg/L	0.002 - 0.02	0.05	0.023	0.13	--

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for commercial/industrial 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) -- No value established in the reference criteria.
- 5) Bold & Shaded - Exceeds the referenced Alberta Tier 1 and CCME guidelines.
- 6) For further laboratory information, refer to the specific laboratory report in Appendix A.

Table 4C
Analytic Results - Groundwater - Metals

Parameter	Unit	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
			08/17/2013			
Total Metals						
Aluminum (Al)	mg/L	0.0030 - 0.0075	4.3	100	74	0.1*
Antimony (Sb)	mg/L	0.00060 - 0.0015	0.00074	ND	ND	0.006
Arsenic (As)	mg/L	0.00020 - 0.00050	0.011	0.066	0.069	0.005
Barium (Ba)	mg/L	0.010	0.320	3.3	3.5	1
Beryllium (Be)	mg/L	0.0010 - 0.0025	ND	0.0099	0.0072	--
Boron (B)	mg/L	0.020	0.28	0.11	0.13	1.5
Calcium (Ca)	mg/L	0.30 - 1.5	270	730	1,000	--
Chromium (Cr)	mg/L	0.0010 - 0.0025	0.010	0.19	0.14	0.001*
Cobalt (Co)	mg/L	0.00030 - 0.00075	0.014	0.12	0.13	--
Copper (Cu)	mg/L	0.00020 - 0.00050	0.025	0.25	0.23	0.003*
Iron (Fe)	mg/L	0.060 - 0.30	20	330	260	0.3
Lead (Pb)	mg/L	0.00020 - 0.00050	0.0068	0.11	0.11	0.004*
Lithium (Li)	mg/L	0.020	0.093	0.32	0.15	--
Magnesium (Mg)	mg/L	0.20	62	230	330	--
Manganese (Mn)	mg/L	0.0040	1.4	13.0	15.0	0.05
Molybdenum (Mo)	mg/L	0.00020 - 0.00050	0.0021	0.012	0.0036	0.073*
Nickel (Ni)	mg/L	0.00050 - 0.0013	0.033	0.29	0.29	0.11*
Phosphorus (P)	mg/L	0.10	0.68	11	7.2	--
Potassium (K)	mg/L	0.30	8.4	20	21	--
Selenium (Se)	mg/L	0.00020 - 0.00050	0.0007	0.0031	0.0014	0.001
Silicon (Si)	mg/L	0.10	17	94	87	--
Silver (Ag)	mg/L	0.00010 - 0.00025	ND	0.001	0.0016	0.0001*
Sodium (Na)	mg/L	0.50	160	230	160	--
Strontium (Sr)	mg/L	0.020	1.4	3.7	2.5	--
Sulphur (S)	mg/L	0.20	180	230	7.8	--
