2019 Groundwater and Soil Vapour Monitoring Report
Red Deer College
Southeast Corner of Section 08-038-27 W4M

PRESENTED TO
City of Red Deer

OCTOBER 26, 2020
ISSUED FOR USE
FILE: SWM.SWOP04071-01.005

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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 near Red Deer College (RDC), located at Lot 1 Block 1 Plan 012 0303 within the southeast corner of Section 08-038-27 W4M, in Red Deer, Alberta, hereafter referred to as the site. The objective of the monitoring program is to identify potential environmental concerns related to former operations at the site.

Tetra Tech's scope of work for the 2019 monitoring and sampling program at the RDC site included conducting quarterly events of groundwater and vapour monitoring, annual groundwater 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 seven monitoring wells (MW-01 to MW-07). MW-01 was noted to be damaged during all events in 2019 and could not be monitored or sampled. The vapour monitoring network consists of five vapour monitoring wells (VW-01 to VW-05). The soil vapour wells were in good condition during 2019. Several other vapour and groundwater wells have been installed at the site by others but were not included in the monitoring program. Monitoring wells MW-03 to MW-06 and VW-05 are installed within the historical waste disposal area.

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 east-northeast, towards Waskasoo Creek, east of Taylor Drive. The average horizontal hydraulic gradient at the site in 2019 was approximately 0.05 m/m. This is consistent with observations made historically in 2013. Groundwater elevations in 2013 were overall slightly higher than groundwater elevations in 2019.

- Groundwater quality parameters that exceeded the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines) at one or more monitoring wells in 2019 included pH, total dissolved solids (TDS), sodium, chloride, ammonia, nitrate, dissolved metals arsenic, barium, iron, manganese, and uranium and benzene, ethylbenzene, xylenes, vinyl chloride, 1,2-dichlorobenzene, and 1,2-dichloroethane. The measured concentrations of one or more of these parameters, in addition to the presence of various volatile organic compounds (VOCs) with no established guideline values, suggest leachate has impacted the groundwater quality at MW-03, MW-04, MW-05, and MW-06. These monitoring wells are all installed within the waste area and the measured concentrations of these parameters are consistent with concentrations of leachate. The measured concentrations of these parameters were generally consistent with previous results.

- Concentrations of adsorbable organic halides (AOX) and volatile fatty/carboxylic acids in 2019 were less than the analytical detection limits at all monitoring wells.

- Concentrations of benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbons (PHCs), and VOCs were less than the soil vapour screening criteria in samples VW-01, VW-02, and VW-04.

- Various VOCs, BTEX, and PHCs exceeded the soil vapour screening criteria at VW-03 and VW-05, situated within (VW-05) and immediately adjacent to (VW-03) the waste footprint. Well headspace monitoring also identified elevated methane at these wells, up to 66.6% gas at VW-05 during the June event. The VOC concentrations at VW-03 in 2019 appear anomalous and should be confirmed. Vapour well VW-05 is installed within the waste area, and VW-03 is installed adjacent to the waste area.

- Concentrations of siloxanes were detected in sample VW-02 greater than the laboratory detection limit.

- 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 for samples VW-01, VW-02, and VW-04; however, they exceeded for samples VW-03 and VW-05. As noted above, the 2019 VOC concentrations at VW-03 appear anomalous and should be confirmed.

Four of the seven groundwater monitoring wells at the site are located within the waste footprint, and either screened within (MW-04 and MW05) or below (MW03 and MW-06) the waste. Each of these four wells are identified to contain leachate impacts, and in at least two wells, the measured liquids may represent leachate. Two of the five vapour wells (VW-03 and VW-05) exhibit impacts by landfill gas (LFG), as evidenced by elevated methane and VOCs; the greatest concentrations were measured at VW-05, located centrally in the waste mass, with lower (but elevated) concentrations noted at VW-03, located immediately adjacent to the waste mass at the northeast corner of the site.

Based on the above, there is a strong correlation between observed impacts and the waste footprint. In the groundwater, the results indicate that impacts may be migrating off site in a hydraulically down-gradient direction (overall easterly towards Waskasoo Creek). In the soil vapours, the two wells closest to the residences to the south (VW-01 and VW-02) do not indicate impacts, and the measured concentrations were less than the target cumulative risks and hazard levels for residential land use. The vapours at VW-05 were collected from within the waste mass (and exceeded the target risk and hazard levels) and confirmed that LFG concentrations typical of a municipal landfill are present. The vapours at VW-03, at the northeast end of the site are also indicative of LFG. This probe is situated immediately adjacent to the waste footprint and is bounded by a road intersection to the north and east. It is an unlikely location for a building; however, the potential extents of LFG migration off site in this direction are not known. The methane gas concentrations measured to date at VW-03 are considerably less than within the waste mass (e.g. at VW-05) however are still considered elevated. The 2019 VOC concentrations at this well appear anomalous and should be confirmed before installation of an additional probe in the area is considered.

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

- Ongoing Monitoring:
  - Conduct an additional year of semi-annual monitoring and annual sampling of groundwater at the site to monitor the trends.
  - Continue to sample monitoring wells MW-02, MW-03, MW-04, MW-05, MW-06, and MW07 for routine groundwater chemistry parameters and dissolved metals. Continue sampling MW-03, MW-04, MW-05, and MW-06 for VOCs, BTEX, and PHCs.
  - Continue with an additional year of quarterly monitoring of vapours at the vapour probes, including one additional sampling event, which will include confirmation of the VOC concentrations at VW-03.
- Additional Assessment and Risk Management:
  - Install two additional groundwater monitoring wells along the east edge of the site, between the waste area and Waskasoo Creek. Proposed locations are to the southeast of MW-04 and approximately halfway between MW-04 and MW-05, immediately west of the curb of south-bound Taylor Drive. Based on historical information, the waste extends to nearby Taylor Drive. The historical information should be reviewed to identify the most appropriate locations for the new wells, if possible. These monitoring wells should be included in the proposed ongoing monitoring program and sampled for the same analytical suite of parameters as MW-03, MW-04, MW-05, and MW-06.

- Based on the nature of thin soil cover identified in the earlier work by Tiamat, we suggest that during field monitoring events, a basic site walkover be conducted to evaluate for potential erosion, cracking, and/or exposed wastes. This information could be used to document whether potential repairs to the cap are warranted. Due to high LFG concentrations within the waste mass, the thin cover and the likely use of the area for recreation and public access, conducting a surface emissions survey should also be considered to document that users of the site are not exposed to LFG.
- The extent and migration of leachate impacted groundwater is poorly defined and the presence of Taylor Drive impedes further assessment of subsurface impacts near the creek. Because Waskasoo Creek is considered to be a receptor, it is recommended to collect upstream and downstream surface water samples during a spring/summer monitoring event for analysis of BTEX, PHC fractions F1 and F2, total metals, routine water chemistry, and VOCs. If the surface water sampling results exceed FAL guidelines and are interpreted to be related to MSW leachate impacts, additional sampling or assessment may be recommended.
- Compile the additional groundwater, vapour and surface water information collected into a risk management approach that is protective of all receptors identified.

- 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 The City policies.
  - Ensure that the site is clearly identified within The City's utility mapping system. Elevated gas concentrations may be present in the subsurface proximate to the Taylor Drive right-of-way. Future activities in this vicinity (e.g., utility work, repairs, paving, etc.) should consider the potential presence of gas and a site-specific safety plan should be developed for work undertaken to limit the potential for exposure to site workers.

Further to the above recommendations, as noted the site remains an historical landfill. It presently has a grass cover. 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 near Red Deer College (RDC), located at Lot 1 Block 1 Plan 012 0303 within the southeast corner of Section 08-038-27 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 groundwater and vapour monitoring well and observing monitoring well integrity.
- Conducting one groundwater sampling event:
  - 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 one vapour sampling event:
  - 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.
- Updated the hazard quotients prepared during previous reports 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. The proposal was submitted in accordance with the Request for Proposal (RFP) No. 1090-2018-261 issued by The City

on November 30, 2018, and Addendum 01 issued by The City on January 7, 2019. This report documents the scope and findings for the RDC site.

The objective of the project was to:

- Confirm and implement the prior recommendations, as per the RFP;
- Consult with the regulator on amendments to the program, as required;
- Conduct environmental monitoring and sampling for each of the eight sites, at outlines 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 Dry Waste Site; and
- Riverside Light Industrial Park.

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

2.0 BACKGROUND INFORMATION

2.1 General Information

The site is located within the SE portion of Section 08-38-27 W4M, at Lot 1 Block 1 Plan 0120303. The site is zoned PS – Public Service (Institutional and Government) District and is located on the east side of the RDC campus. The site is located at the southwest corner of Taylor Drive and 32 Street. Waskasoo Creek flows to the south of the site in an easterly direction, then flows north along the east side of Taylor Drive. The Red Deer River is approximately 1.7 km north of the site. A site location plan is shown on Figure 1. The area around the site has been developed, and includes RDC buildings, student residences, a running track, sports fields, walking paths, and paved and unpaved parking surfaces. These developments are outside (south and west) of the interpreted former waste disposal area, except for a portion of a paved surface parking lot. The surrounding land use consists of Environmental Preservation District, Residential (Low Density) District, and Commercial (Major Arterial) District. A residential subdivision is located northwest of the site. Natural areas at the site consist of grasses and trees. Figure 2 shows the general site plan and surrounding land use.

2.2 Site History

Municipal records indicate that the waste disposal at the site occurred from 1970 to 1972. Historical information indicates the waste as being municipal solid waste (MSW) including a mix of plastics, cans, paper, scrap metals, wires, and glass.

Based on information in a Phase I ESA report (Tiamat 2013), Waskasoo Creek originally meandered through the area that was proposed for waste disposal. Since the construction of Taylor Drive, circa late-1980s early 1990s, Waskasoo Creek flows north in a straight channel immediately east of Taylor Drive. The report stated that the east edge of the landfill is near the west curb of Taylor Drive and that previous studies concluded that the rerouting of Waskasoo Creek may have altered the natural flow pattern of groundwater from the northeast to an easterly flow pattern.

The Phase I ESA report describes that investigations were conducted prior to the construction of the RDC residence buildings south the former landfill. Specifically: "The housing development is not expected to be adversely impacted by soil gas or leachate. Protective measures include the passive sub-foundation venting and regular perimeter monitoring, per the setback relaxation approval".

Historical waste disposal was identified during the 2014 Phase II ESA to extend from the north end of site near 32 Street to the student residence buildings on the south end of the site. The south end of site has a large mound of waste that is mixed with fill material and covered with sod and loam. During the drilling investigation, MSW was identified primarily in the north and central parts of the site. The former landfill is closed and inactive. The historical waste area was calculated to be approximately 38,530 m^2. The estimated waste area is shown on Figure 2.

The Phase II ESA (Tiamat 2014a) indicated that the buried wastes were overlain by surficial sod and loam; in some locations, silty sand and clay fill was encountered below the sod to a depth of approximately 3 m. However, at some borehole locations practically no soil cover was noted below the sod. Bedrock was not encountered at any testholes through the maximum drilling depth of 10.7 m.

The results of the Phase II ESA (Tiamat 2014a) indicated that leachate constituents were present in the groundwater at monitoring wells along Taylor Drive. Tiamat stated: "The results indicate a plume of the leachate constituents to be principally organic hydrocarbons and nutrient compounds. Various VOCs were detected in the local groundwater during this sampling event. The interpreted extent of the plume appears to extend beyond the current monitoring network and towards Waskasoo Creek."

2.3 Historical Groundwater Monitoring and Investigation Summary

Previous reports prepared by Tiamat for the site include:

- Phase I Environmental Site Assessment, Historic Waste Disposal Site, Red Deer Motors Site, The City of Red Deer. September 24, 2013 (Tiamat 2013).
- Phase II Environmental Site Assessment, Historic Waste Disposal Site, Red Deer Motors Site, The City of Red Deer. February 26, 2014 (Tiamat 2014a).
- Environmental Risk Management Plan, Historic Waste Disposal Sites, Red Deer College & Red Deer Motors, The City of Red Deer. November 27, 2014 (Tiamat 2014b).

Fourteen testholes (TH-01, TH-05, TH-09 to TH-15) were advanced in June 2013 as part of the Phase II ESA, five vapour wells (VW-01 to VW-05) and seven monitoring wells (MW-01 to MW-07) were installed.

The results of the Phase II ESA (Tiamat 2014a) indicated the following:

- No obvious activities pose a high risk to the site from the adjacent land uses. The historical waste boundary is within the college campus.
- The historical waste area is estimated to be 38,530 m^2.
- The hydraulically down-gradient groundwater monitoring wells had concentrations of petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs), and chlorinated hydrocarbons greater than Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines).
- Soil vapour concentrations from two vapour wells on site were determined to be mild to moderate. The results indicated concentrations of VOCs, aliphatic and aromatic hydrocarbons, and siloxanes. The concentrations could pose a risk on the water quality within the Waskasoo Creek.

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

- Monitor groundwater elevations and soil vapour data quarterly for one hydrogeological cycle.
- In consultation with ESRD, determine if surface water sampling should be included along with additional groundwater monitoring locations to better define flow patterns and to determine exposure from leachate contaminants in Waskasoo Creek.
- Collect an additional set of soil vapour and groundwater analytical data, groundwater elevations, and volatile headspace measurement during the winter months to determine seasonal changes in soil vapour concentrations.
- Develop a site-specific risk management plan (RMP) to consider future land uses and address environmental concerns.
- Review all data to update the RMP with new information.

The RMP conducted by Tiamat in 2014 stated: “the outcomes of the RMP confirm the identified chemicals of concern and relevant risk are manageable to facilitate future developments which may lie within the regulated setback distance to the historic waste disposal site” (Tiamat 2014b). The following recommendations were made:

- 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.

The RMP (Tiamat 2014b) summarized the key results from the Phase II ESA (Tiamat 2014a) that were not included in the Phase II results. The results were the following:

- The soil materials underlying the MSW on site are native sand or clay till.
- In 2013, the average depth to groundwater was approximately 2.9 m below grade (mbg), which is within the waste material on site. The average hydraulic horizontal gradient was approximately 0.04 m/m with an inferred east-northeast groundwater flow direction towards the northwest. Groundwater flow velocity was calculated to be 4.7 m/year using 30% porosity and 10^{-5} m/sec horizontal permeability.

- VOCs and other PHCs had detectable concentrations in 2013 at monitoring wells hydraulically down-gradient from the site. The concentrations consisted of parameters indicative of leachate. The leachate was characterized showing negative redox potentials and near anoxic conditions for dissolved oxygen.
- Several commercial businesses and residential developments are nearby the RDC site, as well as the College student residences.
- The historical landfill has a sandy soil cap of approximately 15 cm to 30 cm thick. Grass coverage is overlying the fill cap. Settlement has occurred in areas of waste disposal on the site. No activities located on adjacent lands were interpreted to be contributing environmental concerns.
- Volatile PHC compounds with a carbon chain length of up to 12 carbon atoms were detected at the vapour wells at RDC. Semi-volatile, oxygenated, and halogenated volatile hydrocarbons and ketones were also detected in the soil vapour samples.

2.4 Monitoring Well Network

The groundwater monitoring network at the site consists of seven monitoring wells (MW-01 to MW-07). Monitoring well completion details are summarized in Table 1.

MW-01 was noted to be damaged during all events in 2019 and could not be monitored or sampled. Several other groundwater monitoring wells had minor repairs completed throughout the quarterly events including lock replacements, cap replacements, and polyvinyl chloride (PVC) trimming.

The vapour monitoring network consists of five vapour monitoring wells (VW-01 to VW-05). The soil vapour wells were in good condition during 2019. A lock was added to VW-01 in June 2019.

Several other vapour and groundwater wells have been installed at the site but were not included in the monitoring program. Monitoring wells MW-03 to MW-06 and VW-05 are installed within the historical waste disposal area.

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 the site are located within the Red Deer River drainage basin with principal drainage via the Red Deer River located northwest of the site. The river has incised the uplands with gentle slopes to the either side of the river, Waskasoo Creek drains northward, eventually draining into the Red Deer River northeast 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. Key elements of the geological setting are presented below from Tiamat's 2013 Phase I ESA 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.

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 Tiamat's Phase II ESA (Tiamat 2014a), surficial soils at the site consist of gravel and sod overlying clay or sand fill material. Outside of the waste footprint, the fill was observed to approximately 3 mbg. A mound of soil and MSW is built up towards the southern end of the waste footprint. The mound is approximately 4.5 m higher than the surrounding land.

Within the waste footprint, sand fill typically overlays the MSW and in some locations the waste was encountered directly beneath the sod material (MW-03, MW-04, and MW-06). The waste materials were encountered at depths of up to 7.6 m.

The waste materials were overlying clay or sand fill in the central and west portion of the site and were overlying native sand or clay till elsewhere. No bedrock was encountered at any locations through the maximum depth of investigation of 10.7 m.

The Phase I ESA (Tiamat 2013) indicated that the eastern portion of the landfill is near the west side of Taylor Drive and rerouting of Waskasoo Creek may have altered the geology in the area. There is deep fill in areas of the site that did not indicate waste disposal; therefore, possible fill may have been brought into the site during the creek rerouting process.

Cross-sections prepared for the Phase II ESA are included in Appendix B. These sections show the significant topographical relief across the site, as well as the variable materials underlying the site.

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 ESA 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 (McKenzie 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 could be beneath 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."

3.2.2 Local Hydrogeology

Waskasoo Creek is located to the south and east of the RDC campus. It flows south of the campus before crossing underneath Taylor Drive and flowing north along the east side of the road. Waskasoo Creek is located approximately 45 m east of the site and eventually flows into the Red Deer River located approximately 1.7 km north of the site. Based on information presented in a Phase I ESA report for the site (Tiamat 2013), rerouting of Waskasoo Creek may have altered the natural flow pattern of groundwater from the northeast to an easterly flow pattern. It was also stated that the past landfilling activities and "variably transmissive shelves and/or gullies created by the previous location of Waskasoo Creek were redirecting the flow of the groundwater."

The Phase II ESA indicates the area of the site is within a zone of groundwater recharge with a downward flow component (Tiamat 2014a). The average groundwater level is approximately 3 mbg. Shallow groundwater is assumed to flow to the east-northeast, towards the creek.

3.3 Groundwater Resource Usage

A search of the Alberta Water Well Database for groundwater users was conducted in January 2020 within a 1 km radius of the RDC site identified 17 groundwater wells; 7 of the wells are listed as domestic use, 1 is listed as domestic and stock use, 5 are listed as industrial use, 2 as "other", 1 as observation use, and 1 is listed as unknown use (AEP 2019b).

A water well was identified within 500 m of the site; but is believed to be plotted incorrectly based on the address on the water well report and is actually located further than 500 m from the site. No other wells were identified within 500 m of the site. The water wells within a 1 km radius of the site range in depth from 5.8 m to 122 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 RDC 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 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines; AEP 2019a).

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

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

4.1 Chemicals of Potential Concern

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

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

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

- VOCs;
- Methane;
- Benzene, toluene, ethylbenzene, and xylenes (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., 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 Public Service (Institutional or Government) District (PS). The site is surrounded by residential and commercial land to the west and south, and parkland to the north and east. Samples were compared to residential/parkland use guidelines.

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.

During the Phase II ESA, the majority of materials at the site (both fill and native) were observed to be coarse-grained; thus, coarse-grained guidelines have been used.

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 residential/parkland, this pathway is considered to be applicable.

4.4.1.2 Drinking Water (Groundwater Ingestion)

Water bearing units with a saturated hydraulic conductivity of greater than 1.0×10^{-6} m per second (m/sec) are considered to comprise a potential domestic use aquifer (DUA) (AEP 2019a). To eliminate this pathway, the presence of greater than 5 m of unimpacted, 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. No potable groundwater wells were identified within 500 m of the site. Groundwater at the site is not presently used as drinking water.

The DUA pathway is not considered to be active relative to the site; however, it has been included as investigations to eliminate the DUA pathway have not been completed.

4.4.1.3 Inhalation

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

4.4.1.4 Off-site Surface Migration by Wind or Water Erosion

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

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 Waskasoo Creek located to the south and east of the site and within 300 m.

4.4.2.3 Nutrient and Energy Cycling

The nutrient and energy cycling pathway considers 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 direct soil contact and inhalation pathway. The ecological receptor exposures applicable to the site include direct soil contact, FAL, and nutrient and energy cycling.

4.5 Soil Vapour

As recommended by Alberta Environment and Parks, the soil vapour results obtained during this investigation were compared to the Canadian Council of Minister of the Environment (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 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:

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

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

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

4.5.2 Methane

Landfill gas (LFG) can be generated from the degradation of wastes under anaerobic conditions. Methane gas can migrate through the ground and enter structures through porous concrete, joints, or fractures in foundations. When present, methane is considered a safety concern due to its explosive risk when it is in an atmosphere at concentrations between 5% and 15% by volume in air, in the presence of an ignition source. At concentrations less than 5% (the lower explosive limit [LEL]) and above 15% (the upper explosive limit), methane is not explosive. Methane on its own is not considered a health risk, although it can represent a concern if it is present at very high concentrations which could displace oxygen and present a risk of asphyxiation. There are 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 under residential land uses for coarse-grained soils (AEP 2019a).

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

5.0 GROUNDWATER MONITORING AND SAMPLING PROGRAM

A discussion of the methods used for the fieldwork, laboratory testing, and data evaluation is presented in the following sections. In 2019, Tetra Tech conducted groundwater monitoring on May 9, June 26, September 17 and December 6. Groundwater sampling was conducted on December 6, 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 (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 CVC and VOC headspace concentrations in each well using an RKI Eagle II calibrated to hexane and isobutylene 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, 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:

- Samples were collected and place into appropriate laboratory supplied, sterile glass and plastic vials and bottles for the required analytical package, if required, samples were filtered and/or preserved in the field.
- Field measurements were taken for pH, EC, and temperature at the time of sampling.
- Samples were submitted in coolers with ice to ALS Laboratories (ALS) in Calgary, Alberta for laboratory analysis under a chain-of-custody (COC) documentation.

More information on the analytical program is provided in Section 5.2. The groundwater monitoring well locations are shown on Figure 2.

5.2 Analytical Program

The analytical program for the groundwater monitoring wells was developed based on the requirements of the RFP and is summarized below:

- BTEX and PHC fractions F1 to 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, laboratory testing, and data evaluation is presented in the following sections. In 2019, Tetra Tech conducted vapour monitoring on May 9, June 26, September 17, and December 6. Vapour sampling was conducted on December 6, 2019.

6.1 Field Program

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

Each soil vapour probe was inspected for visible signs of damage and the position of the sampling labcock valve was noted. Soil gas pressure was recorded using a digital manometer. Once the soil gas pressure measurement was recorded, the soil gas probe was purged of three well volumes of air, or until readings stabilized. Small diameter soil gas probes (1'' wells) were 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. After recording soil gas concentrations, the probe/well depths and water levels were measured and recorded to confirm the water level within the probe was beneath the screen portion of the soil gas probe (i.e., the probe was not blinded).

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

Sampling of soil vapour probes was based on the methodology of the CCME sampling guidelines, which are summarized as follows:

- Prior to collecting the soil vapour probe samples, the well was purged of three well volumes, or until headspace readings stabilized.
- A 1.4 L Summa vacuum canister was used for sample collection at the soil vapour probe monitoring locations.
- Sample data was recorded on the provided sample tag for each canister.
- Sample tubing that was used to connect the canister to the soil vapour probe was low in VOCs and only used once to prevent sample contamination.

- When beginning sample collection, the end cap was removed, and a 60-minute flow controller was attached to the canister. Start time was recorded on the sample tag.
- When sampling was complete, the valve was closed, and the flow controller was removed. The end time was recorded on the sample tag.
- The protective end cap was replaced back on the canister.
- Canisters, flow controllers, and pressure gauges were placed in the original shipping container and returned to the laboratory with a COC.
- The soil vapour probe sampling port was returned to the closed position and the well was securely locked.

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

The vapour monitoring well locations are shown on Figure 2.

6.2 Analytical Program

Soil vapour samples were collected in December 2019. The analytical program for the vapour monitoring probes is summarized below:

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

7.0 RESULTS AND DISCUSSION

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

7.1 Groundwater Well Headspace Monitoring

Tetra Tech monitored six groundwater wells (MW-02, MW-03, MW-04, MW-05, MW-06, and MW-07) during each monitoring event for measurements of CVCs and VOCs in well headspace using an RKI Eagle 2.

During the May 2019 event, CVCs for all wells were non-detect. In June 2019, CVCs ranged from non-detect at several monitoring wells to 35 parts per million (ppm) at MW-07. In September 2019, concentrations ranged from non-detect at several monitoring wells to 45 ppm at MW-05. In December 2019, CVCs ranged from non-detect to 50 ppm at MW-07.

In May 2019, VOCs ranged from non-detect at several monitoring wells to 5 ppm at MW-05. In June 2019, concentrations ranged from non-detect to 15 ppm at MW-07. VOCs in September 2019 ranged from non-detect to 10 ppm at MW-07, and in December 2019, the range was non-detect at several monitoring wells to 2 ppm at MW-05.

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.

During the groundwater monitoring events in 2019, a measurable thickness of NAPL was not detected; however, the interface probe was noted to be oily during one or more events at MW-03, MW-04, and MW-05, each of which are located within the waste footprint. Ambient hydrocarbon odours were noted at MW-03, MW-04, and MW-05 during monitoring for the December 2019 event.

Figure 3 presents the groundwater elevation trends (hydrographs) for the groundwater monitoring wells. These figures show the groundwater elevations measured in 2013 and 2019. Overall, groundwater elevations decreased at all monitoring wells from 2013. Seasonal fluctuations were observed in 2019.

In 2019, the average depth to groundwater in the monitoring wells was 2.83 mbg in May, 3.84 mbg in June, 3.82 mbg in September, and 3.82 mbg in December. The contoured groundwater elevations for the monitoring wells suggest the groundwater flow was to the east-northeast in 2019. The inferred groundwater flow direction is overall consistent with the information reported in the Tiamat Phase II ESA. Interpreted groundwater elevation contours are shown on Figure 4 to Figure 7.

The average horizontal gradient in 2019 was approximately 0.05 m/m.

7.3 Groundwater Field Parameters

Field measurements for temperature, pH, and EC in December 2019 are shown in Table 2. Monitoring well MW-03 contained insufficient water for field parameter measurements, but sufficient water for analytical sample collection. A discussion of the results of the field testing is summarized in this section.

Groundwater temperatures ranged from 5.3°C (MW-07) to 7.3°C (MW-05).

Field pH values ranged from 8.75 (MW-06) to 9.81 (MW-07) in 2019. pH values were greater than the Tier 1 Guidelines range at all wells in December. Field pH was greater than the laboratory pH at all monitoring wells. The difference between field recorded and laboratory pH values may be due to limitations of the field equipment and differences in sample temperature. Also possible is that the pH probe on the field equipment may have been affected by the cold temperatures and the field pH values may not be representative of site groundwater conditions. Due to the possible bias in field pH results, Tier 1 Guidelines that are calculated using pH values were based on pH results measured in the laboratory (refer to Table 2).

In 2019, field EC measurements ranged from 533 µS/cm (MW-02) to 2,671 µS/cm (MW-06). Field EC results were less than the laboratory measured EC results at most monitoring wells except MW-06, which may be due to limitations of field equipment.

7.4 Groundwater Analytical Results

The groundwater analytical data for 2019 is summarized in Table 2. Monitoring well MW-01 was damaged and could be not sampled in 2019. The 2019 laboratory analytical reports are included in Appendix D and the historical tables are included in Appendix E.

Background Groundwater Quality

MW-07 is located to the northwest of the historical waste disposal area and was identified as an up-gradient well in the Phase II ESA. MW-07 contained concentrations of TDS and ammonia greater than the Tier 1 Guidelines. Ammonia concentrations were less than the analytical detection limit in 2013 and 0.125 mg-N/L in 2019. Concentrations of dissolved manganese and dissolved uranium were greater than the Tier 1 Guidelines in 2019; concentrations in 2013 were less than the Tier 1 Guidelines.

Monitoring well MW-02 is located to the southwest of the historical waste disposal area and is also considered up-gradient. The groundwater quality at MW-02 resembles the quality at MW-07 and has an even lower chloride concentration (both less than 10 mg/L), non-detect ammonia and only trace concentrations of dissolved iron and manganese. Nitrate and uranium marginally exceeded the referenced Tier 1 Guidelines; these concentrations are interpreted to be natural and not related to historical landfill activities.

Concentrations of BTEX, PHC fractions F1 and F2, and VOCs were less than the analytical detection limits at both MW-02 and MW-07.

Routine Water Chemistry Parameters

In 2019, TDS concentrations ranged from 442 mg/L (MW-02) to 1,490 mg/L (MW-04). TDS concentrations at monitoring wells MW-03 to MW-07 were greater than the Tier 1 Guidelines (500 mg/L). In 2013, TDS concentrations also exceeded the guideline at all wells sampled.

Sodium concentrations were greater than the Tier 1 Guidelines (200 mg/L) at MW-03, MW-04, and MW-05 in 2019. Historically, sodium concentrations were less than the guidelines.

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 at MW-03, MW-04, and MW-06 were greater than the referenced guideline (120 mg/L) in 2019, ranging from 271 mg/L at MW-03 to 593 mg/L at MW-04.

Ammonia concentrations at the site in 2019 ranged from less than the analytical detection limit at MW-02 to 22.9 mg/L at MW-04 in December 2019. Concentrations of ammonia exceeded the Tier 1 Guidelines at MW-04, MW-05, and MW-06 Elevated ammonia concentrations of 22.9 mg-N/L at MW-04, 5.80 mg-N/L at MW-05, and 17.9 mg-N/L at MW-06 suggest groundwater quality impact by MSW landfill leachate. Conversely, nitrate concentrations at these wells were generally near or less than the analytical detection limit, while the nitrate concentrations at MW-02 marginally exceeded the guideline of 3 mg-N/L in 2019 (3.46 mg-N/L). The absence of nitrate when ammonia is elevated is often an indication of anoxic groundwater conditions and leachate impact.

The two monitoring wells with the highest ammonia concentrations (MW-04 and MW-06) exhibit the lowest sulphate concentrations. This is expected to be an indication of deep anoxic (sulphate reducing) redox conditions, which are often observed in leachate impacted groundwater.

Concentrations of most parameters, other than TDS, at MW-07 were less than the referenced guidelines.

Dissolved Metals

Concentrations of dissolved arsenic were greater than the Tier 1 Guidelines (0.005 mg/L) at MW-03, MW-05, and MW-06. Arsenic is known to be strongly adsorbed onto iron(hydr)oxides, and when these minerals dissolve, arsenic will also go into solution (Hem 1992). The arsenic exceedances are likely related to the presence of dissolved iron and anoxic conditions due to leachate impacts.

Concentrations of dissolved barium were greater than the Tier 1 Guidelines (1 mg/L) at monitoring well MW-04 (1.14 mg/L). Concentrations of dissolved barium at this well were also greater than the guideline in 2013 (1.4 mg/L). The elevated barium concentration is likely related to the low sulphate concentrations at this well, which increases the dissolution of barium.

Iron and manganese are redox-sensitive parameters that naturally occur in groundwater under anoxic conditions and can help determine whether the groundwater quality is affected by biodegradation reactions, for instance related to landfill leachate. The dissolved manganese concentrations were greater than the Tier 1 Guidelines (0.05 mg/L) at most monitoring wells during the sampling event in 2019 except for MW-02. The dissolved iron concentrations were greater than the Tier 1 Guidelines at monitoring wells MW-03, MW-05, and MW-06 in 2019.

As mentioned, dissolved uranium concentrations were marginally greater than the guideline of 0.015 mg/L at background locations MW-02 (0.0159 mg/L) and MW-07 (0.0167 mg/L), each located outside of the waste footprint. The dissolved uranium concentrations are considered to be naturally occurring and not necessarily of concern.

Organic Parameters

Concentrations of BTEX and PHC fractions F1 to F2, were greater than guidelines at MW-03 (ethylbenzene), MW-04 (benzene), MW-05 (ethylbenzene), and MW-06 (benzene, ethylbenzene, and xylenes) in December 2019. Most monitoring wells except MW-02 and MW-07 had detectable concentrations of more than one BTEX and PHC fraction F1 to F2 parameters. Historically, monitoring wells MW-04 and MW-05 had BTEX and PHC fractions F1 and F2 concentrations greater than guidelines.

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

Monitoring wells MW-03 (0.0138 mg/L), MW-04 (0.0259 mg/L), MW-05 (0.00294 mg/L), and MW-06 (0.0913 mg/L) had concentrations of vinyl chloride greater than Tier 1 Guidelines (0.0011 mg/L). MW-04 had concentrations of 1,2-dichlorobenzene (0.00401 mg/L) and 1,2-dichloroethane (0.0114 mg/L) greater than the guidelines. Historically monitoring wells MW-04 and MW-05 have exceeded the guidelines for more than one VOC parameter.

All four monitoring wells that exhibited exceedances for vinyl chloride also had detectable concentrations of one or more other (chlorinated) VOCs for which Tier 1 Guidelines have not been established (e.g., methylene chloride, 1,2-dichloroethene [cis and trans], 1,4-dichlorobenzene, and dichlorodifluoromethane). Such compounds are commonly present in MSW leachate. Concentrations of all VOCs at MW-02 and MW-07, outside of the landfill footprint, were less than the analytical detection limits.

7.5 Soil Vapour Monitoring Results

The soil vapour monitoring results are presented in Table 3.

Pressures at all vapour wells were negligible during the monitoring events in 2019.

Concentrations of methane were greatest within the waste footprint at VW-05. In 2019, methane gas concentrations ranged from 63.9% (September) to 66.6% (June). The December 2019 methane concentration was 6.1% at VW-05 and may be a result of an instrument detection error. The methane concentrations at the wells along the perimeter of the site, outside the waste footprint, ranged from non-detect at VW-01, VW-02, and most events at VW-04 (June was 0.4%) to a maximum concentration of 3.4% at VW-03 in June 2019. Vapour wells VW-03 with marginally elevated methane concentrations and VW-05 with increased concentrations are located in the northeast area of site, away from RDC residences.

Static water levels varied at VW-01 and VW-02 in 2019. VW-01 ranged from 2.10 m below top of casing (mbtoc) in June 2019 to 2.71 mbtoc in December 2019. VW-02 ranged from dry in December 2019 to 3.97 mbtoc in June 2019. VW-03, VW-04, and VW-05 were all dry during the four monitoring events in 2019. Based on the pressures of the soil vapour wells, they were not suspected to be blinded during the 2019 events.

7.6 Soil 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 C.

BTEX and PHC fractions F1 and F2 (parameters with a TRV for inhalation) were compared against the screening criteria for residential land use for coarse-grained soil. Benzene, xylenes, aliphatic (C8-C10), aromatics (C8-C10), and PHC fraction F2 were detected at concentrations exceeding the soil vapour criteria in samples VW-05 and its duplicate (19DUP01). This well is installed within the waste mass. BTEX, and/or PHC aliphatic and aromatic fractions that comprise F1 and F2 were detected at low concentrations in samples from VW-01, VW-02, VW-03, and VW-04. However, soil vapour concentrations were between 12 and 14,000 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

Siloxanes do not have TRVs for inhalation and were, therefore, not compared against the vapour screening criteria. Concentrations of dodecamethylcyclohexasiloxane and dodecamethylpentasiloxane in sample VW-02 were detected greater than the analytical detection limits but do not appear to be significant as the results were less than five times the detection limit (PQL). Siloxanes were not detected at concentrations greater than the analytical detection limits in VW-01, VW-03, VW-04, VW-05, and 19DUP01.

Naphthalene was not detected at concentrations greater than the analytical detection limit in any of the samples; however, the analytical detection limits for VW-05 and 19DUP01 were raised to greater than the soil vapour criteria.

VOCs (parameters with a TRV for inhalation) were compared against the screening criteria for residential land use, coarse-grained soil. 1,2,4-Trichlorobenzene, trans 1,2-dichloroethene, 1,3,5-trimethylbenzene, dichlorodifluoromethane (a freon compound), and vinyl chloride were detected at concentrations exceeding the soil vapour screening criteria in samples from VW-05 and its duplicate (19DUP01). Several other VOC parameters for VW-05 and 19DUP01 had analytical detection limits raised to greater than the soil vapour screening criteria.

For wells outside the waste footprint, cis 1,2-dichloroethene and vinyl chloride were detected at concentrations exceeding the soil vapour screening criteria in sample VW-03 (adjacent to the northern boundary of the waste area). The concentrations of these parameters at this well were significantly greater than measured in 2013 at this location, and also greater than those at the well installed in waste (VW-05); the VOC concentrations at this location may be anomalous and should be confirmed. Several parameters were detected at low concentrations in samples VW-01, VW-02, and VW-04. However, soil vapour concentrations were between 28 and 157,000 times less than the soil vapour screening criteria, which are protective of vapour intrusion into indoor air.

Methane concentrations in the gas samples suggest that there may have been a field instrument error during the December event; at VW-05, methane concentrations in the sample (57.8%) were greater than the field measured value (6.1%) but were generally comparable with (though slightly lower) the field measurements from the prior three events (63.9% to 66.6%). Similarly, the methane concentration from the sample collected at VW-03 (4.63%) was greater than the field measured value (non-detectable); field measurements from VW-03 prior to December 2019 ranged between 2.0% and 3.4% in 2019.

7.7 Quality Assurance/Quality Control

7.7.1 Methods

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

The field procedures for QA/QC involved:

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

7.7.2 Results

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

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

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

Where:

V_1 = Parent Sample

V_2 = Duplicate Sample

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

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

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

8.0 HAZARD QUOTIENT CALCULATIONS

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

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

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

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

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

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

For non-carcinogens, the individual target risk value used is 0.2 and the cumulative target risk value used is 1.0. This cumulative 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% (the 0.2 target risk value from the individual compound) 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/m^3); and

SF = Route- and chemical-specific SF $(mg/kg/day)^{-1}$ or URF $((mg/m^3)^{-1})$.

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 target risk level is 1×10^{-5}, as this value is considered by Health Canada to represent a negligible risk. This risk level applies to both individual compounds and a summation (i.e. cumulative) of individual compounds risks. For non-carcinogens a cumulative target hazard level of 1.0 is used as potential exposures that result in cumulative hazard indices equal to or less than 1.0 signify negligible potential for adverse health effects. For individual compounds, a hazard index of 0.2 was used. Each sampling location was screened individually for every chemical detected, and the results evaluated relative to both individual and cumulative risks and hazard levels.

The cumulative risk levels for carcinogens in samples from VW-01, VW-02, and VW-04 ranged between 4.9×10^{-7} to 7.2×10^{-8}. The cumulative risk level for carcinogens in sample VW-03 was 3.7×10^{-4}, which is greater than the target risk level of 1×10^{-5}. This risk was due to vinyl chloride at a concentration of 5,220 µg/m^3., and as noted in Section 7.6 this result may be anomalous and should be confirmed. The cumulative risk level for carcinogens in sample VW-05 was 1.2×10^{-4}, which is greater than the target risk level of 1×10^{-5}. At this location, the risk is attributable to vinyl chloride with an individual risk of 3.9×10^{-5} and benzene with an individual risk of 8.1×10^{-5}. Table 6 summarizes the properties of the compounds being assessed. Table 7 summarizes the soil properties used for the calculations. Table 8 summarizes the building properties used for the calculations and Table 9 presents the generic soil vapour criteria calculated.

The cumulative hazard levels identified in samples VW-01, VW-02, and VW-04 collected for the non-carcinogens ranged between 0.003 to 0.14. The cumulative hazard level identified in sample VW-03 collected for the non-carcinogens was 15, which is greater than the target hazard level of 1. This hazard was due to cis 1,2-dichloroethene with an individual hazard of 13 and vinyl chloride with an individual hazard of 1.7. As noted in Section 7.6, these results may be anomalous and should be confirmed. The cumulative hazard level identified in sample VW-05 and its duplicate, collected for the non-carcinogens, was between 234 and 253, which is greater than the cumulative target hazard level of 1.0. The chemicals associated with individual hazard quotients above the individual hazard level (0.2) in VW-05 were xylenes (17.9), PHC fraction F2 (1.3), aliphatics >C8-C10 (8.2), aromatics C8-C10 (150), 1,2,4-trimethylbenzene (4.1), trans 1,2-dichloroethene (4.5), 1,3,5-trimethylbenzene (2.3), and dichlorodifluoromethane (60.5). Table 10 presents the estimated individual and cumulative risks and hazards 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 soil vapour samples VW-01, VW-02, and VW-04 collected in December 2019 did not exceed the corresponding target risk and hazard levels. As presented in Table 10, the estimated individual and cumulative risks and hazards associated with soil vapour samples VW-03 and VW-05 indicate a potential risk from vapour intrusion to indoor air. Soil vapour well VW-03 is located in the northeast corner of the site and is bounded by roads on the north and east. It is approximately 230 m from the nearest residential building and approximately 170 m from the nearest commercial building; however, utility corridors are present along the road rights-of-way, which could be a preferential pathway for the soil vapour. Soil vapour well VW-05 is in the centre of the historical landfill site (installed in waste), it is more than 80 m from Taylor Drive to the east and approximately 275 m from the nearest commercial building. Soil vapour well VW-04 is between the residences across 32 Street to the north and VW-05, and soil vapour well VW-01 is between the college residences to the south and VW-05. In all cases, it is expected that the distance to buildings would decrease the soil vapour concentrations at the point of potential exposure. To date, neither VW-01 or VW-04 have contained significant methane gas concentrations.

9.0 EVALUATION OF SITE CONDITIONS

9.1 Summary of Site Conditions

Based on the 2019 and historical data for the site, there are concerns related to the former landfill operations at RDC. The results collected to date warrant expanding the monitoring well network down-gradient of the waste area (near Taylor Drive) and continuing a soil vapour and groundwater monitoring and sampling program. Semi-annual monitoring and annual sampling for an additional year is suggested, as outlined in Section 10.

With respect to the groundwater quality, monitoring wells that are considered to be hydraulically down-gradient exhibit elevated concentrations of parameters that are typical of MSW leachate, including chloride, ammonia, and VOCs. Due to the proximity of Waskasoo Creek near Taylor Drive, and the interpreted direction of groundwater flow, groundwater is expected to discharge to the east into Waskasoo Creek.

Waskasoo Creek is a likely receptor of any leachate impacted groundwater and should be sampled to determine if the surface water quality is adversely impacted. It is recommended to collect upstream and downstream surface water samples during a spring/summer monitoring event for analysis of BTEX, PHC fractions F1 and F2, total metals, routine water chemistry, and VOCs. If the surface water sampling results exceed FAL guidelines and are interpreted to be related to MSW leachate impacts, additional sampling or assessment may be recommended.

Soil vapour monitoring and sampling has identified elevated methane and several VOCs including vinyl chloride and cis-1,2-DCE. These elevated concentrations are most notable at the location installed with the waste mass (VW-05) but have also been detected to the north at VW-03. At this latter location, the 2019 concentrations for VOCs appear anomalously high, and are recommended to be confirmed.

Based on the nature of thin soil cover identified in the earlier work by Tiamat, we suggest that during field monitoring events, a basic site walkover be conducted to evaluate for potential erosion, cracking, and/or exposed wastes. This information could be used to document whether potential repairs to the cap are warranted. Due to high LFG concentrations within the waste mass, the thin cover and the likely use of the area for recreation and public access, conducting a surface emissions survey should also be considered to document that users of the site are not exposed to LFG. Subsequently, the additional groundwater, vapour and surface water information collected should be compiled into a risk management approach that is protective of all receptors identified.

Immediately south of the waste area are residences of RDC. Tetra Tech understands that RDC accepted the risk, were required to install a passive soil vapour venting system, and are responsible for maintaining the system and monitoring.

9.2 Review of Mitigative Measures from Risk Management Plan

The 2014 RMP presented a proposed site-specific environmental RMP 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 588,280 (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, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene) identified that none of the 2013 concentrations would have unacceptable HQs using the updated CCME methodology. It should be noted that only soil vapour wells VW-03 and VW-04 were sampled in 2013.

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 individual HQ and Cancer Risks calculated by XCG[1]. 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 150 (vs target hazard level of 0.2), the greatest cumulative hazard quotient was 253 (vs target hazard level of 1.0), and the greatest estimated cancer risk was 3.7×10^{-4} (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 active Level E measures would be required for development within the setback area. We note that these hazard quotients and risks are based on samples collected from VW-03 (immediately northeast of landfill footprint) and VW-05 (situated within the landfill footprint and an indicator of source concentrations). While elevated methane has been noted at VW-03, as discussed in Section 7.6, the 2019 VOC concentrations at this well appear anomalous and should be confirmed.

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

10.0 CONCLUSIONS AND RECOMMENDATIONS

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

- The groundwater elevations in 2019 indicated that the inferred groundwater flow direction was to the east-northeast, towards Waskasoo Creek, east of Taylor Drive. The average horizontal hydraulic gradient at the site in 2019 was approximately 0.05 m/m. This is consistent with observations made historically in 2013. Groundwater elevations in 2013 were overall slightly higher than groundwater elevations in 2019.

- Groundwater quality parameters that exceeded the Tier 1 Guidelines at one or more monitoring wells in 2019 included pH, TDS, sodium, chloride, ammonia, nitrate, dissolved metals arsenic, barium, iron, manganese, and uranium, and benzene, ethylbenzene, xylenes, vinyl chloride, 1,2-dichlorobenzene, and 1,2-dichloroethane. The measured concentrations of one or more of these parameters, in addition to the presence of various VOCs with no established guideline values, suggest leachate has impacted the groundwater quality at MW-03, MW-04, MW-05, and MW-06, all situated within the waste footprint. The measured concentrations of these parameters were generally consistent with previous results.

- Concentrations of AOX and volatile fatty/carboxylic acids in 2019 were less than the analytical detection limits at all monitoring wells.
- Concentrations of BTEX, PHCs, and VOCs were less than the soil vapour screening criteria in samples VW-01, VW-02, and VW-04, situated southwest and west of the landfill footprint.
- Various VOCs, BTEX, and PHCs exceeded the soil vapour screening criteria at VW-03 and VW-05, situated within (VW-05) and immediately adjacent to (VW-03) the waste footprint. Well headspace monitoring also identified elevated methane at these wells, up to 66.6% gas at VW-05 during the June event. The VOC concentrations at VW-03 in 2019 appear anomalous and should be confirmed.
- Concentrations of siloxanes were detected in sample VW-02 greater than the laboratory detection limit.
- 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 for samples VW-01, VW-02, and VW-04; however, they exceeded at VW-03 and VW-05. As noted above, the 2019 VOC concentrations at VW-03 appear anomalous and should be confirmed.

Four of the seven groundwater monitoring wells at the site are located within the waste footprint, and either screened within (MW-04 and MW05) or below (MW03 and MW-06) the waste. Each of these four wells are identified above to contain leachate impacts, and in at least two wells the measured liquids may represent leachate. Two of the five vapour wells (VW-03 and VW-05) exhibited impacts by LFG, as evidenced by elevated methane and VOCs; the greatest concentrations were measured at VW-05, located centrally in the waste mass, with lower (but elevated) concentrations noted at VW-03, located immediately adjacent to the waste mass at the northeast corner of the site.

Based on the above, there is a strong correlation between observed impacts and the waste footprint. In the groundwater, the results indicate that impacts may be migrating off site in a hydraulically down-gradient direction (overall easterly towards Waskasoo Creek). In the soil vapours, the two wells closest to the residences (VW-01 and VW-02) do not indicate impacts, and the measured concentrations were less than the target cumulative risks and hazard levels for residential land use. The vapours at VW-05 were collected from within the waste mass (and exceed the target risk and hazard levels) and confirm that LFG concentrations typical of a municipal landfill are present, including methane concentrations up to 66.6%. The vapours at VW-03, at the northeast end of the site are also indicative of LFG. This probe is situated immediately adjacent to the waste footprint and is bounded by a road intersection to the north and east. It is an unlikely location for a building; however, the potential extents of LFG migration off site in this direction are not known. The methane gas concentrations measured to date at VW-03 are considerably less than within the waste mass (e.g. at VW-05) however are still considered elevated. The 2019 VOC concentrations at this well appear anomalous and should be confirmed before installation of an additional probe in the area is considered.

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

- Ongoing Monitoring:
  - Conduct an additional year of semi-annual monitoring and annual sampling of groundwater at the site to monitor the trends.

  - Continue to sample monitoring wells MW-02, MW-03, MW-04, MW-05, MW-06, and MW07 for routine groundwater chemistry parameters and dissolved metals. Continue sampling MW-03, MW-04, MW-05, and MW-06 for VOCs, BTEX, and PHCs.

  - Continue with an additional year of quarterly monitoring of vapours at the vapour probes, including one additional sampling event, which will include confirmation of the VOC concentrations at VW-03.

- Additional Assessment and Risk Management:

  - Install two additional groundwater monitoring wells along the east edge of the site, between the waste area and Waskasoo Creek, immediately west of the curb of south-bound Taylor Drive. Proposed locations are to the southeast of MW-04 and approximately halfway between MW-04 and MW-05, immediately west of the curb of south-bound Taylor Drive. Based on historical information, the waste extends to nearby Taylor Drive. The historical information should be reviewed to identify the most appropriate locations for the new wells, if possible. These monitoring wells should be included in the proposed ongoing monitoring program and sampled for the same analytical suite of parameters as MW-03, MW-04, MW-05, and MW-06.

  - Based on the nature of thin soil cover identified in the earlier work by Tiamat, we suggest that during field monitoring events, a basic site walkover be conducted to evaluate for potential erosion, cracking, and/or exposed wastes. This information could be used to document whether potential repairs to the cap are warranted. Due to high LFG concentrations within the waste mass, the thin cover and the likely use of the area for recreation and public access, conducting a surface emissions survey should also be considered to document that users of the site are not exposed to LFG.

  - The extent and migration of leachate impacted groundwater is poorly defined and the presence of Taylor Drive impedes further assessment of subsurface impacts near the creek. Because Waskasoo Creek is considered to be a receptor, it is recommended to collect upstream and downstream surface water samples during a spring/summer monitoring event for analysis of BTEX, PHC fractions F1 and F2, total metals, routine water chemistry, and VOCs. If the surface water sampling results exceed FAL guidelines and are interpreted to be related to MSW leachate impacts, additional sampling or assessment may be recommended.

  - Compile the additional groundwater, vapour and surface water information collected into a risk management approach that is protective of all receptors identified.

- 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 The City policies.

  - Ensure that the site is clearly identified within The City's utility mapping system. Elevated gas concentrations may be present in the subsurface proximate to the Taylor Drive road right-of-way. Elevated gas concentrations may be present in the subsurface proximate to the Taylor Drive right-of-way. Future activities in this vicinity (e.g., utility work, repairs, paving, etc.) should consider the potential presence of gas and a site-specific safety plan should be developed for work undertaken to limit the potential for exposure to site workers.

Further to the above recommendations, as noted the site remains an historical landfill. It presently has a grass cover. 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.

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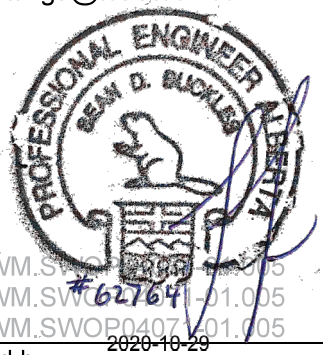

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TABLES

Table 1: Groundwater Elevations

Monitoring Well		MW-01	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07
Total Drilled Depth (m)		4.6	4.6	10.7	8.7	7.5	9.2	6.1
Top of Screened Interval (mbg)		2.5	2.5	7.6	5.6	4.4	6.1	1.5
Bottom of Screened Interval (mbg)		4.6	4.6	10.7	8.7	7.5	9.2	6.1
Stick up (m)		0.80	0.43	0.97	0.97	0.85	0.84	0.76
Ground Elevation (m)		876.98	877.85	877.17	876.01	872.45	877.91	877.41
TPC Elevation (m)		877.79	878.28	878.14	876.99	873.31	878.75	878.17
Depth to Groundwater (mBTPC)	Aug-13	Damaged	CNO	4.89	6.02	2.07	2.79	2.76
	May-19	Damaged	2.58	5.72	7.09	3.43	4.32	4.71
	Jun-19	Damaged	2.58	5.70	7.09	3.44	4.22	4.70
	Sep-19	Damaged	2.42	5.75	7.11	3.58	3.96	4.93
	Dec-19	Damaged	2.78	5.74	7.11	3.78	4.05	4.85
Groundwater Elevation (m)	Aug-13	Damaged	CNO	873.25	870.96	871.24	875.96	875.42
	May-19	Damaged	875.70	872.41	869.90	869.88	874.44	873.47
	Jun-19	Damaged	875.70	872.44	869.89	869.87	874.53	873.47
	Sep-19	Damaged	875.86	872.39	869.88	869.72	874.80	873.25
	Dec-19	Damaged	875.50	872.40	869.88	869.53	874.70	873.32
Combustile Vapour Concentrations* (CVCs) (ppm)	May-19	Damaged	0	0	0	0	0	0
	Jun-19	Damaged	0	0	0	30	0	35
	Sep-19	Damaged	0	5	10	45	0	0
	Dec-19	Damaged	0	5	5	5	5	50
Volatile Organic Compounds* (VOCs) (ppm)	May-19	Damaged	0	0	1	5	0	0
	Jun-19	Damaged	0	0	1	1	0	15
	Sep-19	Damaged	0	0	1	5	0	10
	Dec-19	Damaged	0	0	0	2	1	0

Notes:
mbg - metres below grade.
ppm- parts per million
*- measured using RKI Eagle II calibrated to hexane and isobutylene and operated in methane elimination mode
mBTPC - Metres below top of plastic pipe casing.
CNO - Could not open.