Thallium (Tl)	mg/L	0.00020 - 0.00050	ND	0.0011	0.00087	0.0008*
Tin (Sn)	mg/L	0.0010 - 0.0025	0.0029	0.0044	ND	--
Titanium (Ti)	mg/L	0.0010 - 0.0025	0.19	0.96	0.45	--
Uranium (U)	mg/L	0.00010 - 0.00025	0.012	0.045	0.0075	0.02
Vanadium (V)	mg/L	0.0010 - 0.0025	0.018	0.300	0.200	--
Zinc (Zn)	mg/L	0.0030 - 0.0075	0.057	0.73	0.67	0.03
Dissolved Metals						
Aluminum (Al)	mg/L	0.0030 - 0.0075	0.0044	0.017	0.088	--
Antimony (Sb)	mg/L	0.00060 - 0.0015	ND	0.002	ND	--
Arsenic (As)	mg/L	0.00020 - 0.00050	0.0027	0.0061	0.024	--
Barium (Ba)	mg/L	0.010	0.083	0.081	0.72	--
Beryllium (Be)	mg/L	0.0010 - 0.0025	ND	ND	ND	--
Boron (B)	mg/L	0.020	0.27	0.12	0.12	--
Calcium (Ca)	mg/L	0.30	220	310	210	--
Chromium (Cr)	mg/L	0.0010 - 0.0025	ND	ND	ND	--
Cobalt (Co)	mg/L	0.00030 - 0.00075	0.0043	0.0045	0.012	--
Copper (Cu)	mg/L	0.00020 - 0.00050	0.0023	0.0021	0.0013	--
Iron (Fe)	mg/L	0.060	0.19	0.24	27	--
Lead (Pb)	mg/L	0.00020 - 0.00050	ND	ND	ND	--
Lithium (Li)	mg/L	0.020	0.091	0.130	0.034	--
Magnesium (Mg)	mg/L	0.20	56	110	120	--
Manganese (Mn)	mg/L	0.0040	0.7	0.78	3.6	--
Molybdenum (Mo)	mg/L	0.00020 - .00050	0.0015	0.0059	0.0021	--
Nickel (Ni)	mg/L	0.00050 - 0.0013	0.011	0.013	0.016	--
Phosphorus (P)	mg/L	0.10	ND	ND	ND	--
Potassium (K)	mg/L	0.30	6.9	8.6	9.8	--
Selenium (Se)	mg/L	0.00020 - 0.00050	0.00028	0.00050	ND	--
Silicon (Si)	mg/L	0.10	7.4	6.5	15	--
Silver (Ag)	mg/L	0.00010 - 0.00025	ND	ND	ND	--
Sodium (Na)	mg/L	0.50	170	250	160	--
Strontium (Sr)	mg/L	0.020	1.3	2.7	1.4	--
Sulphur (S)	mg/L	0.20	180	220	3.9	--
Thallium (Tl)	mg/L	0.00020 - 0.00050	ND	ND	ND	--
Tin (Sn)	mg/L	0.0010 - 0.0025	ND	ND	ND	--
Titanium (Ti)	mg/L	0.0010 - 0.0025	ND	ND	ND	--
Uranium (U)	mg/L	0.00010 - 0.00025	0.011	0.021	0.0014	--
Vanadium (V)	mg/L	0.0010 - 0.0025	ND	ND	ND	--
Zinc (Zn)	mg/L	0.0030 - 0.0075	ND	ND	ND	--