Table 2: Groundwater Analytical Results

		Location Code	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07
		Sample Date	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019
		Lab Report Number	L2393430	L2393430	L2393430	L2393430	L2393430	L2393430
		Laboratory ID	L2393430-1	L2393430-2	L2393430-3	L2393430-4	L2393430-5	L2393430-6
Parameter	**Unit**	**Tier 1 Guideline [1,2]**						
Field Testing								
Field Temperature	°C	-	6.50	-	5.82	7.25	5.89	5.30
Field Electric Conductivity	µS/cm	-	533	-	2,376	1,281	2,671	734
Field pH	pH Units	6.5 to 8.5	**9.07**	-	**8.77**	**9.32**	**8.75**	**9.81**
Routine								
pH	pH Units	6.5 to 8.5	8.14	7.37	7.01	7.96	6.85	7.79
Electrical Conductivity (EC)	µS/cm	-	744	2,580	3,840	1,350	2,500	1,130
Total Dissolved Solids (TDS)	mg/L	500	443	**949**	**1,490**	**836**	**872**	**712**
Hardness as $CaCO_3$	mg/L	-	377	1,090	1,550	258	1,230	634
Alkalinity (total as $CaCO_3$)	mg/L	-	428	1,150	1,580	658	1,040	605
Bicarbonate	mg/L	-	523	1,400	1,930	803	1,270	738
Carbonate	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Hydroxide	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Calcium	mg/L	-	66.4	287	186	61.6	240	144
Magnesium	mg/L	-	51.3	91.1	264	25.3	154	66.6
Potassium	mg/L	-	2.77	11.7	13.8	5.52	18.5	7.66
Sodium	mg/L	200	26.6	**275**	**431**	**217**	104	26.1
Chloride	mg/L	120	3.75	**271**	**593**	14.2	**335**	7.10
Fluoride	mg/L	1.5	0.354	<0.10	0.160	0.280	<0.10	<0.10
Phosphorus - Total	mg/L	-	0.105	3.61	0.783	0.337	1.14	26.2
Sulphate	mg/L	429 [3]	19.7	13.4	<1.5	117	20.8	97.2
Ionic Balance	N/A	-	93.7	111	107	94.6	101	97.8
Nutrients								
Ammonia as N	mg/L	0.774 to 17.314 [6]	<0.050	4.56	**22.9**	**5.80**	**17.9**	0.125
Nitrate (as NO_3-N)	mg/L	3	**3.46**	<0.10	0.14	<0.10	<0.10	<0.10
Nitrite (as NO_2-N)	mg/L	0.040 to 0.20 [4]	<0.010	<0.050	<0.050	<0.050	<0.050	<0.050
Nitrate and Nitrite (as N)	mg/L	-	3.46	<0.11	0.14	<0.11	<0.11	<0.11
Total Kjeldahl Nitrogen (TKN)	mg/L	-	0.69	14.4	24.1	6.0	24.3	24.6
Carbon								
Dissolved Organic Carbon (DOC)	mg/L	-	6.6	43.8	48.9	10.3	24.7	5.6
Dissolved Metals								
Aluminum	mg/L	0.050 [5]	0.0019	0.0151	<0.0010	0.0058	0.0042	0.0022
Antimony	mg/L	0.006	<0.00010	0.00048	0.00023	<0.00010	0.00024	0.00017
Arsenic	mg/L	0.005	0.00035	**0.00733**	0.00408	**0.00722**	**0.0122**	0.00050
Barium	mg/L	1	0.147	0.249	**1.14**	0.107	0.580	0.195
Boron	mg/L	1.5	0.076	0.392	0.380	0.225	0.226	0.059
Cadmium	mg/L	0.00035 to 0.00037 [3]	0.0000170	0.0000961	<0.0000050	<0.0000050	<0.0000050	0.0000802
Chromium	mg/L	0.05	<0.00010	0.00079	0.00076	0.00025	0.00067	<0.00010
Copper	mg/L	0.007	0.00121	0.00493	0.00354	0.00027	0.00021	0.00615
Iron	mg/L	0.30	<0.010	**8.63**	0.102	**2.32**	**24.8**	0.019
Lead	mg/L	0.0070 [3]	<0.000050	0.00205	<0.000050	0.000116	0.000066	0.0002
Manganese	mg/L	0.050	0.00542	**0.632**	**0.379**	**0.193**	**2.91**	**0.394**
Mercury	mg/L	0.000005	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Nickel	mg/L	0.116 to 0.530 [3]	0.00130	0.0146	0.0345	0.00128	0.0145	0.00582
Selenium	mg/L	0.002	0.000386	0.00022	0.000399	0.000133	0.000353	0.000052
Silver	mg/L	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium	mg/L	0.015	**0.0159**	0.00151	0.000048	0.00184	0.0061	**0.0167**
Zinc	mg/L	0.03	<0.0010	0.0295	0.0018	<0.0010	0.0015	0.0040
Organics								
AOX	mg/L	-	ND	ND	ND	ND	ND	ND
Hydrocarbons								
Benzene	mg/L	0.005	<0.00050	0.00186	**0.0141**	0.00415	**0.00900**	<0.00050
Toluene	mg/L	0.021	<0.00050	0.00183	0.00164	0.00176	0.00317	<0.00050
Ethylbenzene	mg/L	0.0016	<0.00050	**0.00192**	0.00084	**0.00454**	**0.0132**	<0.00050
Xylenes (m & p)	mg/L	-	<0.00050	<0.00050	0.00147	0.00663	0.0196	<0.00050
Xylene (o)	mg/L	-	<0.00050	<0.00050	0.00116	0.00255	0.00596	<0.00050
Xylenes Total	mg/L	0.020	<0.00071	<0.00071	0.00263	0.00918	**0.0256**	<0.00071
Styrene	mg/L	0.072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
F1 (C_6-C_{10})	mg/L	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
F1 (C_6-C_{10}) - BTEX	mg/L	0.81	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
F2 (C_{10}-C_{16})	mg/L	1.1	<0.10	0.54	0.10	0.31	0.51	<0.10
Volatile Fatty/Carboxylic Acids								
Acetic Acid	mg/L	-	<10	<10	<10	<10	<10	<10
Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Formic Acid	mg/L	-	<50	<50	<50	<50	<50	<50
Hexanoic Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
iso-Butyric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isovaleric acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Propionic Acid	mg/L	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Valeric Acid	mg/L	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Notes:

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

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

[3] Guideline varies with hardness. Values shown based on site hardness range of 258 mg/L to 1,550 mg/L.

[4] Guideline varies with chloride. Values shown based on site chloride range of 3.75 mg/L to 593 mg/L.

[5] Guideline varies with pH. Values shown based on laboratory pH range of 6.85 to 8.14.

[6] Guideline varies with pH and temperature. Values shown based on laboratory pH range of 6.85 to 8.14 and temperature range of 5.30°C to 7.25°C. An average temperature of 6.15°C was used to calculate the appropriate guideline for MW-03.

"-" No applicable guideline.

"ND" Non-detected.

BOLD - Greater than Tier 1 Guideline.

N/A - Not applicable.

Table 2: Groundwater Analytical Results

		Location Code	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07
		Sample Date	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019
		Lab Report Number	L2393430	L2393430	L2393430	L2393430	L2393430	L2393430
		Laboratory ID	L2393430-1	L2393430-2	L2393430-3	L2393430-4	L2393430-5	L2393430-6
Parameter	**Unit**	**Tier 1 Guideline [1,2]**						
Volatile Organic Compounds (VOCs)								
1,1,1,2-Tetrachloroethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,1-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,2,2-Tetrachloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,2-Trichloroethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1-Dichloroethane	mg/L	-	<0.00050	<0.00050	0.00107	<0.00050	<0.00050	<0.00050
1,1-Dichloroethene	mg/L	0.014	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1-Dichloropropene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2,3-Trichlorobenzene	mg/L	0.008	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2,3-Trichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2,4-Trichlorobenzene	mg/L	0.015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2,4-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	0.0058	0.0089	<0.0010
1,2-Dibromo-3-chloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dibromoethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,2-Dichlorobenzene	mg/L	0.0007	<0.00050	<0.00050	**0.00401**	<0.00050	<0.00050	<0.00050
1,2-Dichloroethane	mg/L	0.005	<0.0010	<0.0010	**0.0114**	<0.0010	<0.0025	<0.0010
1,2-Dichloroethene (cis)	mg/L	-	<0.0010	1.75	2.11	0.0014	0.029	<0.0010
1,2-Dichloroethene (trans)	mg/L	-	<0.00050	0.0107	0.0406	0.0006	0.00488	<0.00050
1,2-Dichloropropane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3,5-Trimethylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010
1,3-Dichlorobenzene	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene [cis]	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,3-Dichloropropene [trans]	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,4-Dichlorobenzene	mg/L	0.001	<0.00050	<0.00050	0.00074	<0.00050	<0.00050	<0.00050
2,2-Dichloropropane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
2-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
4-Chlorotoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromobenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromochloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromodichloromethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromoform	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromomethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Carbon tetrachloride	mg/L	0.00057	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.0013	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloroethane	mg/L	-	<0.0010	<0.0010	0.0403	<0.0010	0.0079	<0.0010
Chloroform	mg/L	0.018	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chloromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dibromochloromethane	mg/L	0.19	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dibromomethane	mg/L	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Dichlorodifluoromethane	mg/L	-	<0.00050	0.00067	0.00391	<0.00050	0.0789	<0.00050
Hexachlorobutadiene	mg/L	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
iso-Propylbenzene (cumene)	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Methylene Chloride	mg/L	0.05	<0.0010	0.0023	0.0051	<0.0010	0.0017	<0.0010
n-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
n-Propylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
p-Isopropyltoluene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
sec-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
tert-Butylbenzene	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tetrachloroethene	mg/L	0.01	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Trichloroethene	mg/L	0.005	<0.00050	<0.00050	0.00104	<0.00050	<0.00050	<0.00050
Trichlorofluoromethane	mg/L	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl chloride	mg/L	0.0011	<0.00050	**0.0138**	**0.0259**	**0.00294**	**0.0913**	<0.00050

Notes:

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[4] Guideline varies with chloride. Values shown based on site chloride range of 3.75 mg/L to 593 mg/L.

[5] Guideline varies with pH. Values shown based on site pH range of 8.75 to 9.81.

[6] Guideline varies with pH and temperature. Values shown based on lab pH range of 6.85 to 8.14 and temperature range of 5.30°C to 7.25°C. An average temperture of 6.15°C was used to calculate the appropriate guideline for MW-03.

"-" No applicable guideline.

"ND" Non-detected.

BOLD - Greater than Tier 1 Guideline.

N/A - Not applicable.

Table 3: Soil Vapour Monitoring Results

	Gas Well														
	VW-01					VW-02					VW-03				
Ground Elevation (m)	877.33					877.19					872.69				
Top of Screened Interval (mbg)	875.03					873.19					870.29				
Bottom of Screened Interval (mbg)	874.73					872.89					869.99				
Parameter	**Aug-13**	**May-19**	**Jun-19**	**Sep-19**	**Dec-19**	**Aug-13**	**May-19**	**Jun-19**	**Sep-19**	**Dec-19**	**Aug-13**	**May-19**	**Jun-19**	**Sep-19**	**Dec-19**
Pressure (kPa)[1]	N/A	0.0	Blinded	0.0	0.6	N/A	0.0	Blinded	0.0	0.0		0.0	0.0	0.0	0.0
CH_4 (%)	N/A	0.0	0.0	0.0	0.0	N/A	0.0	0.0	0.0	0.0	5.5	2.0	3.4	2.0	0.0
CO (ppm)[2]	N/A	0.0	0.0	0.0	0.0	N/A	0.0	8.0	0.0	0.0		3.0	12.0	0.0	0.0
CO_2 (%)	N/A	0.0	0.0	1.8	0.1	N/A	0.1	0.0	0.0	0.1	15.1	14.3	11.0	5.2	1.3
O_2 (%)	N/A	22.0	19.9	18.6	19.1	N/A	21.4	20.1	20.2	18.7	8.0	0.4	6.3	15.8	19.8
Balance (% v/v)	N/A	78.0	80.1	79.6	80.8	N/A	78.6	79.9	79.8	81.2	71.8	83.3	79.3	77.0	78.8
Static Water Level (mbtoc)[3]	N/A	2.42	2.10	2.22	2.71	N/A	4.15	3.97	4.67	Dry		Dry	Dry	Dry	Dry
Depth to Bottom (m)	N/A	3.36	3.36	3.48	3.49	N/A	4.30	5.90	5.02	0.75	2.70	3.37	3.37	3.48	3.49
Stick up (m)	N/A	0.73	0.81	0.81	0.90	N/A	0.64	0.64	0.71	0.71		0.63	0.63	0.74	0.73

	Gas Well									
	VW-04					VW-05				
Ground Elevation (m)	877.45					877.72				
Top of Screened Interval (mbg)	875.35					875.62				
Bottom of Screened Interval (mbg)	875.05					875.32				
Parameter	**Aug-13**	**May-19**	**Jun-19**	**Sep-19**	**Dec-19**	**Aug-13**	**May-19**	**Jun-19**	**Sep-19**	**Dec-19**
Pressure (kPa)[1]		0.0	0.01	0.0	0.0	N/A	0.0	0.01	0.0	0.0
CH_4 (%)	0.0	0.0	0.4	0.0	0.0	N/A	64.8	66.6	63.9	6.1
CO (ppm)[2]		1.0	20.0	0.0	0.0	N/A	45.0	29.4	0.0	0.0
CO_2 (%)	2.3	2.1	0.4	3.9	0.4	N/A	29.8	31.2	35.8	4.5
O_2 (%)	20.7	20.0	19.7	18.0	20.2	N/A	0.6	0.4	0.1	18.1
Balance (% v/v)	77.0	78.0	80.8	78.1	79.4	N/A	4.6	1.1	0.2	71.2
Static Water Level (mbtoc)[3]		Dry	Dry	Dry	Dry	N/A	Dry	Dry	Dry	Dry
Depth to Bottom (m)	2.40	3.57	3.36	3.37	3.48	N/A	3.37	3.37	3.48	3.48
Stick up (m)		1.00	1.00	1.00	1.01	N/A	0.94	0.94	1.00	1.01

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 or has a submerged screen (blinded).

Table 4: Soil Vapour Analytical Results

Location Code		Generic Soil Vapour Criteria - Residential Coarse-Grained ($\mu g/m^3$)[1]	VW-01	VW-02	VW-03	VW-04	VW-05	
Field ID			VW-01	VW-02	VW-03	VW-04	VW-05	19DUP01
Sample Date			6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019
Lab Report Number			L2393575	L2393575	L2393575	L2393575	L2393575	L2393575
Laboratory ID			L2393575-1 / L2393575-7	L2393575-2 / L2393575-8	L2393575-3 / L2393575-9	L2393575-4 / L2393575-10	L2393575-5 / L2393575-11	L2393575-6
Parameter	**Unit**	**$\mu g/m^3$**						
Field Tests								
Air Volume	L		0.06	0.06	0.06	0.06	0.06	-
Initial Pressure	in Hg		-5.3	-10.2	-8.8	-9.4	-6.1	-6.7
Aliphatic/Aromatic PHC Sub-Fractionation								
Aliphatics (C_6-C_8)	$\mu g/m^3$	740,737	73	45	912	196	56,900	50,600
Aliphatics (>C_8-C_{10})	$\mu g/m^3$	40,257	101	27	615	247	**331,000**	**290,000**
Aliphatics (>C_{10}-C_{12})	$\mu g/m^3$	40,257	17	<15	223	<15	37,500	32,800
Aliphatics (>C_{12}-C_{16})	$\mu g/m^3$	40,257	<30	<30	<30	<30	<750	<750
Aromatics (>C_8-C_{10})	$\mu g/m^3$	805	<15	<15	65	45	**121,000**	**104,000**
Aromatics (>C_{10}-C_{12})	$\mu g/m^3$	8,051	<15	<15	<15	<15	5,780	5,080
Aromatics (>C_{12}-C_{16})	$\mu g/m^3$	8,051	<30	<30	<30	<30	<750	<750
Linear & Cyclic Methyl Siloxanes								
Hexamethylcyclotrisiloxane, D3(CVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Octamethylcyclotetrasiloxane, D4(CVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Decamethylcyclopentasiloxane, D5(CVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Dodecamethylcyclohexasiloxane, D6(CVMS)	$\mu g/m^3$	NG	<170	210	<170	<170	<170	-
Hexamethyldisiloxane, MM(LVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Octamethyltrisiloxane, MDM(LVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Decamethyltetrasiloxane, MD2M(LVMS)	$\mu g/m^3$	NG	<170	<170	<170	<170	<170	-
Dodecamethylpentasiloxane, MD3M(LVMS)	$\mu g/m^3$	NG	<170	320	<170	170	<170	-
Hydrocarbons								
Benzene	$\mu g/m^3$	195	9.62	1.41	11.6	6.56	**1,570**	**1,500**
Toluene	$\mu g/m^3$	124,220	18.7	1.05	8.91	2.15	1,280	1,230
Ethylbenzene	$\mu g/m^3$	34,330	<0.87	<0.87	2.42	1.08	12,600	11,500
Xylenes (m & p)	$\mu g/m^3$	NG	3.1	<1.7	35	59	106,000	95,800
Xylene (o)	$\mu g/m^3$	NG	<0.87	<0.87	7.62	2.23	7,400	6,700
Xylenes Total	$\mu g/m^3$	6,330	3.1	<2.0	42.7	61.2	**113,000**	**102,000**
Styrene	$\mu g/m^3$	3,220	<0.85	<0.85	<0.85	<0.85	<280	<280
F1 (C_6-C_{10})	$\mu g/m^3$	867,383	175	63	1,410	448	543,000	478,000
F2 (C_{10}-C_{16})	$\mu g/m^3$	52,495	38	<15	375	<15	**67,600**	**59,700**
Alcohols								
Isopropanol	$\mu g/m^3$	6,219	3.6	<2.5	<2.5	6.0	<61	<61
High Level Fixed Gases								
Nitrogen	%	NG	79.7	78	74	75.8	3.4	2.4
Oxygen	%	NG	21.5	21.1	2.58	19.6	0.87	0.57
Carbon Dioxide	%	NG	0.190	0.404	16.1	2.84	30.6	26.7
Carbon Monoxide	%	NG	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Methane	%	NG	<0.050	<0.050	4.63	<0.050	57.8	58.8
Hydrocarbon Gases (C_1-C_5)								
Methane	%	NG	0.00026	0.00023	-	0.0108	-	-
Ethane	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	0.0079	0.00747
Ethene	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	0.0216	0.0223
Propane	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	0.00027	0.00028
Propene	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Butane	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Pentane	%	NG	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Polycyclic Aromatic Hydrocarbons (PAHs)								
Naphthalene	$\mu g/m^3$	112	<2.6	<2.6	<2.6	<2.6	<860*	<860*

Notes:

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

NG - No applicable criteria.

BOLD - Greater than criteria.

* = Detection limit raised above criteria.

Table 4: Soil Vapour Analytical Results

Location Code		Generic Soil Vapour Criteria - Residential Coarse-Grained ($\mu g/m^3$)[1]	VW-01	VW-02	VW-03	VW-04	VW-05	
Field ID			VW-01	VW-02	VW-03	VW-04	VW-05	19DUP01
Sample Date			6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019	6-Dec-2019
Lab Report Number			L2393575	L2393575	L2393575	L2393575	L2393575	L2393575
Laboratory ID			L2393575-1 / L2393575-7	L2393575-2 / L2393575-8	L2393575-3 / L2393575-9	L2393575-4 / L2393575-10	L2393575-5 / L2393575-11	L2393575-6
Parameter	**Unit**	**$\mu g/m^3$**						
Volatile Organic Compounds (VOCs)								
1,1,1-Trichloroethane	$\mu g/m^3$	1,693,510	<1.1	<1.1	<1.1	<1.1	<360	<360
1,1,2,2-Tetrachloroethane	$\mu g/m^3$	11	<1.4	<1.4	<1.4	<1.4	<450*	<450*
1,1,2-Trichloroethane	$\mu g/m^3$	7	<1.1	<1.1	<1.1	<1.1	<360*	<360*
1,1-Dichloroethane	$\mu g/m^3$	430	<0.81	<0.81	<0.81	<0.81	<260	<260
1,1-Dichloroethene	$\mu g/m^3$	6,470	<0.79	<0.79	<0.79	<0.79	<260	<260
1,2,4-Trichlorobenzene	$\mu g/m^3$	365	<1.5	<1.5	<1.5	<1.5	<490*	<490*
1,2,4-Trimethylbenzene	$\mu g/m^3$	2,235	<0.98	<0.98	7.07	1.38	**9,100**	**7,400**
1,2-Dibromoethane	$\mu g/m^3$	590	<1.5	<1.5	<1.5	<1.5	<500	<500
1,2-Dichlorobenzene	$\mu g/m^3$	7,072	<1.2	<1.2	<1.2	<1.2	<390	<390
1,2-Dichloroethane	$\mu g/m^3$	24	<0.81	<0.81	<0.81	<0.81	<260*	<260*
1,2-Dichloroethene (cis)	$\mu g/m^3$	242	<0.79	<0.79	**3,140**	1.14	<260*	<260*
1,2-Dichloroethene (trans)	$\mu g/m^3$	245	<0.79	<0.79	116	5.18	**1,100**	**1,110**
1,2-Dichloropropane	$\mu g/m^3$	135	<0.92	<0.92	<0.92	<0.92	<300*	<300*
1,2-Dichlorotetrafluoroethane	$\mu g/m^3$	566,335	<1.4	<1.4	48.3	3.6	2,980	3,020
1,3,5-Trimethylbenzene	$\mu g/m^3$	2,235	<0.98	<0.98	3.24	1.28	**5,090**	**4,250**
1,3-Butadiene	$\mu g/m^3$	17	<0.44	<0.44	<0.44	<0.44	<140*	<140*
1,3-Dichlorobenzene	$\mu g/m^3$	64	<1.2	<1.2	<1.2	<1.2	<390*	<390*
1,3-Dichloropropene [cis]	$\mu g/m^3$	163	<0.91	<0.91	<0.91	<0.91	<300*	<300*
1,3-Dichloropropene [trans]	$\mu g/m^3$	149	<0.91	<0.91	<0.91	<0.91	<300*	<300*
1,4-Dichlorobenzene	$\mu g/m^3$	64	<1.2	<1.2	<1.2	<1.2	<390*	<390*
1,4-Dioxane	$\mu g/m^3$	105	<0.72	<0.72	<0.72	<0.72	<240*	<240*
1-Methyl-4 ethyl benzene	$\mu g/m^3$	14,461	<0.98	<0.98	1.59	<0.98	1,890	1,510
2-Butanone (MEK)	$\mu g/m^3$	167,364	1.67	0.78	0.87	1.76	<190	<190
2-Hexanone (MBK)	$\mu g/m^3$	1,053	<4.1	<4.1	<5.4	<4.1	<1,600*	<1,600*
4-Methyl-2-pentanone (MIBK)	$\mu g/m^3$	103	<0.82	<0.82	<0.82	<0.82	<270*	<270*
Acetone	$\mu g/m^3$	918,788	22.8	8.0	<9.8	14.6	840	<390
Allyl chloride	$\mu g/m^3$	32	<0.63	<0.63	<0.63	<0.63	<200*	<200*
Benzyl chloride	$\mu g/m^3$	34	<1.0	<1.0	<1.0	<1.0	<340*	<340*
Bromodichloromethane	$\mu g/m^3$	28	<1.3	<1.3	<1.3	<1.3	<440*	<440*
Bromoform	$\mu g/m^3$	1,494	<2.1	<2.1	<2.1	<2.1	<680	<680
Bromomethane	$\mu g/m^3$	173	<0.78	<0.78	<0.78	<0.78	<250*	<250*
Carbon disulfide	$\mu g/m^3$	21,713	1.97	3.67	3.84	4.41	<200	<200
Carbon tetrachloride	$\mu g/m^3$	113	<1.3	<1.3	<1.3	<1.3	<410*	<410*
Chlorobenzene	$\mu g/m^3$	347	<0.92	<0.92	<0.92	<0.92	<300	<300
Chloroethane	$\mu g/m^3$	31,019	<0.53	<0.53	11.8	1.82	430	470
Chloroform	$\mu g/m^3$	27	<0.98	<0.98	<0.98	<0.98	<320*	<320*
Chloromethane	$\mu g/m^3$	2,657	1.39	1.46	1.32	1.98	<140	<140
Cyclohexane	$\mu g/m^3$	201,510	3.66	0.72	71.8	11.8	2,290	2,380
Dibromochloromethane	$\mu g/m^3$	4,750	<1.7	<1.7	<1.7	<1.7	<560	<560
Dichlorodifluoromethane	$\mu g/m^3$	3,584	5.73	2.42	18.7	128	**217,000**	**241,000**
Ethyl acetate	$\mu g/m^3$	2,509	5.75	<0.72	<0.72	-	<240	<240
Freon 113	$\mu g/m^3$	230,627	<1.5	<1.5	<1.5	<1.5	<500	<500
Heptane	$\mu g/m^3$	14,461	2.38	<0.82	17.6	12.4	6,100	6,100
Hexachlorobutadiene	$\mu g/m^3$	51	<2.1	<2.1	<2.1	<2.1	<700*	<700*
Hexane	$\mu g/m^3$	18,839	7.59	1.6	46.3	14.5	2,940	2,890
Isooctane	$\mu g/m^3$	14,917	<0.93	<0.93	29.7	2.68	520	540
iso-Propylbenzene (cumene)	$\mu g/m^3$	14,461	1.13	<0.98	<0.98	<0.98	990	880
Methyl t-Butyl Ether (MTBE)	$\mu g/m^3$	1,153	4.72	<0.72	<0.72	<0.72	<240	<240
Methylene Chloride	$\mu g/m^3$	18,764	1.80	<0.69	<0.69	<0.69	<230	<230
Propene	$\mu g/m^3$	91,723	<0.34	<0.34	<0.34	<0.34	<110	<110
Tetrachloroethene	$\mu g/m^3$	2,679	<1.4	<1.4	<1.4	<1.4	<440	<440
Tetrahydrofuran	$\mu g/m^3$	62,828	<0.59	<0.59	<0.59	<0.59	<190	<190
Trichloroethene	$\mu g/m^3$	153	<1.1	<1.1	<1.1	<1.1	<350	<350
Trichlorofluoromethane	$\mu g/m^3$	34,325	1.3	1.8	<1.1	3.5	<370	<370
Vinyl acetate	$\mu g/m^3$	6,586	<1.8	<1.8	<1.8	<1.8	<580	<580
Vinyl bromide (bromoethene)	$\mu g/m^3$	94	<0.87	<0.87	<0.87	<0.87	<290*	<290*
Vinyl chloride	$\mu g/m^3$	140	<0.51	<0.51	**5,220**	2.44	**550**	**570**

Notes:

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

NG - No applicable criteria.

BOLD - Greater than criteria.

* = Detection limit raised above criteria.