Notes:

- 1) Tier 1 Guideline - Alberta Tier 1 Soil and Groundwater Remediation Guidelines, December 2010 and amendments. Coarse-grained criteria for commercial/industrial 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) -- No value established in the reference criteria.
- 5) Bold & Shaded - Exceeds the referenced Alberta Tier 1 and CCME guidelines.
- 6) For further laboratory information, refer to the specific laboratory report in Appendix A.

Table 4D
Analytical Results - Groundwater - VOCs

Parameter	Unit	Detection Limit	MW-01	MW-02	MW-03	Tier 1 Guideline
			08/17/2013			
Volatiles						
Benzene	mg/L	0.00040	ND	ND	ND	0.005
Toluene	mg/L	0.00040	ND	ND	ND	0.024
Ethylbenzene	mg/L	0.00040	ND	ND	ND	0.0024
Xylenes (Total)	mg/L	0.00080	ND	ND	ND	0.3
F1 (C ₆ -C ₁₀)	mg/L	0.10	ND	ND	ND	2.2
F2 (C ₁₀ -C ₁₆)	mg/L	0.10	ND	ND	ND	1.1
Total Trihalomethanes	mg/L	0.0020	ND	ND	ND	0.1
Bromodichloromethane	mg/L	0.00050	ND	ND	ND	--
Bromoform	mg/L	0.00050	ND	ND	ND	--
Bromomethane	mg/L	0.0020	ND	ND	ND	--
Carbon tetrachloride	mg/L	0.00050	ND	ND	ND	0.005
Chlorobenzene	mg/L	0.00050	ND	ND	ND	0.0013
Chlorodibromomethane	mg/L	0.0010	ND	ND	ND	--
Chloroethane	mg/L	0.0010	ND	ND	ND	--
Chloroform	mg/L	0.00050	ND	ND	ND	0.0018
Chloromethane	mg/L	0.0020	ND	ND	ND	--
1,2-dibromoethane	mg/L	0.00050	ND	ND	ND	--
1,2-dichlorobenzene	mg/L	0.00050	ND	ND	ND	0.0007
1,3-dichlorobenzene	mg/L	0.00050	ND	ND	ND	--
1,4-dichlorobenzene	mg/L	0.00050	ND	ND	ND	0.001
1,1-dichloroethane	mg/L	0.00050	ND	ND	ND	--
1,2-dichloroethane	mg/L	0.00050	ND	ND	ND	0.005
1,1-dichloroethene	mg/L	0.00050	ND	ND	ND	0.014
cis-1,2-dichloroethene	mg/L	0.00050	ND	ND	ND	--
trans-1,2-dichloroethene	mg/L	0.00050	ND	ND	ND	--
Dichloromethane	mg/L	0.0020	ND	ND	ND	0.05
1,2-dichloropropane	mg/L	0.00050	ND	ND	ND	--
cis-1,3-dichloropropene	mg/L	0.00050	ND	ND	ND	--
trans-1,3-dichloropropene	mg/L	0.00050	ND	ND	ND	--
Methyl methacrylate	mg/L	0.00050	ND	ND	ND	0.47
Methyl-tert-butylether (MTBE)	mg/L	0.00050	ND	ND	ND	0.015
Styrene	mg/L	0.00050	ND	ND	ND	0.072
1,1,1,2-tetrachloroethane	mg/L	0.0020	ND	ND	ND	--
1,1,2,2-tetrachloroethane	mg/L	0.0020	ND	ND	ND	--
Tetrachloroethene	mg/L	0.00050	ND	ND	ND	0.03
1,2,3-trichlorobenzene	mg/L	0.0010	ND	ND	ND	0.008
1,2,4-trichlorobenzene	mg/L	0.0010	ND	ND	ND	0.015
1,3,5-trichlorobenzene	mg/L	0.00050	ND	ND	ND	0.014
1,1,1-trichloroethane	mg/L	0.00050	ND	ND	ND	--
1,1,2-trichloroethane	mg/L	0.00050	ND	ND	ND	--
Trichloroethene	mg/L	0.00050	ND	ND	ND	0.005
Trichlorofluoromethane	mg/L	0.00050	ND	ND	ND	--
1,2,4-trimethylbenzene	mg/L	0.00050	ND	ND	ND	--
1,3,5-trimethylbenzene	mg/L	0.00050	ND	ND	ND	--
Vinyl chloride	mg/L	0.00050	ND	ND	ND	0.002

Notes:

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

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

Parameter	Well Diameter (mm)	Screen Length (cm)	Well Depth (m)	Headspace Volume (cm ³)	Purge Rate (cm ³ /min)	Purge Time (min)	Pressure	
							Ambient (psi)	Vapour Well (psi)
VW-01	25	30	7.3	3,583.4	943.3	9	15.03	15.05

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) Screen set at base of well.
- 4) Soil vapour sampling was completed Saturday, August 17, 2013.

Table 5B
Analytical Results - Soil Vapour - General Indices

Parameters	Units	Detection Limit	VW-01
<u>Gause Pressure</u>			
pressure after sampling	psig	--	-5.0
pressure on receipt	psig	--	-4.6
<u>Fixed Gases</u>			
Oxygen	% v/v	0.3	14.2
Nitrogen	% v/v	0.3	78.8
Carbon Monoxide	% v/v	0.3	ND
Methane	% v/v	0.3	ND
Carbon Dioxide	% v/v	0.3	7.0