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

		Field ID	VW-05	19DUP01	RPD (%)
		Sample Date	6-Dec-2019	6-Dec-2019	
		Lab Report Number	L2393575	L2393575	
		Laboratory ID	L2393575-5 / L2393575-11	L2393575-6	
Parameter	**Unit**	**RDL**			
Field Tests					
Air Volume	L	0.01	0.06	-	-
Initial Pressure	in Hg	-30	-6.1	-6.7	-
Aliphatic/Aromatic PHC Sub-Fractionation					
Aliphatics (C_6-C_8)	µg/m^3	15	56,900	50,600	12
Aliphatics (>C_8-C_{10})	µg/m^3	15	331,000	290,000	13
Aliphatics (>C_{10}-C_{12})	µg/m^3	15	37,500	32,800	13
Aliphatics (>C_{12}-C_{16})	µg/m^3	30	<750	<750	-
Aromatics (>C_8-C_{10})	µg/m^3	15	121,000	104,000	15
Aromatics (>C_{10}-C_{12})	µg/m^3	15	5,780	5,080	13
Aromatics (>C_{12}-C_{16})	µg/m^3	30	<750	<750	-
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	1,570	1,500	5
Toluene	µg/m^3	0.75	1,280	1,230	4
Ethylbenzene	µg/m^3	0.87	12,600	11,500	9
Xylenes (m & p)	µg/m^3	1.7	106,000	95,800	10
Xylene (o)	µg/m^3	0.87	7,400	6,700	10
Xylenes Total	µg/m^3	2	113,000	102,000	10
Styrene	µg/m^3	0.85	<280	<280	-
F1 (C_6-C_{10})	µg/m^3	15	543,000	478,000	13
F2 (C_{10}-C_{16})	µg/m^3	15	67,600	59,700	12
Alcohols					
Isopropanol	µg/m^3	2.5	<61	<61	-
High Level Fixed Gases					
Nitrogen	%	1	3.4	2.4	-
Oxygen	%	0.1	0.87	0.57	34
Carbon Dioxide	%	0.05	30.6	26.7	13
Carbon Monoxide	%	0.05	<0.050	<0.050	-
Methane	%	0.05	57.8	58.8	2
Hydrocarbon Gases (C_1-C_5)					
Methane	%	0.0001	-	-	-
Ethane	%	0.0002	0.0079	0.00747	5
Ethene	%	0.0002	0.0216	0.0223	3
Propane	%	0.0002	0.00027	0.00028	4
Propene	%	0.0002	<0.00020	<0.00020	-
Butane	%	0.0002	<0.00020	<0.00020	-
Pentane	%	0.0002	<0.00020	<0.00020	-
Polycyclic Aromatic Hydrocarbons (PAHs)					
Naphthalene	µg/m^3	2.6	<860	<860	-
Volatile Organic Compounds (VOCs)					
1,1,1-Trichloroethane	µg/m^3	1.1	<360	<360	-
1,1,2,2-Tetrachloroethane	µg/m^3	1.4	<450	<450	-
1,1,2-Trichloroethane	µg/m^3	1.1	<360	<360	-
1,1-Dichloroethane	µg/m^3	0.81	<260	<260	-
1,1-Dichloroethene	µg/m^3	0.79	<260	<260	-
1,2,4-Trichlorobenzene	µg/m^3	1.5	<490	<490	-
1,2,4-Trimethylbenzene	µg/m^3	0.98	9,100	7,400	21
1,2-Dibromoethane	µg/m^3	1.5	<500	<500	-
1,2-Dichlorobenzene	µg/m^3	1.2	<390	<390	-
1,2-Dichloroethane	µg/m^3	0.81	<260	<260	-
1,2-Dichloroethene (cis)	µg/m^3	0.79	<260	<260	-
1,2-Dichloroethene (trans)	µg/m^3	0.79	1,100	1,110	1
1,2-Dichloropropane	µg/m^3	0.92	<300	<300	-
1,2-Dichlorotetrafluoroethane	µg/m^3	1.4	2,980	3,020	1
1,3,5-Trimethylbenzene	µg/m^3	0.98	5,090	4,250	18
1,3-Butadiene	µg/m^3	0.44	<140	<140	-
1,3-Dichlorobenzene	µg/m^3	1.2	<390	<390	-
1,3-Dichloropropene [cis]	µg/m^3	0.91	<300	<300	-
1,3-Dichloropropene [trans]	µg/m^3	0.91	<300	<300	-
1,4-Dichlorobenzene	µg/m^3	1.2	<390	<390	-
1,4-Dioxane	µg/m^3	0.72	<240	<240	-
1-Methyl-4 ethyl benzene	µg/m^3	0.98	1,890	1,510	22
2-Butanone (MEK)	µg/m^3	0.59	<190	<190	-
2-Hexanone (MBK)	µg/m^3	4.1	<1,600	<1,600	-
4-Methyl-2-pentanone (MIBK)	µg/m^3	0.82	<270	<270	-
Acetone	µg/m^3	1.2	840	<390	-
Allyl chloride	µg/m^3	0.63	<200	<200	-
Benzyl chloride	µg/m^3	1	<340	<340	-
Bromodichloromethane	µg/m^3	1.3	<440	<440	-
Bromoform	µg/m^3	2.1	<680	<680	-
Bromomethane	µg/m^3	0.78	<250	<250	-
Carbon disulfide	µg/m^3	0.62	<200	<200	-
Carbon tetrachloride	µg/m^3	1.3	<410	<410	-
Chlorobenzene	µg/m^3	0.92	<300	<300	-
Chloroethane	µg/m^3	0.53	430	470	9
Chloroform	µg/m^3	0.98	<320	<320	-
Chloromethane	µg/m^3	0.41	<140	<140	-
Cyclohexane	µg/m^3	0.69	2,290	2,380	4
Dibromochloromethane	µg/m^3	1.7	<560	<560	-
Dichlorodifluoromethane	µg/m^3	0.99	217,000	241,000	10
Ethyl acetate	µg/m^3	0.72	<240	<240	-
Freon 113	µg/m^3	1.5	<500	<500	-

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(%)=(|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-05	19DUP01	RPD (%)
		Sample Date	6-Dec-2019	6-Dec-2019	
		Lab Report Number	L2393575	L2393575	
		Laboratory ID	L2393575-5 / L2393575-11	L2393575-6	
Parameter	**Unit**	**RDL**			
Volatile Organic Compounds (VOCs)					
Heptane	µg/m^3	0.82	6,100	6,100	0
Hexachlorobutadiene	µg/m^3	2.1	<700	<700	-
Hexane	µg/m^3	0.7	2,940	2,890	2
Isooctane	µg/m^3	0.93	520	540	4
iso-Propylbenzene (cumene)	µg/m^3	0.98	990	880	12
Methyl t-Butyl Ether (MTBE)	µg/m^3	0.72	<240	<240	-
Methylene Chloride	µg/m^3	0.69	<230	<230	-
Propene	µg/m^3	0.34	<110	<110	-
Tetrachloroethene	µg/m^3	1.4	<440	<440	-
Tetrahydrofuran	µg/m^3	0.59	<190	<190	-
Trichloroethene	µg/m^3	1.1	<350	<350	-
Trichlorofluoromethane	µg/m^3	1.1	<370	<370	-
Vinyl acetate	µg/m^3	1.8	<580	<580	-
Vinyl bromide (bromoethene)	µg/m^3	0.87	<290	<290	-
Vinyl chloride	µg/m^3	0.51	550	570	4

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(%)=(|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:

cm^2/s Square centimetres per second.
F1 Fraction 1 (C6-C10).
F2 Fraction 2 (C>10-C16).
mg/m^3 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	Residential Land Use
			Basement
L_B	Building length	cm	1,225
W_B	Building width	cm	1,225
A_B	Building area exposed to soil, including basement wall area	cm^2	2.7E+06
H_B	Building height	cm	360
L_{crack}	Thickness of the foundation	cm	11.25
A_{crack}	Area of cracks through which contaminant vapours enter the building	cm^2	994.5
ACH	Air exchanges per hour	h^{-1}	0.5

Notes:

Values taken from CCME (2014).

cm Centimetre.

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

Notes:

mg/m^3 Milligrams per cubic metre.
µg/m^3 Micrograms per cubic metre.

Table 10: Soil Vapour Risk Evaluation

Parameter	Unit	Soil Vapour Screening Criteria [a]	Soil Vapour Results (µg/m³)						Comparisons of Soil Vapour Measurements to Soil Vapour Criteria											
									Estimated Cancer Risk [b]						Estimated Hazard Quotients [c]					
			VW-01	VW-02	VW-03	VW-04	VW-05	19DUP01	VW-01	VW-02	VW-03	VW-04	VW-05	19DUP01	VW-01	VW-02	VW-03	VW-04	VW-05	19DUP01
Benzene	µg/m³	195	9.62	1.41	11.6	6.56	1,570	1,500	4.9E-07	7.2E-08	5.9E-07	3.4E-07	8.1E-05	7.7E-05	--	--	--	--		--
Toluene	µg/m³	124,220	18.7	1.05	8.91	2.15	1,280	1,230	-	-	-	-	-	-	1.51E-04	8.45E-06	7.17E-05	1.73E-05	1.03E-02	9.90E-03
Ethylbenzene	µg/m³	34,330	<0.87	<0.87	2.42	1.08	12,600	11,500	-	-	-	-	-	-	ND	ND	7.05E-05	3.15E-05	3.67E-01	3.35E-01
Xylenes Total	µg/m³	6,330	3.1	<2.0	42.7	61.2	113,000	102,000	-	-	-	-	-	-	4.90E-04	ND	6.75E-03	9.67E-03	1.79E+01	1.61E+01
F1 (C_6-C_{10})	µg/m³	867,383	175	63	1,410	448	543,000	478,000	-	-	-	-	-	-	2.02E-04	7.26E-05	1.63E-03	5.16E-04	6.26E-01	5.51E-01
F2 (C_{10}-C_{16})	µg/m³	52,495	38	<15	375	<15	67,600	59,700	-	-	-	-	-	-	7.24E-04	ND	7.14E-03	ND	1.29E+00	1.14E+00
Aliphatics (C_6-C_8)	µg/m³	740,737	73	45	912	196	56,900	50,600	-	-	-	-	-	-	9.86E-05	6.08E-05	1.23E-03	2.65E-04	7.68E-02	6.83E-02
Aliphatics (>C_8-C_{10})	µg/m³	40,257	101	27	615	247	331,000	290,000	-	-	-	-	-	-	2.51E-03	6.71E-04	1.53E-02	6.14E-03	8.22E+00	7.20E+00
Aliphatics (>C_{10}-C_{12})	µg/m³	40,257	17	<15	223	<15	37,500	32,800	-	-	-	-	-	-	4.22E-04	ND	5.54E-03	ND	9.32E-01	8.15E-01
Aromatics (>C_8-C_{10})	µg/m³	805	<15	<15	65	45	121,000	104,000	-	-	-	-	-	-	ND	ND	8.07E-02	5.59E-02	1.50E+02	1.29E+02
Aromatics (>C_{10}-C_{12})	µg/m³	8,051	<15	<15	<15	<15	5,780	5,080	-	-	-	-	-	-	ND	ND	ND	ND	7.18E-01	6.31E-01
Isopropanol	µg/m³	6,219	3.6	<2.5	<2.5	6.0	<61	<61	-	-	-	-	-	-	5.79E-04	ND	ND	9.65E-04	ND	ND
1,2,4-Trimethylbenzene	µg/m³	2,235	<0.98	<0.98	7.07	1.38	9,100	7,400	-	-	-	-	-	-	ND	ND	3.16E-03	6.17E-04	4.07E+00	3.31E+00
1,2-Dichloroethene (cis)	µg/m³	242	<0.79	<0.79	3,140	1.14	<260*	<260*	-	-	-	-	-	-	ND	ND	1.30E+01	4.71E-03	ND	ND
1,2-Dichloroethene (trans)	µg/m³	245	<0.79	<0.79	116	5.18	1,100	1,110	-	-	-	-	-	-	ND	ND	4.73E-01	2.11E-02	4.49E+00	4.53E+00
1,2-Dichlorotetrafluoroethane	µg/m³	566,335	<1.4	<1.4	48.3	3.6	2,980	3,020	-	-	-	-	-	-	ND	ND	8.53E-05	6.36E-06	5.26E-03	5.33E-03
1,3,5-Trimethylbenzene	µg/m³	2,235	<0.98	<0.98	3.24	1.28	5,090	4,250	-	-	-	-	-	-	ND	ND	1.45E-03	5.73E-04	2.28E+00	1.90E+00
1-Methyl-4 ethyl benzene	µg/m³	14,461	<0.98	<0.98	1.59	<0.98	1,890	1,510	-	-	-	-	-	-	ND	ND	1.10E-04	ND	1.31E-01	1.04E-01
2-Butanone (MEK)	µg/m³	167,364	1.67	0.78	0.87	1.76	<190	<190	-	-	-	-	-	-	9.98E-06	4.66E-06	5.20E-06	1.05E-05	ND	ND
Acetone	µg/m³	918,788	22.8	8.0	<9.8	14.6	840	<390	-	-	-	-	-	-	2.48E-05	8.71E-06	ND	1.59E-05	9.14E-04	ND
Carbon disulfide	µg/m³	21,713	1.97	3.67	3.84	4.41	<200	<200	-	-	-	-	-	-	9.07E-05	1.69E-04	1.77E-04	2.03E-04	ND	ND
Chloroethane	µg/m³	31,019	<0.53	<0.53	11.8	1.82	430	470	-	-	-	-	-	-	ND	ND	3.80E-04	5.87E-05	1.39E-02	1.52E-02
Chloromethane	µg/m³	2,657	1.39	1.46	1.32	1.98	<140	<140	-	-	-	-	-	-	5.23E-04	5.49E-04	4.97E-04	7.45E-04	ND	ND
Cyclohexane	µg/m³	201,510	3.66	0.72	71.8	11.8	2,290	2,380	-	-	-	-	-	-	1.82E-05	3.57E-06	3.56E-04	5.86E-05	1.14E-02	1.18E-02
Dichlorodifluoromethane	µg/m³	3,584	5.73	2.42	18.7	128	217,000	241,000	-	-	-	-	-	-	1.60E-03	6.75E-04	5.22E-03	3.57E-02	6.05E+01	6.72E+01
Ethyl acetate	µg/m³	2,509	5.75	<0.72	<0.72	-	<240	<240	-	-	-	-	-	-	2.29E-03	ND	ND	ND	ND	ND
Heptane	µg/m³	14,461	2.38	<0.82	17.6	12.4	6,100	6,100	-	-	-	-	-	-	1.65E-04	ND	1.22E-03	8.57E-04	4.22E-01	4.22E-01
Hexane	µg/m³	18,839	7.59	1.6	46.3	14.5	2,940	2,890	-	-	-	-	-	-	4.03E-04	8.49E-05	2.46E-03	7.70E-04	1.56E-01	1.53E-01
Isooctane	µg/m³	14,917	<0.93	<0.93	29.7	2.68	520	540	-	-	-	-	-	-	ND	ND	1.99E-03	1.80E-04	3.49E-02	3.62E-02
iso-Propylbenzene (cumene)	µg/m³	14,461	1.13	<0.98	<0.98	<0.98	990	880	-	-	-	-	-	-	7.81E-05	ND	ND	ND	6.85E-02	6.09E-02
Methyl t-Butyl Ether (MTBE)	µg/m³	1,153	4.72	<0.72	<0.72	<0.72	<240	<240	-	-	-	-	-	-	4.09E-03	ND	ND	ND	ND	ND
Methylene Chloride	µg/m³	18,764 / 62,546 [e]	1.80	<0.69	<0.69	<0.69	<230	<230	2.9E-10	ND	ND	ND	ND	ND	9.59E-05	ND	ND	ND	ND	ND
Trichlorofluoromethane	µg/m³	6,586	1.3	1.8	<1.1	3.5	<370	<370	-	-	-	-	-	-	1.97E-04	2.73E-04	ND	5.31E-04	ND	ND
Vinyl chloride	µg/m³	3,086 / 140 [e]	<0.51	<0.51	5,220	2.44	550	570	ND	ND	3.7E-04	1.7E-07	3.9E-05	4.1E-05	ND	ND	1.69E+00	7.91E-04	1.78E-01	1.85E-01
Cumulative Risk and Hazard Index [d]									4.9E-07	7.2E-08	**3.7E-04**	5.1E-07	**1.2E-04**	**1.2E-04**	0.015	0.003	**15**	0.140	**253**	**234**
Target Risk and Hazard Levels									**1.0×10^{-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 exceed 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}.

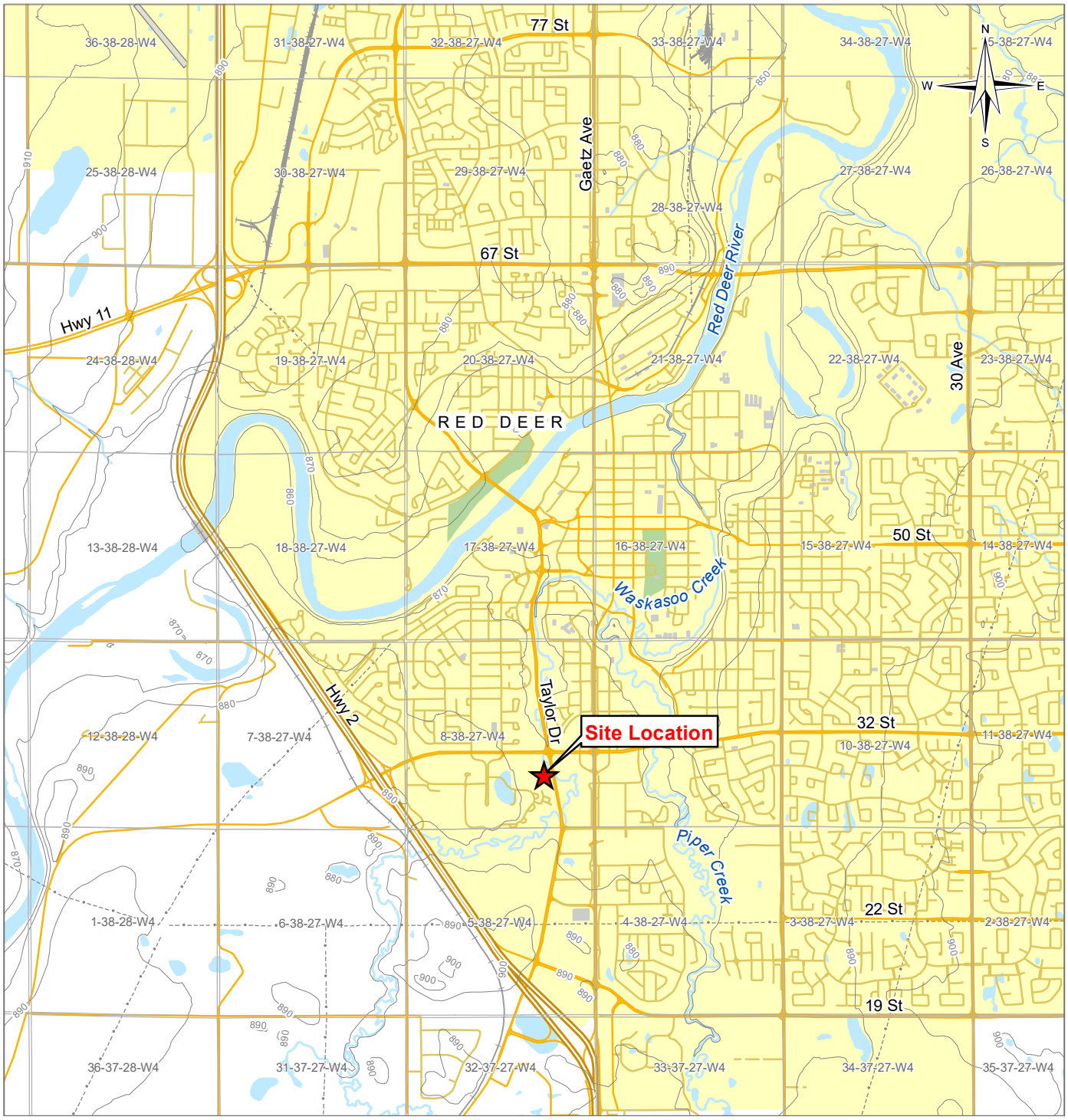
[c] Estimated hazard quotient = (soil vapour concentration/non-cancer soil vapour screening level).

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

[e] Soil vapour screening criteria shows both the threshold criteria and non-threshold criteria. Target risk and hazard levels are calculated with the appropriate criteria.

* = Detection limit raised above the criteria.

FIGURES



LEGEND

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

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

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Site Location Plan

PROJECTION	DATUM	CLIENT
3TM 114	NAD83	THE CITY OF Red Deer

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO. SWOP04071-01_Figure1_SiteLocation.mxd

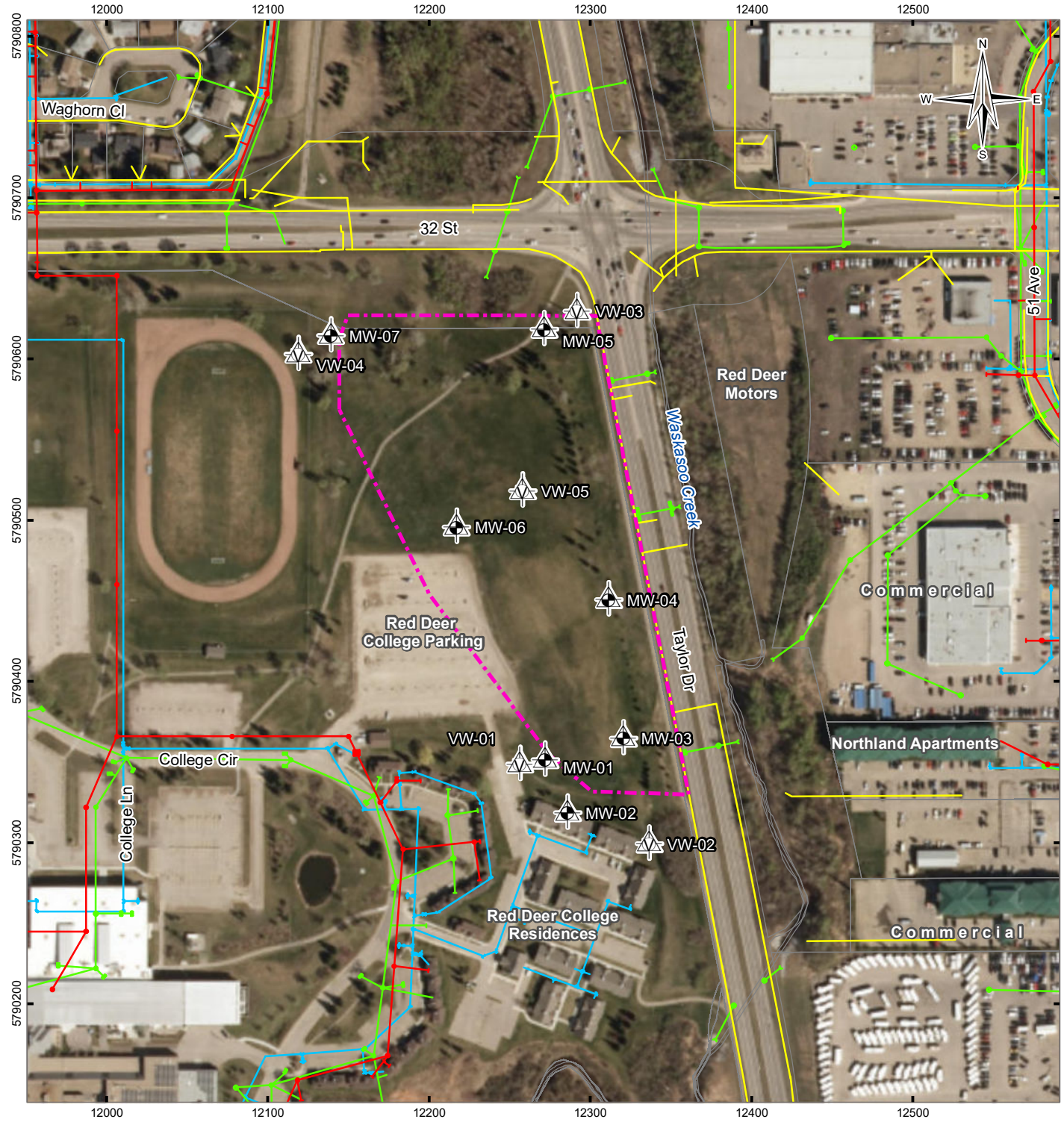
OFFICE	DWN	CKD	APVD	REV
Tt-EDM	MRV	SL	MR	0

DATE	PROJECT NO.
October 16, 2020	SWM.SWOP04071-01.005

TETRA TECH

Figure 1

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Maps\Task005\SWOP04071-01_Figure1_SiteLocation.mxd modified 2020-10-16 by Darren.Schouls



LEGEND

- Monitoring Well
- Vapour Well
- Historic Waste Disposal (Provided by Tiamat, 2014)
- Lot Boundary

Utilities

- Electrical
- Sanitary
- Storm
- Water

NOTES

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

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Site Plan and Surrounding Land Use

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	The City of Red Deer

Scale: 1:3,500
60 30 0 60
Metres

TETRA TECH

FILE NO.
SWOP04071-01_Figure2_LandUse.mxd

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

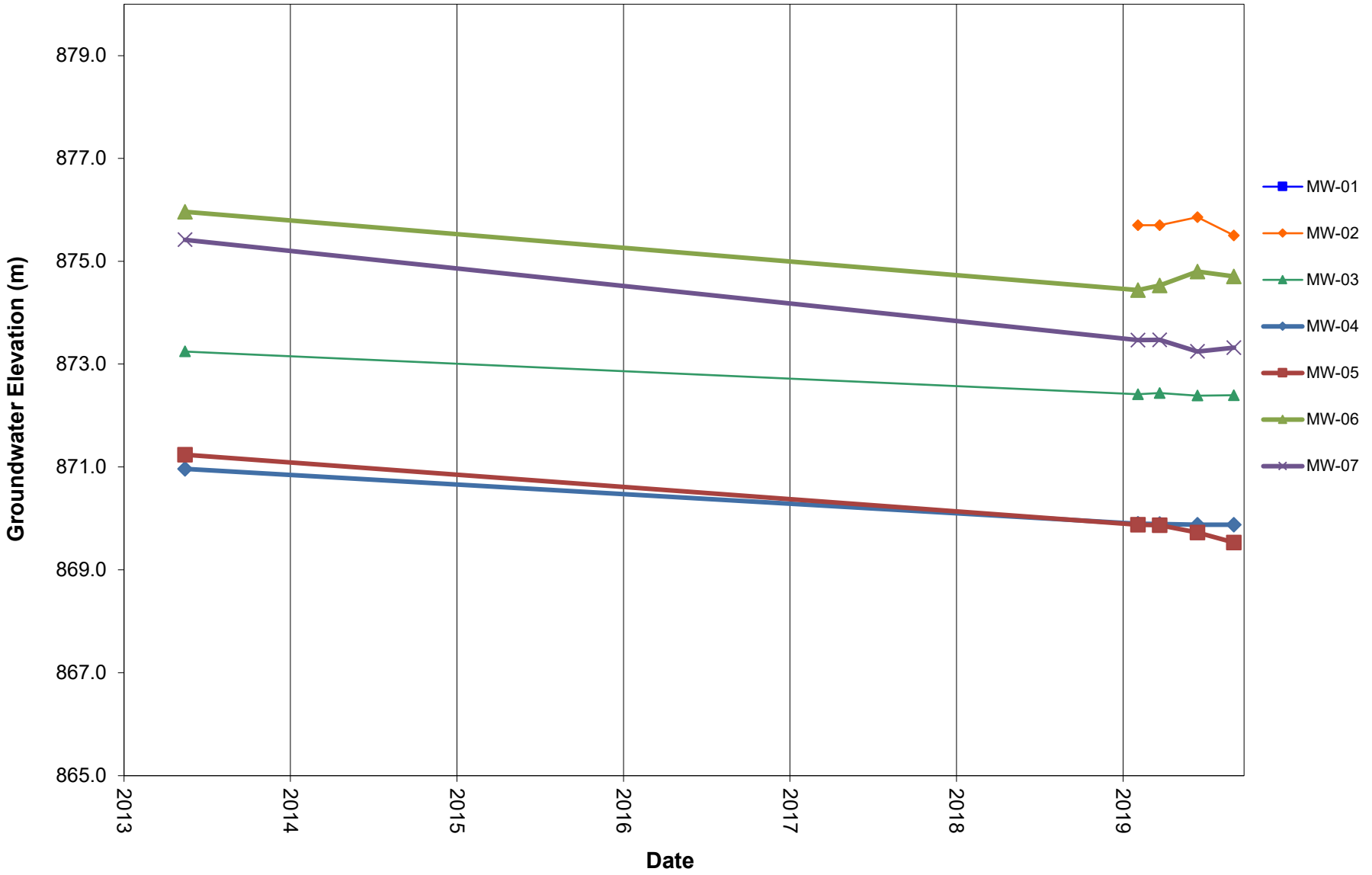
DATE
October 16, 2020

PROJECT NO.
SWM.SWOP04071-01.005

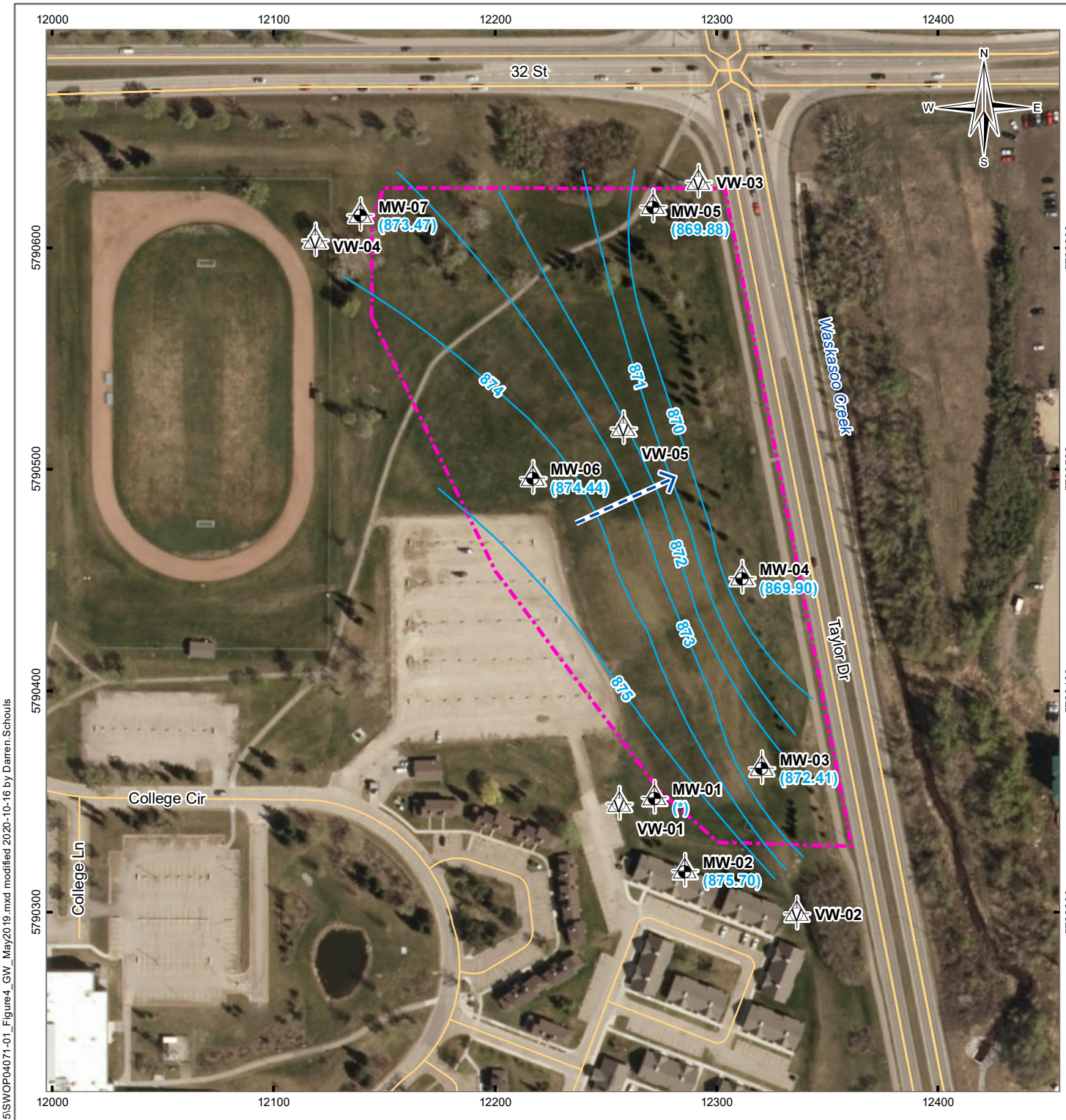
Figure 2

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Mapsl\Task005\SWOP04071-01_Figure2_LandUse.mxd modified 2020-10-16 by Darren.Schouls

FIGURE 3
HISTORICAL GROUNDWATER ELEVATIONS
(GROUNDWATER MONITORING WELLS)



TETRA TECH



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)
- 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
* - damaged

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Groundwater Elevation Contours May 2019

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	The City of Red Deer

Scale: 1:2,500
50 25 0 50
Metres

FILE NO. SWOP04071-01_Figure4_GW_May2019.mxd

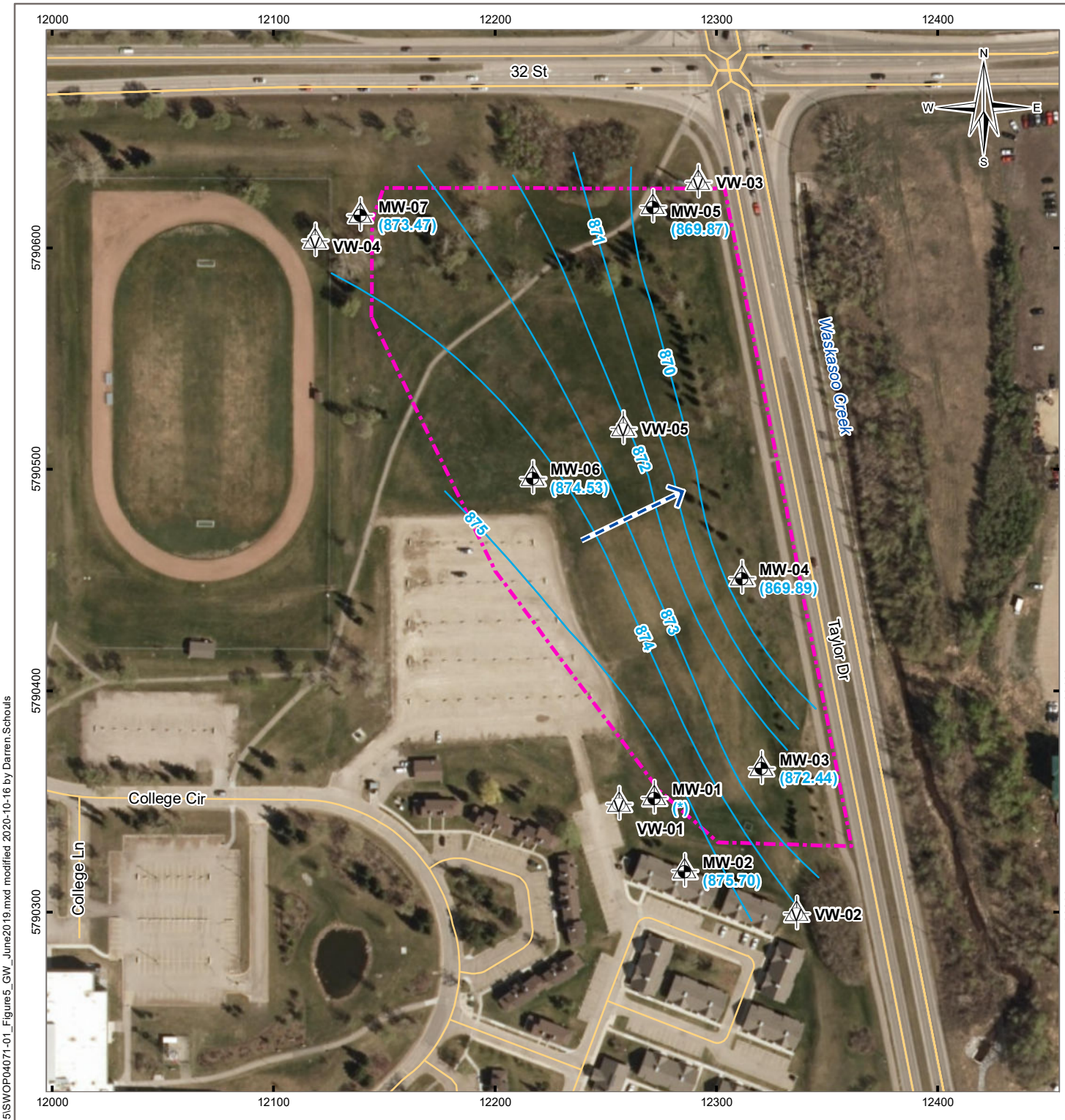
OFFICE	DWN	CKD	APVD	REV
Tt-EDM	MRV	SL	MR	0

DATE October 16, 2020
PROJECT NO. SWM.SWOP04071-01.005

TETRA TECH

Figure 4

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Maps\Task005\SWOP04071-01_Figure4_GW_May2019.mxd modified 2020-10-16 by Darren.Schouls



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)
- 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
* - damaged

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Groundwater Elevation Contours June 2019

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	The City of Red Deer

Scale: 1:2,500
50 25 0 50
Metres

FILE NO. SWOP04071-01_Figure5_GW_June2019.mxd

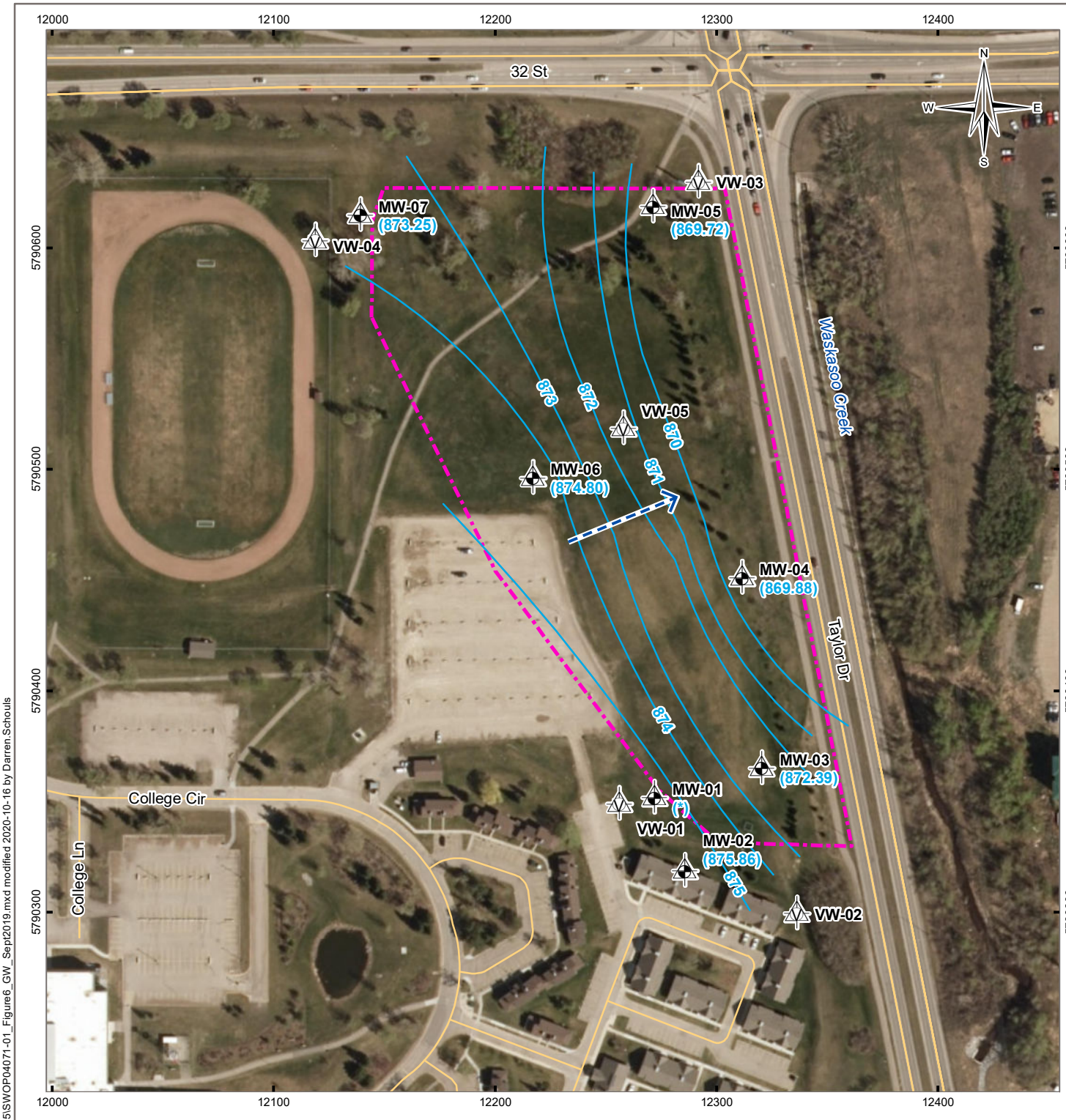
OFFICE	DWN	CKD	APVD	REV
Tt-EDM	MRV	SL	MR	0

DATE	PROJECT NO.
October 16, 2020	SWM.SWOP04071-01.005

TETRA TECH

Figure 5

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Mapsl\Task005\SWOP04071-01_Figure5_GW_June2019.mxd modified 2020-10-16 by Darren.Schouls



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)
- 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
* - damaged

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Groundwater Elevation Contours September 2019

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	The City of Red Deer

Scale: 1:2,500
50 25 0 50
Metres

FILE NO. SWOP04071-01_Figure6_GW_Sept2019.mxd

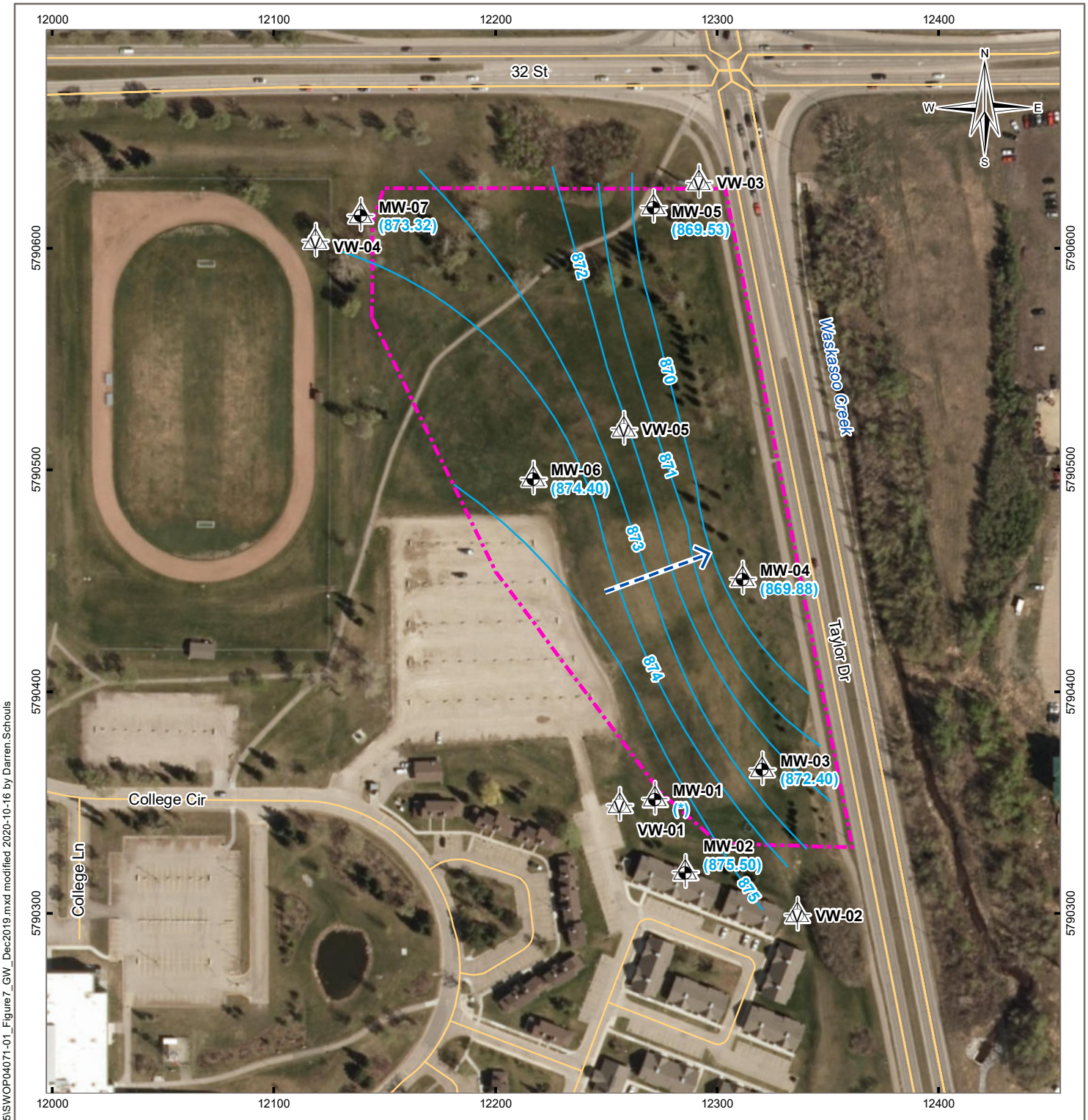
OFFICE	DWN	CKD	APVD	REV
Tt-EDM	MRV	SL	MR	0

DATE October 16, 2020
PROJECT NO. SWM.SWOP04071-01.005

TETRA TECH

Figure 6

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Maps\Task005\SWOP04071-01_Figure6_GW_Sept2019.mxd modified 2020-10-16 by Darren.Schouls



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)
- 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
* - damaged

STATUS
ISSUED FOR USE

2019 GROUNDWATER AND SOIL VAPOUR MONITORING REPORT RED DEER COLLEGE

Groundwater Elevation Contours December 2019

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	The City of Red Deer

Scale: 1:2,500
50 25 0 50
Metres

TETRA TECH

FILE NO.				
SWOP04071-01_Figure7_GW_Dec2019.mxd				
OFFICE	**DWN**	**CKD**	**APVD**	**REV**
Tt-EDM	MRV	SL	MR	0
DATE	**PROJECT NO.**			
October 16, 2020	SWM.SWOP04071-01.005			

Figure 7

Q:\Edmonton\GIS\SOLID_WASTE\SWOP\SWOP04071-01\Mapsl\Task005\SWOP04071-01_Figure7_GW_Dec2019.mxd modified 2020-10-16 by Darren.Schouls

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

1.1 USE OF DOCUMENT AND OWNERSHIP

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

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

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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.

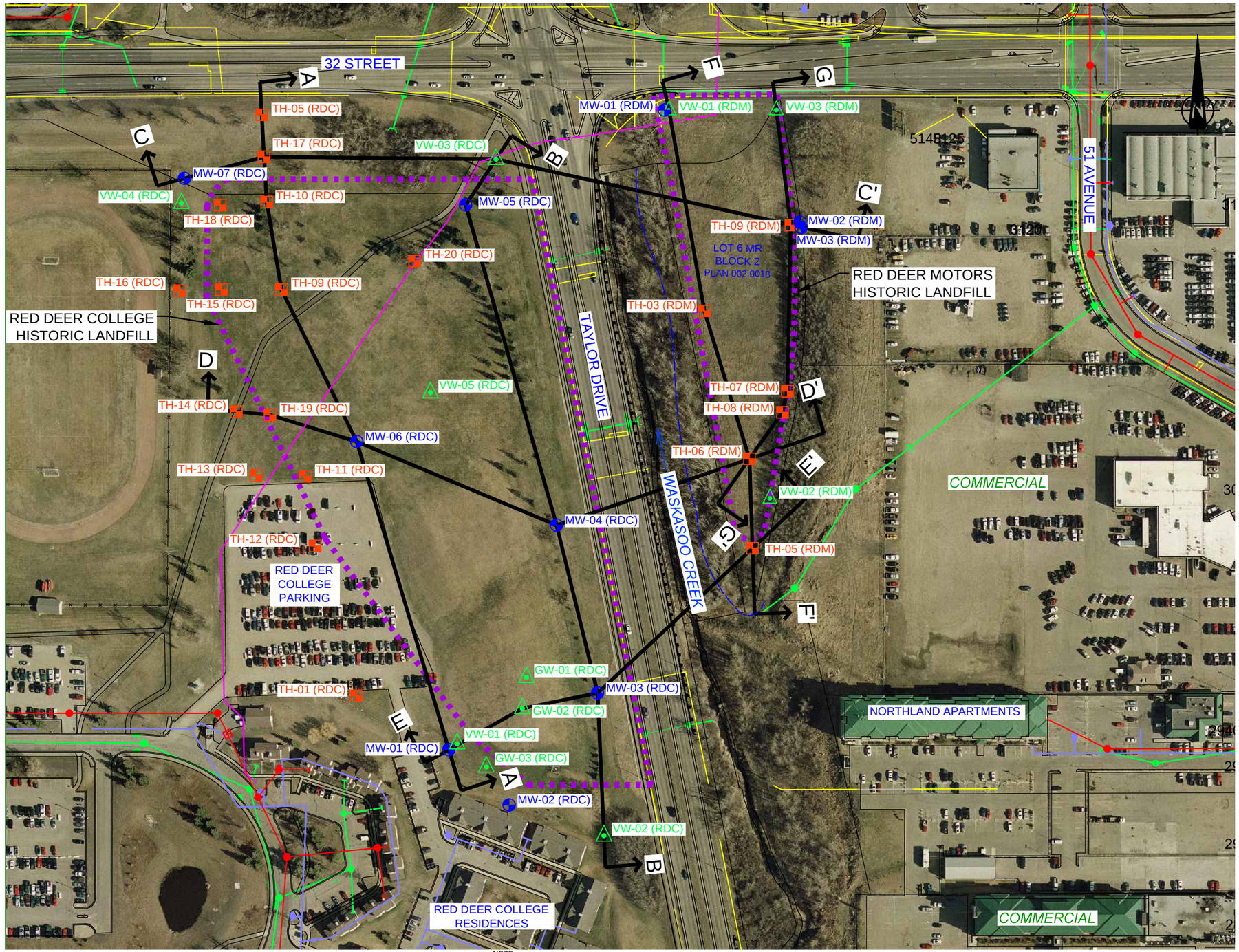
TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

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
2010 ORTHOGRAPHIC IMAGE © COPYRIGHT WITH PERMISSION FROM THE CITY OF RED DEER.

0 20 50 100m
Scale 1:2000

PHASE II TEST LOCATIONS
MW-## GROUNDWATER MONITORING WELL INSTALLED BY TIAMAT
TH-## TESTHOLE
VW-## SOIL VAPOUR MONITORING WELL
MW-## GROUNDWATER MONITORING WELL INSTALLED BY OTHERS
REFER TO TABLE 1 FOR TESTHOLE INFORMATION

LEGEND
HISTORIC WASTE DISPOSAL
LOT BOUNDARY
100 YEAR FLOOD LINE
CROSS SECTION LOCATION
ELECTRICAL
SANITARY
STORM
WATER
PRIVATE COMMUNICATIONS CABLE INSTALLED JULY 2011

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.