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

Parameters	Unit	Detection Limit	VW-01 08/17/13
Hydrocarbon Fractions			
Aliphatic >C ₅ -C ₆	µg/m ³	5.0	7.3
Aliphatic >C ₆ -C ₈	µg/m ³	5.0	34.9
Aliphatic >C ₈ -C ₁₀	µg/m ³	5.0	27.8
Aliphatic >C ₁₀ -C ₁₂	µg/m ³	5.0	39.7
Aliphatic >C ₁₂ -C ₁₆	µg/m ³	5.0	15.2
Aromatic >C ₇ -C ₈ (TEX Excluded)	µg/m ³	5.0	ND
Aromatic >C ₈ -C ₁₀	µg/m ³	5.0	6.7
Aromatic >C ₁₀ -C ₁₂	µg/m ³	5.0	6.1
Aromatic >C ₁₂ -C ₁₆	µg/m ³	5.0	ND
Select Volatile Gases			
Acetylene	ppm	0.26	ND
Ethane	ppm	0.26	ND
Ethylene	ppm	0.26	ND
Methane	ppm	5.1	ND
n-Butane	ppm	0.51	ND
n-Pentane	ppm	0.26	ND
Propane	ppm	0.26	ND
Propene	ppm	0.26	ND
Propyne	ppm	0.51	ND
Volatile Organic Compounds			
Dichlorodifluoromethane (FREON 12)	ppbv	0.20	1.08
1,2-Dichlorotetrafluoroethane	ppbv	0.17	ND
Chloromethane	ppbv	0.30	1.21
Vinyl Chloride	ppbv	0.18	ND
Chloroethane	ppbv	0.30	ND
1,3-Butadiene	ppbv	0.50	ND
Trichlorofluoromethane (FREON 11)	ppbv	0.20	0.40
Ethanol (ethyl alcohol)	ppbv	2.3	21.8
Trichlorotrifluoroethane	ppbv	0.15	ND
2-propanol	ppbv	3.0	3.2
2-Propanone	ppbv	0.80	22.8
Methyl Ethyl Ketone (2-Butanone)	ppbv	5.0	ND
Methyl Isobutyl Ketone	ppbv	3.2	ND
Methyl Butyl Ketone (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	0.33
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	ppbv	0.30	ND
Tetrachloroethylene	ppbv	0.20	ND
Benzene	ppbv	0.18	0.48
Toluene	ppbv	0.20	1.86
Ethylbenzene	ppbv	0.20	0.55
p+m-Xylene	ppbv	0.37	2.53
o-Xylene	ppbv	0.20	0.84
Styrene	ppbv	0.20	ND
4-ethyltoluene	ppbv	2.2	ND
1,3,5-Trimethylbenzene	ppbv	0.50	ND
1,2,4-Trimethylbenzene	ppbv	0.50	ND
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	3.44
Heptane	ppbv	0.30	0.49
Cyclohexane	ppbv	0.20	0.40
Tetrahydrofuran	ppbv	0.40	3.49
1,4-Dioxane	ppbv	2.0	ND
Xylene (Total)	ppbv	0.60	3.37
Vinyl Bromide	ppbv	0.20	ND
Propene	ppbv	0.30	1.29
2,2,4-Trimethylpentane	ppbv	0.20	0.25
Carbon Disulfide	ppbv	0.50	6.98
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
Analytical Results - Soil Vapour - Siloxanes

Parameter	Detection Limit		VW-01	
			08/17/2013	
	mg/m ³	ppm	mg/m ³	ppm
Trimethylsilyl Fluoride	--	--	0.0011	0.0003
Tetramethylsilane	0.0001	0.0001	ND	ND
Methoxytrimethylsilane	0.0019	0.0004	ND	ND
Ethoxytrimethylsilane	0.0018	0.0004	ND	ND
Trimethylsilanol	--	--	0.0526	0.0143
Isopropoxytrimethylsilane	0.0008	0.0001	ND	ND
Trimethoxymethyl Silane #	--	--	ND	ND
Hexamethyl Disiloxane - L2	--	--	0.0006	0.0001
Propoxytrimethylsilane	0.0021	0.0004	ND	ND
1-Methylbutoxytrimethylsilane *	--	--	ND	ND
Butoxytrimethylsilane *	--	--	ND	ND
Trimethoxyvinyl Silane #	--	--	ND	ND
Hexamethyl Cyclotrisiloxane - D3	--	--	0.0111	0.0012
Octamethyl Trisiloxane - L3	0.0001	0.0001	ND	ND
Triethoxyvinyl Silane #	--	--	ND	ND
Triethoxyethyl Silane #	--	--	ND	ND
Octamethyl Cyclotetrasiloxane - D4	--	--	0.0090	0.0007
Decamethyl Tetrasiloxane - L4	0.0002	0.0001	ND	ND
Tetraethylsilicate #	--	--	ND	ND
Decamethyl Cyclopentasiloxane - D5	--	--	0.0236	0.0016
Dodecamethyl Pentasiloxane - L5	0.0018	0.0001	ND	ND
Dodecamethyl Cyclohexasiloxane - D6	--	--	0.1655	0.0091
Sum	--	--	0.2722	0.0288

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.