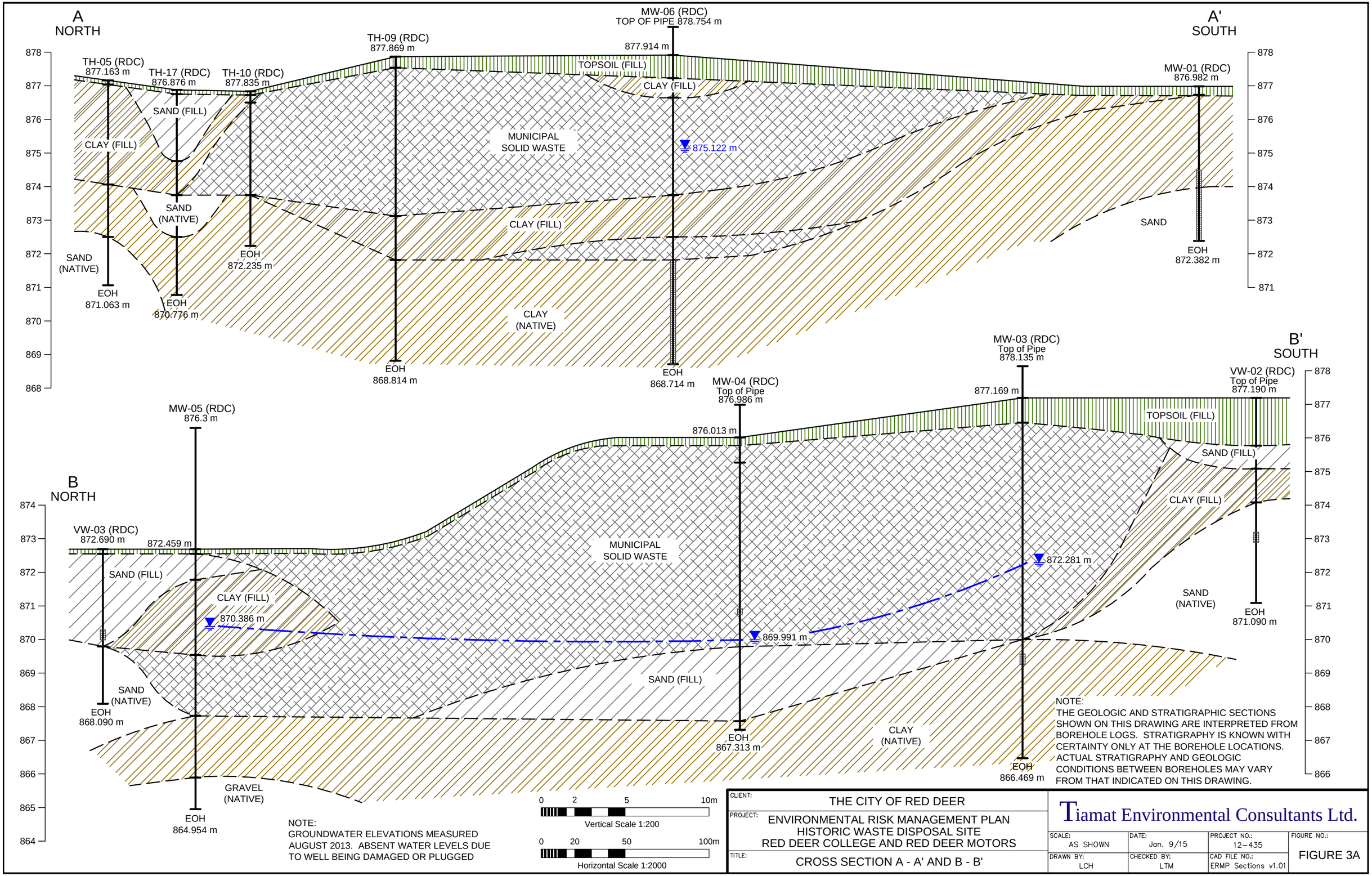
CLIENT: THE CITY OF RED DEER

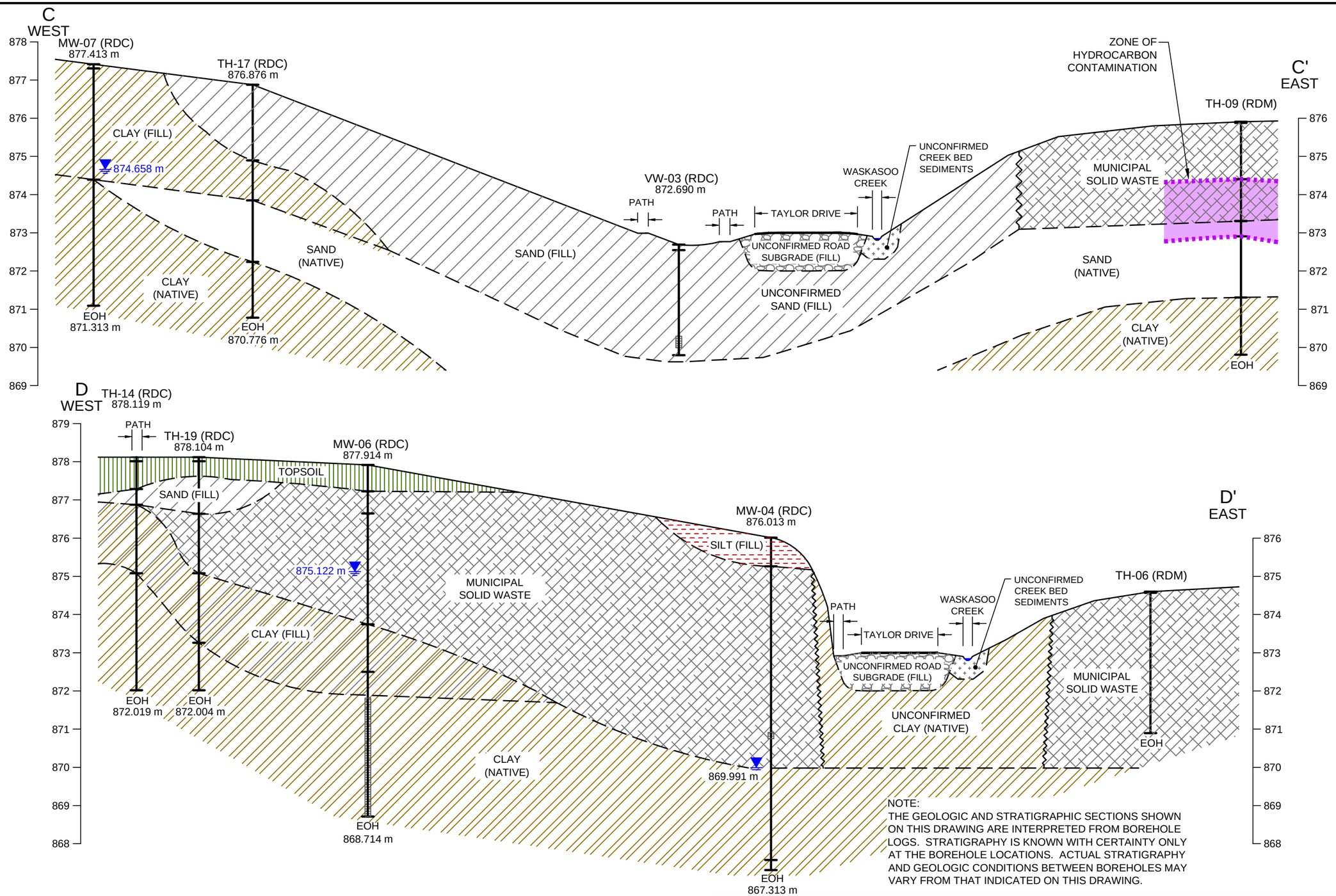
PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN
HISTORIC WASTE DISPOSAL SITE
RED DEER COLLEGE AND RED DEER MOTORS

TITLE: INTERPRETED EXTENT OF WASTE

Tiamat Environmental Consultants Ltd.

SCALE:	DATE:	PROJECT NO.:	FIGURE NO.:
1 : 2000	JAN. 18/15	12-435	FIGURE 2
DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP v1.03	


A
NORTH
A'
SOUTH
TH-05 (RDC)
877.163 m
TH-17 (RDC)
876.876 m
TH-10 (RDC)
877.835 m
TH-09 (RDC)
877.869 m
MW-06 (RDC)
TOP OF PIPE 878.754 m
877.914 m
MW-01 (RDC)
876.982 m
TOPSOIL (FILL)
CLAY (FILL)
SAND (FILL)
CLAY (FILL)
MUNICIPAL
SOLID WASTE
875.122 m
SAND
(NATIVE)
CLAY (FILL)
SAND
SAND
(NATIVE)
EOH
872.235 m
EOH
872.382 m
EOH
871.063 m
EOH
870.776 m
CLAY
(NATIVE)
EOH
868.814 m
EOH
868.714 m
878
877
876
875
874
873
872
871
870
869
868
B
NORTH
B'
SOUTH
MW-05 (RDC)
876.3 m
MW-04 (RDC)
Top of Pipe
876.986 m
MW-03 (RDC)
Top of Pipe
878.135 m
VW-02 (RDC)
Top of Pipe
877.190 m
877.169 m
876.013 m
TOPSOIL (FILL)
SAND (FILL)
CLAY (FILL)
VW-03 (RDC)
872.690 m
872.459 m
MUNICIPAL
SOLID WASTE
872.281 m
SAND
(NATIVE)
EOH
871.090 m
SAND (FILL)
CLAY (FILL)
870.386 m
869.991 m
SAND
(NATIVE)
SAND (FILL)
EOH
868.090 m
CLAY
(NATIVE)
EOH
867.313 m
EOH
866.469 m
GRAVEL
(NATIVE)
EOH
864.954 m
878
877
876
875
874
873
872
871
870
869
868
867
866
874
873
872
871
870
869
868
867
866
865
864
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.
NOTE:
GROUNDWATER ELEVATIONS MEASURED AUGUST 2013. ABSENT WATER LEVELS DUE TO WELL BEING DAMAGED OR PLUGGED
0 2 5 10m
Vertical Scale 1:200
0 20 50 100m
Horizontal Scale 1:2000
CLIENT: THE CITY OF RED DEER
PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN
HISTORIC WASTE DISPOSAL SITE
RED DEER COLLEGE AND RED DEER MOTORS
TITLE: CROSS SECTION A - A' AND B - B'
Tiamat Environmental Consultants Ltd.
SCALE: AS SHOWN
DATE: Jan. 9/15
PROJECT NO.: 12-435
FIGURE NO.: FIGURE 3A
DRAWN BY: LCH
CHECKED BY: LTM
CAD FILE NO.: ERMP Sections v1.01



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.

0 2 5 10m
Vertical Scale 1:200

0 20 50 100m
Horizontal Scale 1:2000

NOTE:
GROUNDWATER ELEVATIONS MEASURED AUGUST 2013. ABSENT WATER LEVELS DUE TO WELL BEING DAMAGED OR PLUGGED

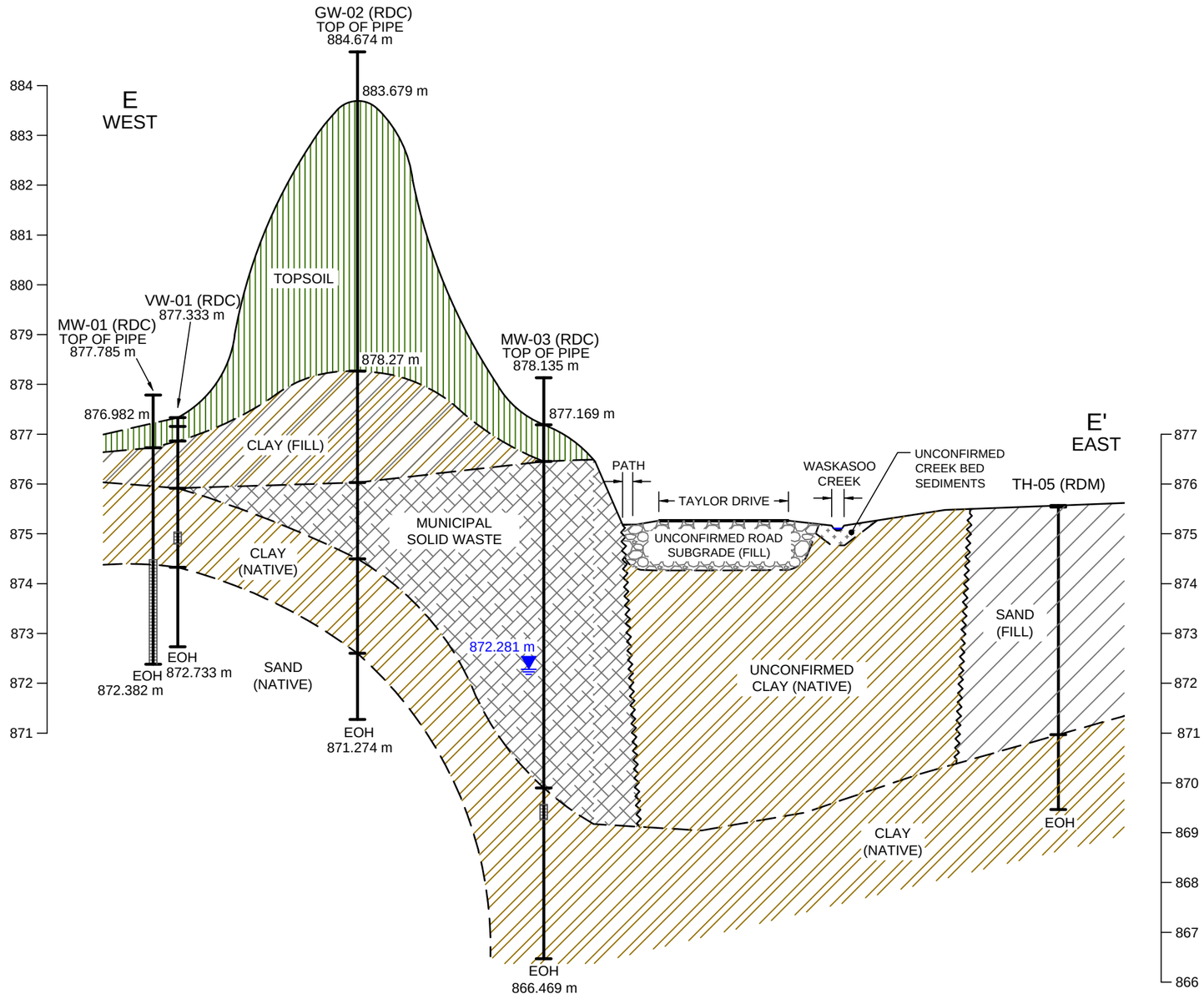
CLIENT: THE CITY OF RED DEER

PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN
HISTORIC WASTE DISPOSAL SITE
RED DEER COLLEGE AND RED DEER MOTORS

TITLE: CROSS SECTION C - C' AND D - D'

Tiamat Environmental Consultants Ltd.

SCALE:	DATE:	PROJECT NO.:	FIGURE NO.:
AS SHOWN	June 27/14	12-435	FIGURE 3B
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.

0 2 5 10m
Vertical Scale 1:200

0 20 50 100m
Horizontal Scale 1:2000

NOTE:
GROUNDWATER ELEVATIONS MEASURED AUGUST 2013. ABSENT WATER LEVELS DUE TO WELL BEING DAMAGED OR PLUGGED

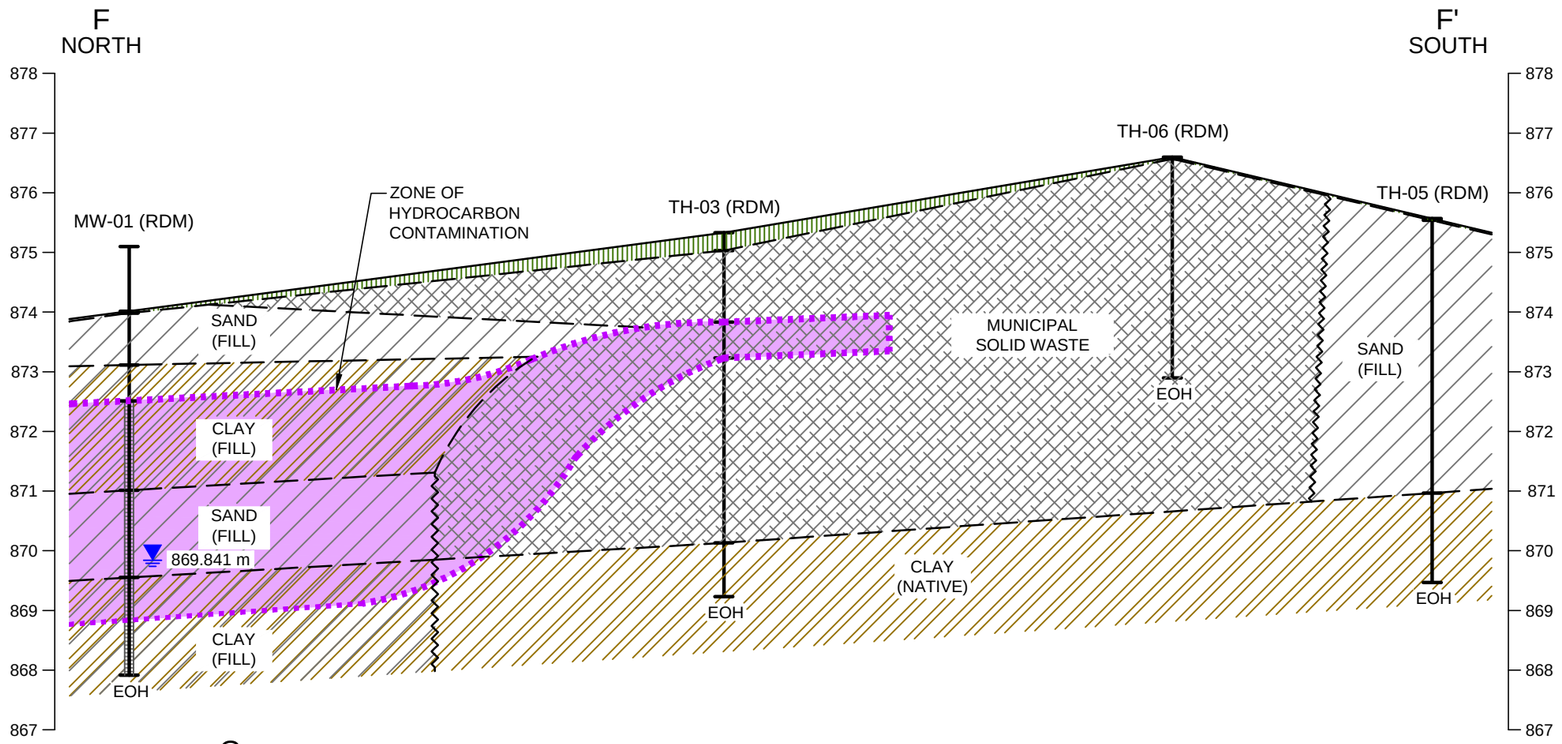
CLIENT: THE CITY OF RED DEER

PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN
HISTORIC WASTE DISPOSAL SITE
RED DEER COLLEGE AND RED DEER MOTORS

TITLE: CROSS SECTION E - E'

Tiamat Environmental Consultants Ltd.

SCALE:	DATE:	PROJECT NO.:	FIGURE NO.:
AS SHOWN	June 27/14	12-435	FIGURE 3C
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.

0 2 5 10m
Vertical Scale 1:200

0 20 50 100m
Horizontal Scale 1:2000

NOTE:
GROUNDWATER ELEVATIONS MEASURED AUGUST 2013. ABSENT WATER LEVELS DUE TO WELL BEING DAMAGED OR PLUGGED

CLIENT: THE CITY OF RED DEER

PROJECT: ENVIRONMENTAL RISK MANAGEMENT PLAN
HISTORIC WASTE DISPOSAL SITE
RED DEER COLLEGE AND RED DEER MOTORS

TITLE: CROSS SECTION F - F' AND G - G'

Tiamat Environmental Consultants Ltd.

SCALE:	DATE:	PROJECT NO.:	FIGURE NO.:
AS SHOWN	June 27/14	12-435	FIGURE 3D
DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: ERMP Sections v1.00	

APPENDIX C

WATER WELL DATA

Reconnaissance Report

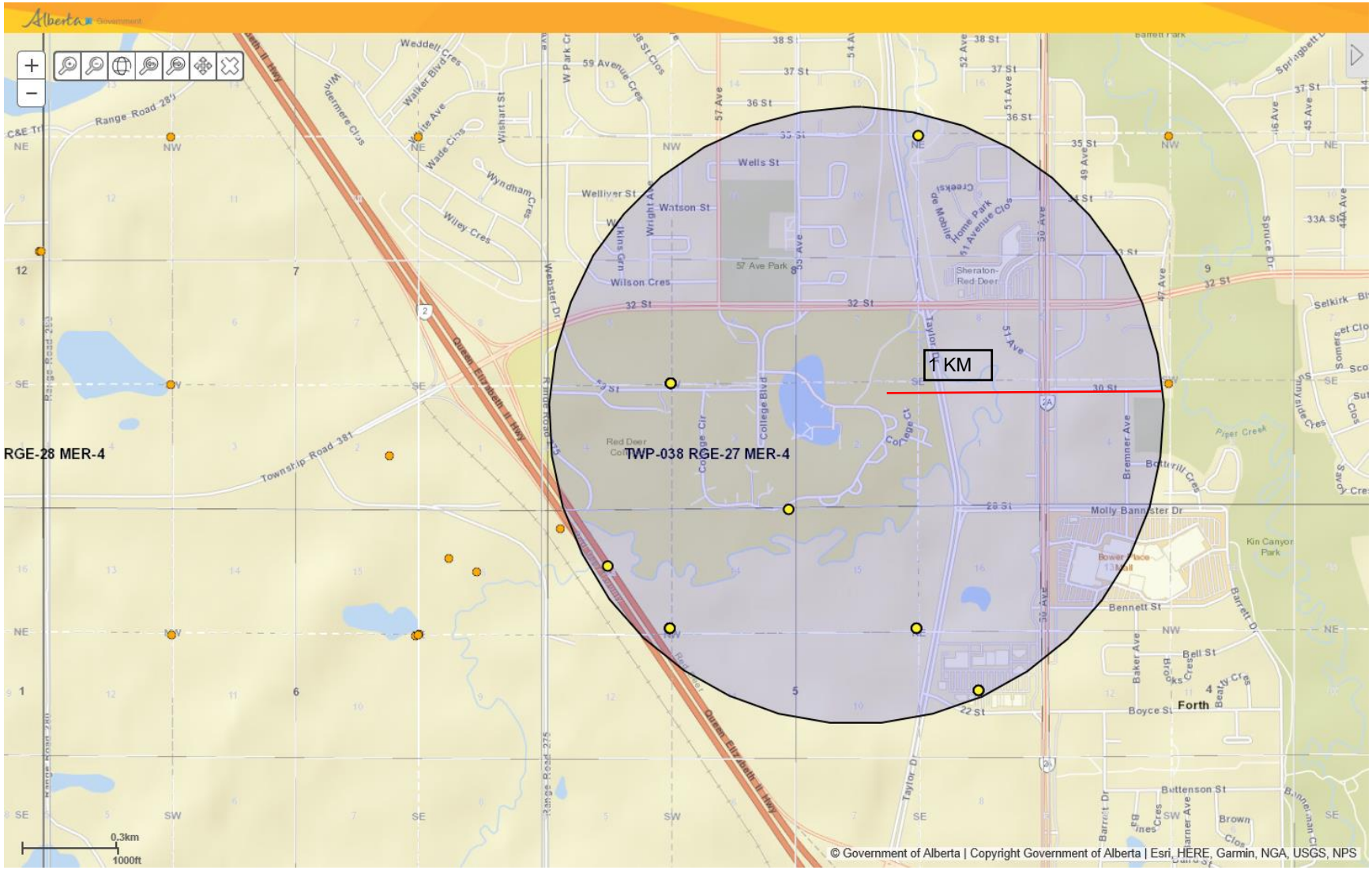
View in Metric

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)
96111	NW	5	38	27	4	UNKNOWN DRILLER		135.00	Chemistry	Domestic	1			SOLTICE, G.E.			0.00
96112	NW	5	38	27	4	UNKNOWN DRILLER		80.00	Chemistry	Domestic	1			CAMERON, ROSS			0.00
96113	NW	5	38	27	4	UNKNOWN DRILLER		0.00	Chemistry	Domestic				RED DEER COLLEGE			0.00
96114	13	5	38	27	4	GERMAN R E	1961-01-01	190.00	New Well	Unknown	1	4	1	LEA, W.N.	95.00	4.00	4.00
96115	9	5	38	27	4	FORRESTER DRILLING	1961-05-12	270.00	New Well	Industrial	3	11	1	CHRYSLER CORP OF CAN LTD	63.00	15.00	7.00
96115	9	5	38	27	4	AERO DRILLING & CONSULTING LTD.	2002-04-19	270.00	Existing Well-Decommissioned	Industrial				CHRYSLER CORP OF CAN			0.00
96136	SW	8	38	27	4	FORRESTER DRILLING	1974-12-17	137.00	New Well	Domestic		11		BANTING, LAWRENCE A.	47.00	15.00	6.63
96137	SW	8	38	27	4	BRADY C	1922-01-01	110.00	Federal Well Survey	Domestic & Stock				BANTING			6.00
96138	SW	8	38	27	4	ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION	1986-10-01	198.00	New Well	Other		11		RED DEER COLLEGE# 2417E			0.00
96139	SW	8	38	27	4	ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION	1986-10-01	19.00	New Well	Other		3		RED DEER COLLEGE			0.00
96140	NE	8	38	27	4	RICHMOND WW DRLG	1979-10-26	255.00	New Well	Domestic		6		RUSSELL, MIKE	200.00	8.00	4.50
160374	NE	5	38	27	4	FORRESTER WATER WELL DRILLING (1981) LTD.	1971-11-12	400.00	New Well	Industrial		32	84	DRUMMOND BREWERIES/UNCLE BEN T	61.30	19.29	8.62
160374	NE	5	38	27	4	ALBERTA EAGLE DRILLING LTD.	1990-08-29	400.00	Existing Well-Decommissioned	Industrial				DRUMMOND BREWERIES			0.00
282162	SW	8	38	27	4	FORRESTER WATER WELL DRILLING (1981) LTD.	1981-10-26	180.00	Test Hole	Observation		24		RED DEER COLLEGE	40.00	22.00	7.00
289673	14	5	38	27	4	RANKIN DRILLING	1998-07-31	142.00	New Well	Domestic		13	24	GEORGE, KEVIN	54.00	6.00	5.50
292658	NW	5	38	27	4	ALKEN BASIN DRILLING LTD.	1999-09-08	180.00	New Well	Domestic		15	15	HARTLEY, RICK	57.00	6.00	5.50
299978	9	5	38	27	4	AERO DRILLING & CONSULTING LTD.	2002-04-22	42.00	Existing Well-Decommissioned	Industrial				CHRYSLER CORP OF CAN			0.00


1 KM
TWP-038 RGE-27 MER-4
RGE-28 MER-4
Queen Elizabeth II Hwy
Township Road 381
Range Road 283
Range Road 275
Wilson Cres
Watson St
Wells St
Wellyer St
32 St
30 St
28 St
22 St
College Blvd
College Cir
College Ct
Bremner Ave
Molly Bannister Dr
Bennett St
Boyce St
Forth
Buttenson St
Taylor Dr
Webster Dr
Wiley Cres
Wade Cres
Wyndham Cres
Sheraton-Red Deer
Kin Canyon Park
Piper Creek
0.3km
1000ft
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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: 24-DEC-19 13:28 (MT)
Version: FINAL

Client Phone: 403-203-3355

Certificate of Analysis

Lab Work Order #: L2393575

Project P.O. #: SWM.SWOP04071-01.005
Job Reference: SWM.SWOP04071-01.005 (RED DEER COLLEGE)
C of C Numbers:
Legal Site Desc:

Inayat Dhaliwal
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-1 VW-01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:40							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	73		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	101		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	17		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	175		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	38		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	99.8		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	79.7		1.0	%		13-DEC-19	R4944389
Oxygen	21.5		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	0.190		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		22-DEC-19	R4952666
Naphthalene	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	93.3		50-150	%		22-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dibromoethane	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<0.92		0.92	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<0.44		0.44	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666

* 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
L2393575-1 VW-01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:40							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<0.72		0.72	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<4.1		4.1	ug/m3		22-DEC-19	R4952666
2-Hexanone	<1.0		1.0	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Acetone	22.8	DLA	5.9	ug/m3		23-DEC-19	R4952666
Acetone	9.6	DLA	2.5	ppb(V)		23-DEC-19	R4952666
Allyl chloride	<0.63		0.63	ug/m3		22-DEC-19	R4952666
Allyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Benzene	9.62		0.64	ug/m3		22-DEC-19	R4952666
Benzene	3.01		0.20	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<1.0		1.0	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromoform	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Bromoform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromomethane	<0.78		0.78	ug/m3		22-DEC-19	R4952666
Bromomethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	1.97		0.62	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	0.63		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<0.92		0.92	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroethane	<0.53		0.53	ug/m3		22-DEC-19	R4952666
Chloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroform	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Chloroform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloromethane	1.39		0.41	ug/m3		22-DEC-19	R4952666
Chloromethane	0.67		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Cyclohexane	3.66		0.69	ug/m3		22-DEC-19	R4952666
Cyclohexane	1.06		0.20	ppb(V)		22-DEC-19	R4952666
Dibromochloromethane	<1.7		1.7	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	5.73		0.99	ug/m3		22-DEC-19	R4952666
Dichlorodifluoromethane	1.16		0.20	ppb(V)		22-DEC-19	R4952666
Ethyl acetate	5.75		0.72	ug/m3		22-DEC-19	R4952666
Ethyl acetate	1.60		0.20	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Ethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 113	<1.5		1.5	ug/m3		22-DEC-19	R4952666
Freon 113	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 114	<1.4		1.4	ug/m3		22-DEC-19	R4952666

* 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
L2393575-1 VW-01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:40							
Matrix: SG							
Canister EPA TO-15							
Freon 114	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Hexachlorobutadiene	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isooctane	<0.93		0.93	ug/m3		22-DEC-19	R4952666
Isooctane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isopropyl alcohol	3.6		2.5	ug/m3		22-DEC-19	R4952666
Isopropyl alcohol	1.5		1.0	ppb(V)		22-DEC-19	R4952666
Isopropylbenzene	1.13		0.98	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	0.23		0.20	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	3.1		1.7	ug/m3		22-DEC-19	R4952666
m&p-Xylene	0.72		0.40	ppb(V)		22-DEC-19	R4952666
Methyl ethyl ketone	1.67		0.59	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	0.57		0.20	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.82		0.82	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Methylene chloride	1.80		0.69	ug/m3		22-DEC-19	R4952666
Methylene chloride	0.52		0.20	ppb(V)		22-DEC-19	R4952666
MTBE	4.72		0.72	ug/m3		22-DEC-19	R4952666
MTBE	1.31		0.20	ppb(V)		22-DEC-19	R4952666
n-Heptane	2.38		0.82	ug/m3		22-DEC-19	R4952666
n-Heptane	0.58		0.20	ppb(V)		22-DEC-19	R4952666
n-Hexane	7.59		0.70	ug/m3		22-DEC-19	R4952666
n-Hexane	2.15		0.20	ppb(V)		22-DEC-19	R4952666
o-Xylene	<0.87		0.87	ug/m3		22-DEC-19	R4952666
o-Xylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Propylene	<0.34		0.34	ug/m3		22-DEC-19	R4952666
Propylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Styrene	<0.85		0.85	ug/m3		22-DEC-19	R4952666
Styrene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<1.4		1.4	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<0.59		0.59	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Toluene	18.7	DLA	3.8	ug/m3		23-DEC-19	R4952666
Toluene	5.0	DLA	1.0	ppb(V)		23-DEC-19	R4952666
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<1.1		1.1	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	1.3		1.1	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	0.23		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<1.8		1.8	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	<0.51		0.51	ug/m3		22-DEC-19	R4952666
Vinyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	93.3		50-150	%		22-DEC-19	R4952666
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
L2393575-1 VW-01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:40							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	0.72		0.45	ppb(V)		23-DEC-19	
Xylenes (Total)	3.1		2.0	ug/m3		23-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	-5.3		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0355				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G171				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.115				17-DEC-19	17-DEC-19	R4945043

* 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
L2393575-2 VW-02							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 10:16							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	45		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	27		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	63		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	<15		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	99.2		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	78.0		1.0	%		13-DEC-19	R4944389
Oxygen	21.1		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	0.404		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		22-DEC-19	R4952666
Naphthalene	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	90.4		50-150	%		22-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dibromoethane	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<0.92		0.92	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<0.44		0.44	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666

* 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
L2393575-2 VW-02							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 10:16							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<0.72		0.72	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<4.1		4.1	ug/m3		22-DEC-19	R4952666
2-Hexanone	<1.0		1.0	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Acetone	8.0		1.2	ug/m3		22-DEC-19	R4952666
Acetone	3.39		0.50	ppb(V)		22-DEC-19	R4952666
Allyl chloride	<0.63		0.63	ug/m3		22-DEC-19	R4952666
Allyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Benzene	1.41		0.64	ug/m3		22-DEC-19	R4952666
Benzene	0.44		0.20	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<1.0		1.0	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromoform	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Bromoform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromomethane	<0.78		0.78	ug/m3		22-DEC-19	R4952666
Bromomethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	3.67		0.62	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	1.18		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<0.92		0.92	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroethane	<0.53		0.53	ug/m3		22-DEC-19	R4952666
Chloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroform	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Chloroform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloromethane	1.46		0.41	ug/m3		22-DEC-19	R4952666
Chloromethane	0.71		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Cyclohexane	0.72		0.69	ug/m3		22-DEC-19	R4952666
Cyclohexane	0.21		0.20	ppb(V)		22-DEC-19	R4952666
Dibromochloromethane	<1.7		1.7	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	2.42		0.99	ug/m3		22-DEC-19	R4952666
Dichlorodifluoromethane	0.49		0.20	ppb(V)		22-DEC-19	R4952666
Ethyl acetate	<0.72		0.72	ug/m3		22-DEC-19	R4952666
Ethyl acetate	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Ethylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 113	<1.5		1.5	ug/m3		22-DEC-19	R4952666
Freon 113	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 114	<1.4		1.4	ug/m3		22-DEC-19	R4952666

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-2 VW-02							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 10:16							
Matrix: SG							
Canister EPA TO-15							
Freon 114	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Hexachlorobutadiene	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isooctane	<0.93		0.93	ug/m3		22-DEC-19	R4952666
Isooctane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isopropyl alcohol	<2.5		2.5	ug/m3		22-DEC-19	R4952666
Isopropyl alcohol	<1.0		1.0	ppb(V)		22-DEC-19	R4952666
Isopropylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	<1.7		1.7	ug/m3		22-DEC-19	R4952666
m&p-Xylene	<0.40		0.40	ppb(V)		22-DEC-19	R4952666
Methyl ethyl ketone	0.78		0.59	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	0.27		0.20	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.82		0.82	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Methylene chloride	<0.69		0.69	ug/m3		22-DEC-19	R4952666
Methylene chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
MTBE	<0.72		0.72	ug/m3		22-DEC-19	R4952666
MTBE	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
n-Heptane	<0.82		0.82	ug/m3		22-DEC-19	R4952666
n-Heptane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
n-Hexane	1.60		0.70	ug/m3		22-DEC-19	R4952666
n-Hexane	0.45		0.20	ppb(V)		22-DEC-19	R4952666
o-Xylene	<0.87		0.87	ug/m3		22-DEC-19	R4952666
o-Xylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Propylene	<0.34		0.34	ug/m3		22-DEC-19	R4952666
Propylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Styrene	<0.85		0.85	ug/m3		22-DEC-19	R4952666
Styrene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<1.4		1.4	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<0.59		0.59	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Toluene	1.05		0.75	ug/m3		22-DEC-19	R4952666
Toluene	0.28		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,2-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
trans-1,2-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<1.1		1.1	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	1.8		1.1	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	0.32		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<1.8		1.8	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	<0.51		0.51	ug/m3		22-DEC-19	R4952666
Vinyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	90.4		50-150	%		22-DEC-19	R4952666
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
L2393575-2 VW-02							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 10:16							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	<0.45		0.45	ppb(V)		23-DEC-19	
Xylenes (Total)	<2.0		2.0	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.00023		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	-10.2		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0039				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G111				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.127				17-DEC-19	17-DEC-19	R4945043

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-3 VW-03							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:40							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	912		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	615		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	223		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	65		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	1410		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	375		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	100.2		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	74.0		1.0	%		13-DEC-19	R4944389
Oxygen	2.58		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	16.1		0.050	%		13-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		13-DEC-19	R4944389
Methane	4.63		0.050	%		13-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<2.6		2.6	ug/m3		22-DEC-19	R4952666
Naphthalene	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	94.6		50-150	%		22-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	7.07		0.98	ug/m3		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	1.44		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dibromoethane	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<0.92		0.92	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	3.24		0.98	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	0.66		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<0.44		0.44	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666

* 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
L2393575-3 VW-03							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:40							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<0.72		0.72	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<5.4	DLQ	5.4	ug/m3		22-DEC-19	R4952666
2-Hexanone	<1.3	DLQ	1.3	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	1.59		0.98	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	0.32		0.20	ppb(V)		22-DEC-19	R4952666
Acetone	<9.8	DLQ	9.8	ug/m3		22-DEC-19	R4952666
Acetone	<4.1	DLQ	4.1	ppb(V)		22-DEC-19	R4952666
Allyl chloride	<0.63		0.63	ug/m3		22-DEC-19	R4952666
Allyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Benzene	11.6		0.64	ug/m3		22-DEC-19	R4952666
Benzene	3.63		0.20	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<1.0		1.0	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromoform	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Bromoform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromomethane	<0.78		0.78	ug/m3		22-DEC-19	R4952666
Bromomethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	3.84		0.62	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	1.23		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<0.92		0.92	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroethane	11.8	DLA	2.6	ug/m3		23-DEC-19	R4952666
Chloroethane	4.5	DLA	1.0	ppb(V)		23-DEC-19	R4952666
Chloroform	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Chloroform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloromethane	1.32		0.41	ug/m3		22-DEC-19	R4952666
Chloromethane	0.64		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	3140	DLA	99	ug/m3		23-DEC-19	R4952666
cis-1,2-Dichloroethene	792	DLA	25	ppb(V)		23-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Cyclohexane	71.8	DLA	3.4	ug/m3		23-DEC-19	R4952666
Cyclohexane	20.9	DLA	1.0	ppb(V)		23-DEC-19	R4952666
Dibromochloromethane	<1.7		1.7	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	18.7	AI	0.99	ug/m3		22-DEC-19	R4952666
Dichlorodifluoromethane	3.79	AI	0.20	ppb(V)		22-DEC-19	R4952666
Ethyl acetate	<0.72		0.72	ug/m3		22-DEC-19	R4952666
Ethyl acetate	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	2.42		0.87	ug/m3		22-DEC-19	R4952666
Ethylbenzene	0.56		0.20	ppb(V)		22-DEC-19	R4952666
Freon 113	<1.5		1.5	ug/m3		22-DEC-19	R4952666
Freon 113	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 114	48.3	DLA	7.0	ug/m3		23-DEC-19	R4952666

* 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
L2393575-3 VW-03							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:40							
Matrix: SG							
Canister EPA TO-15							
Freon 114	6.9	DLA	1.0	ppb(V)		23-DEC-19	R4952666
Hexachlorobutadiene	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isooctane	29.7	AI	4.7	ug/m3		23-DEC-19	R4952666
Isooctane	6.4	AI	1.0	ppb(V)		23-DEC-19	R4952666
Isopropyl alcohol	<2.5		2.5	ug/m3		22-DEC-19	R4952666
Isopropyl alcohol	<1.0		1.0	ppb(V)		22-DEC-19	R4952666
Isopropylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	35.0		1.7	ug/m3		22-DEC-19	R4952666
m&p-Xylene	8.07		0.40	ppb(V)		22-DEC-19	R4952666
Methyl ethyl ketone	0.87		0.59	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	0.30		0.20	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.82		0.82	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Methylene chloride	<0.69		0.69	ug/m3		22-DEC-19	R4952666
Methylene chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
MTBE	<0.72		0.72	ug/m3		22-DEC-19	R4952666
MTBE	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
n-Heptane	17.6		0.82	ug/m3		22-DEC-19	R4952666
n-Heptane	4.29		0.20	ppb(V)		22-DEC-19	R4952666
n-Hexane	46.3	DLA	3.5	ug/m3		23-DEC-19	R4952666
n-Hexane	13.1	DLA	1.0	ppb(V)		23-DEC-19	R4952666
o-Xylene	7.62		0.87	ug/m3		22-DEC-19	R4952666
o-Xylene	1.75		0.20	ppb(V)		22-DEC-19	R4952666
Propylene	<0.34		0.34	ug/m3		22-DEC-19	R4952666
Propylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Styrene	<0.85		0.85	ug/m3		22-DEC-19	R4952666
Styrene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<1.4		1.4	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<0.59		0.59	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Toluene	8.91		0.75	ug/m3		22-DEC-19	R4952666
Toluene	2.36		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,2-Dichloroethene	116	DLA	4.0	ug/m3		23-DEC-19	R4952666
trans-1,2-Dichloroethene	29.2	DLA	1.0	ppb(V)		23-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<1.1		1.1	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<1.8		1.8	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	5220	DLA	770	ug/m3		23-DEC-19	R4952666
Vinyl chloride	2040	DLA	300	ppb(V)		23-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	94.6		50-150	%		22-DEC-19	R4952666
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
L2393575-3 VW-03							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:40							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	9.82		0.45	ppb(V)		23-DEC-19	
Xylenes (Total)	42.7		2.0	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	N/A	MP	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	-8.8		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0167				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G157				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.107				17-DEC-19	17-DEC-19	R4945043

* 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
L2393575-4 VW-04							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:19							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	196		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	247		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	45		15	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	<15		15	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<30		30	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	448		15	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	<15		15	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	99.3		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	75.8		1.0	%		13-DEC-19	R4944389
Oxygen	19.6		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	2.84		0.050	%		13-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		13-DEC-19	R4944389
Methane	<0.050		0.050	%		13-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<2.6		2.6	ug/m3		23-DEC-19	R4952666
Naphthalene	<0.50		0.50	ppb(V)		23-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	90.9		50-150	%		23-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<1.4		1.4	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<1.1		1.1	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<0.79		0.79	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	1.38		0.98	ug/m3		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	0.28		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dibromoethane	<1.5		1.5	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<0.81		0.81	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<0.92		0.92	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	1.28		0.98	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	0.26		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<0.44		0.44	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-4 VW-04							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:19							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<1.2		1.2	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<0.72		0.72	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<4.1		4.1	ug/m3		22-DEC-19	R4952666
2-Hexanone	<1.0		1.0	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Acetone	14.6	DLA	5.9	ug/m3		23-DEC-19	R4952666
Acetone	6.1	DLA	2.5	ppb(V)		23-DEC-19	R4952666
Allyl chloride	<0.63		0.63	ug/m3		22-DEC-19	R4952666
Allyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Benzene	6.56		0.64	ug/m3		22-DEC-19	R4952666
Benzene	2.05		0.20	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<1.0		1.0	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromoform	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Bromoform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Bromomethane	<0.78		0.78	ug/m3		22-DEC-19	R4952666
Bromomethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	4.41		0.62	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	1.42		0.20	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<1.3		1.3	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<0.92		0.92	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloroethane	1.82		0.53	ug/m3		22-DEC-19	R4952666
Chloroethane	0.69		0.20	ppb(V)		22-DEC-19	R4952666
Chloroform	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Chloroform	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Chloromethane	1.98		0.41	ug/m3		22-DEC-19	R4952666
Chloromethane	0.96		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	1.14		0.79	ug/m3		22-DEC-19	R4952666
cis-1,2-Dichloroethene	0.29		0.20	ppb(V)		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Cyclohexane	11.8		0.69	ug/m3		22-DEC-19	R4952666
Cyclohexane	3.42		0.20	ppb(V)		22-DEC-19	R4952666
Dibromochloromethane	<1.7		1.7	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	128	DLA	4.9	ug/m3		23-DEC-19	R4952666
Dichlorodifluoromethane	26.0	DLA	1.0	ppb(V)		23-DEC-19	R4952666
Ethyl acetate	1.57	R	0.72	ug/m3		22-DEC-19	R4952666
Ethyl acetate	0.44	R	0.20	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	1.08		0.87	ug/m3		22-DEC-19	R4952666
Ethylbenzene	0.25		0.20	ppb(V)		22-DEC-19	R4952666
Freon 113	<1.5		1.5	ug/m3		22-DEC-19	R4952666
Freon 113	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Freon 114	3.6		1.4	ug/m3		22-DEC-19	R4952666

* 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
L2393575-4 VW-04							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:19							
Matrix: SG							
Canister EPA TO-15							
Freon 114	0.51		0.20	ppb(V)		22-DEC-19	R4952666
Hexachlorobutadiene	<2.1		2.1	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Isooctane	2.68	AI	0.93	ug/m3		22-DEC-19	R4952666
Isooctane	0.57	AI	0.20	ppb(V)		22-DEC-19	R4952666
Isopropyl alcohol	6.0		2.5	ug/m3		22-DEC-19	R4952666
Isopropyl alcohol	2.4		1.0	ppb(V)		22-DEC-19	R4952666
Isopropylbenzene	<0.98		0.98	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	59.0	DLA	8.7	ug/m3		23-DEC-19	R4952666
m&p-Xylene	13.6	DLA	2.0	ppb(V)		23-DEC-19	R4952666
Methyl ethyl ketone	1.76		0.59	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	0.60		0.20	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.82		0.82	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Methylene chloride	<0.69		0.69	ug/m3		22-DEC-19	R4952666
Methylene chloride	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
MTBE	<0.72		0.72	ug/m3		22-DEC-19	R4952666
MTBE	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
n-Heptane	12.4		0.82	ug/m3		22-DEC-19	R4952666
n-Heptane	3.03		0.20	ppb(V)		22-DEC-19	R4952666
n-Hexane	14.5		0.70	ug/m3		22-DEC-19	R4952666
n-Hexane	4.10		0.20	ppb(V)		22-DEC-19	R4952666
o-Xylene	2.23		0.87	ug/m3		22-DEC-19	R4952666
o-Xylene	0.51		0.20	ppb(V)		22-DEC-19	R4952666
Propylene	<0.34		0.34	ug/m3		22-DEC-19	R4952666
Propylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Styrene	<0.85		0.85	ug/m3		22-DEC-19	R4952666
Styrene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<1.4		1.4	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<0.59		0.59	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Toluene	2.15		0.75	ug/m3		22-DEC-19	R4952666
Toluene	0.57		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,2-Dichloroethene	5.18		0.79	ug/m3		22-DEC-19	R4952666
trans-1,2-Dichloroethene	1.31		0.20	ppb(V)		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.91		0.91	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<1.1		1.1	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	3.5		1.1	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	0.62		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<1.8		1.8	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<0.50		0.50	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<0.87		0.87	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<0.20		0.20	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	2.44		0.51	ug/m3		22-DEC-19	R4952666
Vinyl chloride	0.96		0.20	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	90.9		50-150	%		22-DEC-19	R4952666
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
L2393575-4 VW-04							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:19							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	14.1		2.0	ppb(V)		23-DEC-19	
Xylenes (Total)	61.2		8.7	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	0.0108		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	-9.4		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0060				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G224				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.117				17-DEC-19	17-DEC-19	R4945043

* 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
L2393575-5 VW-05							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:05							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	56900	DLHC	380	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	331000	DLA	8100	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	37500	DLHC	380	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<750	DLHC	750	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	121000	DLA	8100	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	5780	DLHC	380	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<750	DLHC	750	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	543000	DLA	8100	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	67600	DLHC	380	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	106.9		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	3.4		1.0	%		13-DEC-19	R4944389
Oxygen	0.87		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	30.6		0.050	%		13-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		13-DEC-19	R4944389
Methane	57.8	DLA	0.10	%		13-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<860	DLM	860	ug/m3		22-DEC-19	R4952666
Naphthalene	<160	DLM	160	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	98.4		50-150	%		22-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<360	DLM	360	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<450	DLM	450	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<360	DLM	360	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<490	DLM	490	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	9100	DLA	1600	ug/m3		23-DEC-19	R4952666
1,2,4-Trimethylbenzene	1850	DLA	330	ppb(V)		23-DEC-19	R4952666
1,2-Dibromoethane	<500	DLM	500	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<300	DLM	300	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	5090	DLM	320	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	1040	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<140	DLM	140	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666

* 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
L2393575-5 VW-05							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:05							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<240	DLM	240	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<1600	DLQ	1600	ug/m3		22-DEC-19	R4952666
2-Hexanone	<380	DLQ	380	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	1890	DLM	320	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	384	DLM	65	ppb(V)		22-DEC-19	R4952666
Acetone	840	DLM	390	ug/m3		22-DEC-19	R4952666
Acetone	360	DLM	160	ppb(V)		22-DEC-19	R4952666
Allyl chloride	<200	DLM	200	ug/m3		22-DEC-19	R4952666
Allyl chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Benzene	1570	DLM	210	ug/m3		22-DEC-19	R4952666
Benzene	491	DLM	65	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<340	DLM	340	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<440	DLM	440	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromoform	<680	DLM	680	ug/m3		22-DEC-19	R4952666
Bromoform	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromomethane	<250	DLM	250	ug/m3		22-DEC-19	R4952666
Bromomethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	<200	DLM	200	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<410	DLM	410	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloroethane	430	DLM	170	ug/m3		22-DEC-19	R4952666
Chloroethane	164	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloroform	<320	DLM	320	ug/m3		22-DEC-19	R4952666
Chloroform	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloromethane	<140	DLM	140	ug/m3		22-DEC-19	R4952666
Chloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<260	DLM	260	ug/m3		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Cyclohexane	2290	DLM	230	ug/m3		22-DEC-19	R4952666
Cyclohexane	667	DLM	65	ppb(V)		22-DEC-19	R4952666
Dibromochloromethane	<560	DLM	560	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	217000	DLA	40000	ug/m3		23-DEC-19	R4952666
Dichlorodifluoromethane	43800	DLA	8200	ppb(V)		23-DEC-19	R4952666
Ethyl acetate	<240	DLM	240	ug/m3		22-DEC-19	R4952666
Ethyl acetate	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	12600	DLA	1400	ug/m3		23-DEC-19	R4952666
Ethylbenzene	2900	DLA	330	ppb(V)		23-DEC-19	R4952666
Freon 113	<500	DLM	500	ug/m3		22-DEC-19	R4952666
Freon 113	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Freon 114	2980	DLM	460	ug/m3		22-DEC-19	R4952666

* 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
L2393575-5 VW-05							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:05							
Matrix: SG							
Canister EPA TO-15							
Freon 114	426	DLM	65	ppb(V)		22-DEC-19	R4952666
Hexachlorobutadiene	<700	DLM	700	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Isooctane	520	AI	310	ug/m3		22-DEC-19	R4952666
Isooctane	112	AI	65	ppb(V)		22-DEC-19	R4952666
Isopropyl alcohol	<61	DLM	61	ug/m3		23-DEC-19	R4952666
Isopropyl alcohol	<25	DLM	25	ppb(V)		23-DEC-19	R4952666
Isopropylbenzene	990	DLM	320	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	201	DLM	65	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	106000	DLA	2800	ug/m3		23-DEC-19	R4952666
m&p-Xylene	24400	DLA	650	ppb(V)		23-DEC-19	R4952666
Methyl ethyl ketone	<190	DLM	190	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<270	DLM	270	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Methylene chloride	<230	DLM	230	ug/m3		22-DEC-19	R4952666
Methylene chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
MTBE	<240	DLM	240	ug/m3		22-DEC-19	R4952666
MTBE	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
n-Heptane	6100	DLA	1300	ug/m3		23-DEC-19	R4952666
n-Heptane	1500	DLA	330	ppb(V)		23-DEC-19	R4952666
n-Hexane	2940	DLM	230	ug/m3		22-DEC-19	R4952666
n-Hexane	836	DLM	65	ppb(V)		22-DEC-19	R4952666
o-Xylene	7400	DLA	1400	ug/m3		23-DEC-19	R4952666
o-Xylene	1700	DLA	330	ppb(V)		23-DEC-19	R4952666
Propylene	<110	DLM	110	ug/m3		22-DEC-19	R4952666
Propylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Styrene	<280	DLM	280	ug/m3		22-DEC-19	R4952666
Styrene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<440	DLM	440	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<190	DLM	190	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Toluene	1280	DLM	250	ug/m3		22-DEC-19	R4952666
Toluene	339	DLM	65	ppb(V)		22-DEC-19	R4952666
trans-1,2-Dichloroethene	1100	DLM	260	ug/m3		22-DEC-19	R4952666
trans-1,2-Dichloroethene	276	DLM	65	ppb(V)		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<350	DLM	350	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	<370	DLM	370	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<580	DLM	580	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<160	DLM	160	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<290	DLM	290	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	550	DLM	170	ug/m3		22-DEC-19	R4952666
Vinyl chloride	214	DLM	65	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	98.4		50-150	%		22-DEC-19	R4952666
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
L2393575-5 VW-05							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 09:05							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	26100		730	ppb(V)		23-DEC-19	
Xylenes (Total)	113000		3200	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	N/A	MP	0.00010	%		10-DEC-19	R4944650
Ethane	0.00790		0.00020	%		10-DEC-19	R4944650
Ethene	0.0216	DLA	0.00040	%		20-DEC-19	R4944650
Propane	0.00027		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	-6.1		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0179				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G131				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.114				17-DEC-19	17-DEC-19	R4945043

* 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
L2393575-6 19DUP01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 12:00							
Matrix: SG							
Total F1 and F2+ Sub Fractionation							
Aliphatic/Aromatic PHC Sub-Fractionation							
Aliphatic C6-C8	50600	DLHC	380	ug/m3		23-DEC-19	R4953011
Aliphatic C>8-C10	290000	DLA	8100	ug/m3		23-DEC-19	R4953011
Aliphatic C>10-C12	32800	DLHC	380	ug/m3		23-DEC-19	R4953011
Aliphatic C>12-C16	<750	DLHC	750	ug/m3		23-DEC-19	R4953011
Aromatic C>8-C10	104000	DLA	8100	ug/m3		23-DEC-19	R4953011
Aromatic C>10-C12	5080	DLHC	380	ug/m3		23-DEC-19	R4953011
Aromatic C>12-C16	<750	DLHC	750	ug/m3		23-DEC-19	R4953011
Total F1and F2 fractions (not corrected)							
F1 (C6-C10)	478000	DLA	8100	ug/m3		23-DEC-19	R4953011
F2 (C10-C16)	59700	DLHC	380	ug/m3		23-DEC-19	R4953011
Surrogate: 4-Bromofluorobenzene	105.0		50-150	%		23-DEC-19	R4953011
High Level Fixed Gases by TCD							
Nitrogen	2.4		1.0	%		13-DEC-19	R4944389
Oxygen	0.57		0.10	%		13-DEC-19	R4944389
Carbon Dioxide	26.7		0.050	%		13-DEC-19	R4944389
Carbon Monoxide	<0.050		0.050	%		13-DEC-19	R4944389
Methane	58.8	DLA	0.10	%		13-DEC-19	R4944389
BTEX and Naphthalene							
Naphthalene	<860	DLM	860	ug/m3		22-DEC-19	R4952666
Naphthalene	<160	DLM	160	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	97.2		50-150	%		22-DEC-19	R4952666
Canister EPA TO-15							
1,1,1-Trichloroethane	<360	DLM	360	ug/m3		22-DEC-19	R4952666
1,1,1-Trichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<450	DLM	450	ug/m3		22-DEC-19	R4952666
1,1,2,2-Tetrachloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1,2-Trichloroethane	<360	DLM	360	ug/m3		22-DEC-19	R4952666
1,1,2-Trichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethane	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,1-Dichloroethene	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,1-Dichloroethene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<490	DLM	490	ug/m3		22-DEC-19	R4952666
1,2,4-Trichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2,4-Trimethylbenzene	7400	DLA	1600	ug/m3		23-DEC-19	R4952666
1,2,4-Trimethylbenzene	1500	DLA	330	ppb(V)		23-DEC-19	R4952666
1,2-Dibromoethane	<500	DLM	500	ug/m3		22-DEC-19	R4952666
1,2-Dibromoethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,2-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichloroethane	<260	DLM	260	ug/m3		22-DEC-19	R4952666
1,2-Dichloroethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,2-Dichloropropane	<300	DLM	300	ug/m3		22-DEC-19	R4952666
1,2-Dichloropropane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	4250	DLM	320	ug/m3		22-DEC-19	R4952666
1,3,5-Trimethylbenzene	864	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3-Butadiene	<140	DLM	140	ug/m3		22-DEC-19	R4952666
1,3-Butadiene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,3-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,3-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666

* 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
L2393575-6 19DUP01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 12:00							
Matrix: SG							
Canister EPA TO-15							
1,4-Dichlorobenzene	<390	DLM	390	ug/m3		22-DEC-19	R4952666
1,4-Dichlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
1,4-Dioxane	<240	DLM	240	ug/m3		22-DEC-19	R4952666
1,4-Dioxane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
2-Hexanone	<1600	DLQ	1600	ug/m3		22-DEC-19	R4952666
2-Hexanone	<380	DLQ	380	ppb(V)		22-DEC-19	R4952666
4-Ethyltoluene	1510	DLM	320	ug/m3		22-DEC-19	R4952666
4-Ethyltoluene	308	DLM	65	ppb(V)		22-DEC-19	R4952666
Acetone	<390	DLM	390	ug/m3		22-DEC-19	R4952666
Acetone	<160	DLM	160	ppb(V)		22-DEC-19	R4952666
Allyl chloride	<200	DLM	200	ug/m3		22-DEC-19	R4952666
Allyl chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Benzene	1500	DLM	210	ug/m3		22-DEC-19	R4952666
Benzene	470	DLM	65	ppb(V)		22-DEC-19	R4952666
Benzyl chloride	<340	DLM	340	ug/m3		22-DEC-19	R4952666
Benzyl chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromodichloromethane	<440	DLM	440	ug/m3		22-DEC-19	R4952666
Bromodichloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromoform	<680	DLM	680	ug/m3		22-DEC-19	R4952666
Bromoform	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Bromomethane	<250	DLM	250	ug/m3		22-DEC-19	R4952666
Bromomethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Carbon Disulfide	<200	DLM	200	ug/m3		22-DEC-19	R4952666
Carbon Disulfide	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Carbon Tetrachloride	<410	DLM	410	ug/m3		22-DEC-19	R4952666
Carbon Tetrachloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chlorobenzene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
Chlorobenzene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloroethane	470	DLM	170	ug/m3		22-DEC-19	R4952666
Chloroethane	177	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloroform	<320	DLM	320	ug/m3		22-DEC-19	R4952666
Chloroform	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Chloromethane	<140	DLM	140	ug/m3		22-DEC-19	R4952666
Chloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<260	DLM	260	ug/m3		22-DEC-19	R4952666
cis-1,2-Dichloroethene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
cis-1,3-Dichloropropene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Cyclohexane	2380	DLM	230	ug/m3		22-DEC-19	R4952666
Cyclohexane	691	DLM	65	ppb(V)		22-DEC-19	R4952666
Dibromochloromethane	<560	DLM	560	ug/m3		22-DEC-19	R4952666
Dibromochloromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Dichlorodifluoromethane	241000	DLA	40000	ug/m3		23-DEC-19	R4952666
Dichlorodifluoromethane	48800	DLA	8200	ppb(V)		23-DEC-19	R4952666
Ethyl acetate	<240	DLM	240	ug/m3		22-DEC-19	R4952666
Ethyl acetate	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Ethylbenzene	11500	DLA	1400	ug/m3		23-DEC-19	R4952666
Ethylbenzene	2640	DLA	330	ppb(V)		23-DEC-19	R4952666
Freon 113	<500	DLM	500	ug/m3		22-DEC-19	R4952666
Freon 113	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Freon 114	3020	DLM	460	ug/m3		22-DEC-19	R4952666

* 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
L2393575-6 19DUP01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 12:00							
Matrix: SG							
Canister EPA TO-15							
Freon 114	432	DLM	65	ppb(V)		22-DEC-19	R4952666
Hexachlorobutadiene	<700	DLM	700	ug/m3		22-DEC-19	R4952666
Hexachlorobutadiene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Isooctane	540	AI	310	ug/m3		22-DEC-19	R4952666
Isooctane	116	AI	65	ppb(V)		22-DEC-19	R4952666
Isopropyl alcohol	<61	DLM	61	ug/m3		23-DEC-19	R4952666
Isopropyl alcohol	<25	DLM	25	ppb(V)		23-DEC-19	R4952666
Isopropylbenzene	880	DLM	320	ug/m3		22-DEC-19	R4952666
Isopropylbenzene	178	DLM	65	ppb(V)		22-DEC-19	R4952666
m&p-Xylene	95800	DLA	2800	ug/m3		23-DEC-19	R4952666
m&p-Xylene	22100	DLA	650	ppb(V)		23-DEC-19	R4952666
Methyl ethyl ketone	<190	DLM	190	ug/m3		22-DEC-19	R4952666
Methyl ethyl ketone	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Methyl isobutyl ketone	<270	DLM	270	ug/m3		22-DEC-19	R4952666
Methyl isobutyl ketone	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Methylene chloride	<230	DLM	230	ug/m3		22-DEC-19	R4952666
Methylene chloride	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
MTBE	<240	DLM	240	ug/m3		22-DEC-19	R4952666
MTBE	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
n-Heptane	6100	DLA	1300	ug/m3		23-DEC-19	R4952666
n-Heptane	1480	DLA	330	ppb(V)		23-DEC-19	R4952666
n-Hexane	2890	DLM	230	ug/m3		22-DEC-19	R4952666
n-Hexane	821	DLM	65	ppb(V)		22-DEC-19	R4952666
o-Xylene	6700	DLA	1400	ug/m3		23-DEC-19	R4952666
o-Xylene	1540	DLA	330	ppb(V)		23-DEC-19	R4952666
Propylene	<110	DLM	110	ug/m3		22-DEC-19	R4952666
Propylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Styrene	<280	DLM	280	ug/m3		22-DEC-19	R4952666
Styrene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Tetrachloroethylene	<440	DLM	440	ug/m3		22-DEC-19	R4952666
Tetrachloroethylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Tetrahydrofuran	<190	DLM	190	ug/m3		22-DEC-19	R4952666
Tetrahydrofuran	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Toluene	1230	DLM	250	ug/m3		22-DEC-19	R4952666
Toluene	325	DLM	65	ppb(V)		22-DEC-19	R4952666
trans-1,2-Dichloroethene	1110	DLM	260	ug/m3		22-DEC-19	R4952666
trans-1,2-Dichloroethene	280	DLM	65	ppb(V)		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<300	DLM	300	ug/m3		22-DEC-19	R4952666
trans-1,3-Dichloropropene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Trichloroethylene	<350	DLM	350	ug/m3		22-DEC-19	R4952666
Trichloroethylene	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Trichlorofluoromethane	<370	DLM	370	ug/m3		22-DEC-19	R4952666
Trichlorofluoromethane	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Vinyl acetate	<580	DLM	580	ug/m3		22-DEC-19	R4952666
Vinyl acetate	<160	DLM	160	ppb(V)		22-DEC-19	R4952666
Vinyl bromide	<290	DLM	290	ug/m3		22-DEC-19	R4952666
Vinyl bromide	<65	DLM	65	ppb(V)		22-DEC-19	R4952666
Vinyl chloride	570	DLM	170	ug/m3		22-DEC-19	R4952666
Vinyl chloride	224	DLM	65	ppb(V)		22-DEC-19	R4952666
Surrogate: 4-Bromofluorobenzene	97.2		50-150	%		22-DEC-19	R4952666
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
L2393575-6 19DUP01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 12:00							
Matrix: SG							
Sum of Xylene Isomer Concentrations							
Xylenes (Total)	23600		730	ppb(V)		23-DEC-19	
Xylenes (Total)	102000		3200	ug/m3		23-DEC-19	
Select list of 7 C1-C5 hydrocarbon gases							
Methane	N/A	MP	0.00010	%		10-DEC-19	R4944650
Ethane	0.00747		0.00020	%		10-DEC-19	R4944650
Ethene	0.0223	DLA	0.00040	%		20-DEC-19	R4944650
Propane	0.00028		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	-6.7		-30	in Hg	17-DEC-19	17-DEC-19	R4945043
Canister ID	01400-0369				17-DEC-19	17-DEC-19	R4945043
Regulator ID	G131				17-DEC-19	17-DEC-19	R4945043
Batch Proof ID	191119.11				17-DEC-19	17-DEC-19	R4945043

* 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
L2393575-7 VW-01							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 12:30							
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	102.4		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150320SVI					13-DEC-19	R4942791
Batch Proof ID	13-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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-8 VW-02							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:55							
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)	210		170	ug/m3		18-DEC-19	R4945277
D6(CVMS)	12		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)	320		170	ug/m3		18-DEC-19	R4945277
MD3M(LVMS)	19		10	ng		18-DEC-19	R4945277
Surrogate: 4-Bromofluorobenzene	104.9		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150599SVI					13-DEC-19	R4942791
Batch Proof ID	13-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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-9 VW-03							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:10							
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	107.4		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150342SVI					13-DEC-19	R4942791
Batch Proof ID	13-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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-10 VW-04							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 10:35							
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	101.8		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150366SVI					13-DEC-19	R4942791
Batch Proof ID	13-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.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2393575-11 VW-05							
Sampled By: MEGAN ROUSE on 06-DEC-19 @ 11:15							
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	105.3		50-150	%		18-DEC-19	R4945277
Tube Information							
Tube ID	G0150360SVI					13-DEC-19	R4942791
Batch Proof ID	13-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
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).
DLQ	Detection Limit raised due to co-eluting interference. GCMS qualifier ion ratio did not meet acceptance criteria.
R	The ion abundance ratio(s) did not meet the acceptance criteria. Value is an estimated maximum.

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

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

This analysis is performed using procedures adapted from ASTM D1946/EPA Method 3C. Air samples are collected into cleaned evaculated 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

Batch Proof ID, Canister ID, Pressure on Receipt, Regulator ID.

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

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

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

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

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

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.

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

L2393575

Lab ID	Sample ID				Lab ID	Sample ID			

ALS LABORATORY GROUP SOIL SALINITY CONVERSION

L2393575

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, CI.
August, 1961."

Quality Control Report

Workorder: L2393575 Report Date: 24-DEC-19

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALIPH/AROM-GCMS-WT	**Canister**							
Batch R4953011								
WG3247105-2 LCS								
Aliphatic C6-C8			121.6		%		50-150	23-DEC-19
Aliphatic C>8-C10			101.0		%		50-150	23-DEC-19
Aliphatic C>10-C12			117.1		%		50-150	23-DEC-19
Aliphatic C>12-C16			128.7		%		50-150	23-DEC-19
Aromatic C>8-C10			105.7		%		50-150	23-DEC-19
Aromatic C>10-C12			101.0		%		50-150	23-DEC-19
Aromatic C>12-C16			87.2		%		50-150	23-DEC-19
WG3247105-3 LCSD		**WG3247105-2**						
Aliphatic C6-C8		121.6	128.6		%	5.6	50	23-DEC-19
Aliphatic C>8-C10		101.0	103.8		%	2.8	50	23-DEC-19
Aliphatic C>10-C12		117.1	119.5		%	2.0	50	23-DEC-19
Aliphatic C>12-C16		128.7	136.9		%	6.2	50	23-DEC-19
Aromatic C>8-C10		105.7	108.2		%	2.3	50	23-DEC-19
Aromatic C>10-C12		101.0	104.3		%	3.2	50	23-DEC-19
Aromatic C>12-C16		87.2	95.6		%	9.2	50	23-DEC-19
WG3247105-1 MB								
Aliphatic C6-C8			<15		ug/m3		15	23-DEC-19
Aliphatic C>8-C10			<15		ug/m3		15	23-DEC-19
Aliphatic C>10-C12			<15		ug/m3		15	23-DEC-19
Aliphatic C>12-C16			<30		ug/m3		30	23-DEC-19
Aromatic C>8-C10			<15		ug/m3		15	23-DEC-19
Aromatic C>10-C12			<15		ug/m3		15	23-DEC-19
Aromatic C>12-C16			<30		ug/m3		30	23-DEC-19
BTEX+NAPH-GCMS-WT	**Canister**							
Batch R4952666								
WG3246686-4 DUP		**L2393570-2**						
Naphthalene		<0.50	<0.50	RPD-NA	ppb(V)	N/A	30	20-DEC-19
WG3246686-2 LCS								
Naphthalene			128.8		%		70-130	20-DEC-19
WG3246686-3 LCSD		**WG3246686-2**						
Naphthalene		128.8	128.3		%	0.4	50	23-DEC-19
WG3246686-1 MB								
Naphthalene			<0.50		ppb(V)		0.5	20-DEC-19
Surrogate: 4-Bromofluorobenzene			94.7		%		50-150	20-DEC-19

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C1-C5-FID-WT	**Canister**							
Batch R4944650								
WG3239341-4 DUP		**L2393570-1**						
Methane		0.00029	0.00027		%	7.3	20	10-DEC-19
Ethane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Ethene		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Propane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Propene		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Butane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
Pentane		<0.00020	<0.00020	RPD-NA	%	N/A	20	10-DEC-19
WG3239341-1 LCS								
Methane			78.8		%		70-130	10-DEC-19
Ethane			88.3		%		70-130	10-DEC-19
Ethene			84.4		%		70-130	10-DEC-19
Propane			88.8		%		70-130	10-DEC-19
Propene			96.7		%		70-130	10-DEC-19
Pentane			92.4		%		70-130	10-DEC-19
WG3239341-2 LCSD		**WG3239341-1**						
Methane		78.8	82.3		%	4.4	50	10-DEC-19
Ethane		88.3	89.4		%	1.2	50	10-DEC-19
Ethene		84.4	84.6		%	0.1	50	10-DEC-19
Propane		88.8	88.5		%	0.4	50	10-DEC-19
Propene		96.7	96.9		%	0.2	50	10-DEC-19
Pentane		92.4	92.2		%	0.2	50	10-DEC-19
WG3239341-3 MB								
Methane			<0.00010		%		0.0001	10-DEC-19
Ethane			<0.00020		%		0.0002	10-DEC-19
Ethene			<0.00020		%		0.0002	10-DEC-19
Propane			<0.00020		%		0.0002	10-DEC-19
Propene			<0.00020		%		0.0002	10-DEC-19
Butane			<0.00020		%		0.0002	10-DEC-19
Pentane			<0.00020		%		0.0002	10-DEC-19
F1-F2-GCMS-WT	**Canister**							
Batch R4953011								
WG3247105-2 LCS								
F1 (C6-C10)			110.1		%		50-150	23-DEC-19
WG3247105-3 LCSD		**WG3247105-2**						

Quality Control Report

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

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F1-F2-GCMS-WT	**Canister**							
Batch R4953011								
WG3247105-3 LCSD		**WG3247105-2**						
F1 (C6-C10)		110.1	108.4		%	1.5	50	23-DEC-19
WG3247105-1 MB								
F1 (C6-C10)			<15		ug/m3		15	23-DEC-19
F2 (C10-C16)			<15		ug/m3		15	23-DEC-19
Surrogate: 4-Bromofluorobenzene			98.3		%		50-150	23-DEC-19
FIXED GASES-TCD-WT	**Canister**							
Batch R4944389								
WG3236065-3 DUP		**L2391113-1**						
Nitrogen		75.0	75.1		%	0.2	30	12-DEC-19
Oxygen		20.4	20.4		%	0.4	30	12-DEC-19
Carbon Dioxide		0.202	0.206		%	2.2	30	12-DEC-19
Carbon Monoxide		<0.050	<0.050	RPD-NA	%	N/A	30	12-DEC-19
Methane		<0.050	<0.050	RPD-NA	%	N/A	30	12-DEC-19
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
WG3236065-1 LCS								
Nitrogen			99.4		%		70-130	12-DEC-19
Oxygen			98.2		%		70-130	12-DEC-19
Carbon Dioxide			93.9		%		70-130	12-DEC-19
Carbon Monoxide			96.3		%		70-130	12-DEC-19
Methane			100.1		%		70-130	12-DEC-19
WG3236065-5 LCS								
Nitrogen			98.5		%		70-130	13-DEC-19
Oxygen			97.5		%		70-130	13-DEC-19
Carbon Dioxide			95.4		%		70-130	13-DEC-19
Carbon Monoxide			95.7		%		70-130	13-DEC-19
Methane			98.3		%		70-130	13-DEC-19
WG3236065-2 LCSD		**WG3236065-1**						
Nitrogen		99.4	98.5		%	0.9	25	12-DEC-19
Oxygen		98.2	97.2		%	1.0	25	12-DEC-19

Quality Control Report

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								
WG3236065-2 LCSD		**WG3236065-1**						
Carbon Dioxide		93.9	95.6		%	1.8	25	12-DEC-19
Carbon Monoxide		96.3	95.9		%	0.4	25	12-DEC-19
Methane		100.1	99.1		%	1.0	25	12-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
WG3236065-4 MB								
Nitrogen			<1.0		%		1	12-DEC-19
Oxygen			<0.10		%		0.1	12-DEC-19
Carbon Dioxide			<0.050		%		0.05	12-DEC-19
Carbon Monoxide			<0.050		%		0.05	12-DEC-19
Methane			<0.050		%		0.05	12-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 R4952666								
WG3246686-4 DUP		**L2393570-2**						
1,1,1-Trichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,1,2,2-Tetrachloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,1,2-Trichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,1-Dichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,1-Dichloroethene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,2,4-Trichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,2,4-Trimethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,2-Dibromoethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,2-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,2-Dichloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-4 DUP		**L2393570-2**						
1,2-Dichloropropane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,3,5-Trimethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,3-Butadiene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,3-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,4-Dichlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
1,4-Dioxane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
2-Hexanone		<1.0	<1.0	RPD-NA	ppb(V)	N/A	30	20-DEC-19
4-Ethyltoluene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Acetone		5.5	5.1		ppb(V)	8.0	30	23-DEC-19
Allyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Benzene		0.66	0.58		ppb(V)	12	30	20-DEC-19
Benzyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Bromodichloromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Bromoform		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Bromomethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Carbon Disulfide		3.74	3.37		ppb(V)	11	30	20-DEC-19
Carbon Tetrachloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Chlorobenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Chloroethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Chloroform		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Chloromethane		0.82	0.74		ppb(V)	11	30	20-DEC-19
cis-1,2-Dichloroethene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
cis-1,3-Dichloropropene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Cyclohexane		0.35	0.33		ppb(V)	4.9	30	20-DEC-19
Dibromochloromethane		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Dichlorodifluoromethane		4.8	4.5		ppb(V)	6.5	30	23-DEC-19
Ethyl acetate		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Ethylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Freon 113		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Freon 114		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Hexachlorobutadiene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Isooctane		0.41	0.36		ppb(V)	13	30	20-DEC-19
Isopropyl alcohol		<1.0	<1.0		ppb(V)			20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-4 DUP		**L2393570-2**						
Isopropyl alcohol		<1.0	<1.0	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Isopropylbenzene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	50	20-DEC-19
m&p-Xylene		0.55	0.54		ppb(V)	2.3	30	20-DEC-19
Methyl ethyl ketone		0.39	0.36		ppb(V)	8.8	30	20-DEC-19
Methyl isobutyl ketone		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Methylene chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
MTBE		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
n-Heptane		0.33	0.28		ppb(V)	17	30	20-DEC-19
n-Hexane		0.69	0.61		ppb(V)	12	30	20-DEC-19
o-Xylene		0.21	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Propylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Styrene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Tetrachloroethylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Tetrahydrofuran		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Toluene		1.26	1.15		ppb(V)	9.3	30	20-DEC-19
trans-1,2-Dichloroethene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
trans-1,3-Dichloropropene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Trichloroethylene		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Trichlorofluoromethane		0.28	0.26		ppb(V)	5.3	30	20-DEC-19
Vinyl acetate		<0.50	<0.50	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Vinyl bromide		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
Vinyl chloride		<0.20	<0.20	RPD-NA	ppb(V)	N/A	30	20-DEC-19
WG3246686-2 LCS								
1,1,1-Trichloroethane			96.6		%		70-130	20-DEC-19
1,1,2,2-Tetrachloroethane			98.8		%		70-130	20-DEC-19
1,1,2-Trichloroethane			100.9		%		70-130	20-DEC-19
1,1-Dichloroethane			99.4		%		70-130	20-DEC-19
1,1-Dichloroethene			98.5		%		70-130	20-DEC-19
1,2,4-Trichlorobenzene			122.1		%		70-130	20-DEC-19
1,2,4-Trimethylbenzene			106.2		%		70-130	20-DEC-19
1,2-Dibromoethane			98.4		%		70-130	20-DEC-19
1,2-Dichlorobenzene			101.1		%		70-130	20-DEC-19
1,2-Dichloroethane			97.9		%		70-130	20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-2 LCS								
1,2-Dichloropropane			104.1		%		70-130	20-DEC-19
1,3,5-Trimethylbenzene			103.8		%		70-130	20-DEC-19
1,3-Butadiene			93.2		%		70-130	20-DEC-19
1,3-Dichlorobenzene			95.9		%		70-130	20-DEC-19
1,4-Dichlorobenzene			105.4		%		70-130	20-DEC-19
1,4-Dioxane			102.7		%		70-130	20-DEC-19
2-Hexanone			106.1		%		70-130	20-DEC-19
4-Ethyltoluene			102.7		%		70-130	20-DEC-19
Acetone			100.3		%		70-130	20-DEC-19
Allyl chloride			100.0		%		70-130	20-DEC-19
Benzene			94.9		%		70-130	20-DEC-19
Benzyl chloride			101.8		%		70-130	20-DEC-19
Bromodichloromethane			101.8		%		70-130	20-DEC-19
Bromoform			98.7		%		70-130	20-DEC-19
Bromomethane			101.8		%		70-130	20-DEC-19
Carbon Disulfide			91.0		%		70-130	20-DEC-19
Carbon Tetrachloride			98.5		%		70-130	20-DEC-19
Chlorobenzene			98.6		%		70-130	20-DEC-19
Chloroethane			103.2		%		70-130	20-DEC-19
Chloroform			99.8		%		70-130	20-DEC-19
Chloromethane			105.4		%		70-130	20-DEC-19
cis-1,2-Dichloroethene			96.6		%		70-130	20-DEC-19
cis-1,3-Dichloropropene			95.1		%		70-130	20-DEC-19
Cyclohexane			101.3		%		70-130	20-DEC-19
Dibromochloromethane			93.6		%		70-130	20-DEC-19
Dichlorodifluoromethane			100.7		%		70-130	20-DEC-19
Ethyl acetate			98.0		%		70-130	20-DEC-19
Ethylbenzene			96.1		%		70-130	20-DEC-19
Freon 113			98.1		%		70-130	20-DEC-19
Freon 114			105.6		%		70-130	20-DEC-19
Hexachlorobutadiene			109.1		%		70-130	20-DEC-19
Isooctane			97.2		%		70-130	20-DEC-19
Isopropyl alcohol			90.0		%		70-130	20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-2 LCS								
Isopropylbenzene			99.4		%		50-150	20-DEC-19
m&p-Xylene			102.0		%		70-130	20-DEC-19
Methyl ethyl ketone			97.7		%		70-130	20-DEC-19
Methyl isobutyl ketone			96.6		%		70-130	20-DEC-19
Methylene chloride			97.1		%		70-130	20-DEC-19
MTBE			95.2		%		70-130	20-DEC-19
n-Heptane			99.0		%		70-130	20-DEC-19
n-Hexane			95.1		%		70-130	20-DEC-19
o-Xylene			102.7		%		70-130	20-DEC-19
Propylene			94.6		%		70-130	20-DEC-19
Styrene			102.4		%		70-130	20-DEC-19
Tetrachloroethylene			97.7		%		70-130	20-DEC-19
Tetrahydrofuran			98.3		%		70-130	20-DEC-19
Toluene			95.4		%		70-130	20-DEC-19
trans-1,2-Dichloroethene			96.8		%		70-130	20-DEC-19
trans-1,3-Dichloropropene			102.5		%		70-130	20-DEC-19
Trichloroethylene			98.8		%		70-130	20-DEC-19
Trichlorofluoromethane			98.7		%		70-130	20-DEC-19
Vinyl acetate			101.3		%		70-130	20-DEC-19
Vinyl bromide			97.4		%		70-130	20-DEC-19
Vinyl chloride			98.8		%		70-130	20-DEC-19
WG3246686-3 LCSD		**WG3246686-2**						
1,1,1-Trichloroethane		96.6	100.2		%	3.6	25	23-DEC-19
1,1,2,2-Tetrachloroethane		98.8	104.5		%	5.6	25	23-DEC-19
1,1,2-Trichloroethane		100.9	101.4		%	0.6	25	23-DEC-19
1,1-Dichloroethane		99.4	102.6		%	3.2	25	23-DEC-19
1,1-Dichloroethene		98.5	103.7		%	5.1	25	23-DEC-19
1,2,4-Trichlorobenzene		122.1	123.0		%	0.7	25	23-DEC-19
1,2,4-Trimethylbenzene		106.2	110.5		%	4.0	25	23-DEC-19
1,2-Dibromoethane		98.4	101.7		%	3.3	25	23-DEC-19
1,2-Dichlorobenzene		101.1	103.0		%	1.8	25	23-DEC-19
1,2-Dichloroethane		97.9	96.9		%	1.1	25	23-DEC-19
1,2-Dichloropropane		104.1	102.1		%	1.9	25	23-DEC-19

Quality Control Report

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 R4952666								
WG3246686-3 LCSD		**WG3246686-2**						
1,3,5-Trimethylbenzene		103.8	107.0		%	3.0	25	23-DEC-19
1,3-Butadiene		93.2	97.4		%	4.4	25	23-DEC-19
1,3-Dichlorobenzene		95.9	101.0		%	5.1	25	23-DEC-19
1,4-Dichlorobenzene		105.4	107.8		%	2.2	25	23-DEC-19
1,4-Dioxane		102.7	104.4		%	1.7	25	23-DEC-19
2-Hexanone		106.1	108.2		%	1.9	25	23-DEC-19
4-Ethyltoluene		102.7	107.4		%	4.5	25	23-DEC-19
Acetone		100.3	98.9		%	1.4	25	23-DEC-19
Allyl chloride		100.0	99.7		%	0.3	25	23-DEC-19
Benzene		94.9	102.2		%	7.4	25	23-DEC-19
Benzyl chloride		101.8	102.5		%	0.8	25	23-DEC-19
Bromodichloromethane		101.8	103.5		%	1.6	25	23-DEC-19
Bromoform		98.7	106.0		%	7.2	25	23-DEC-19
Bromomethane		101.8	105.0		%	3.1	25	23-DEC-19
Carbon Disulfide		91.0	93.7		%	3.0	25	23-DEC-19
Carbon Tetrachloride		98.5	99.1		%	0.6	25	23-DEC-19
Chlorobenzene		98.6	105.5		%	6.8	25	23-DEC-19
Chloroethane		103.2	104.0		%	0.8	25	23-DEC-19
Chloroform		99.8	103.7		%	3.9	25	23-DEC-19
Chloromethane		105.4	104.9		%	0.5	25	23-DEC-19
cis-1,2-Dichloroethene		96.6	104.0		%	7.4	25	23-DEC-19
cis-1,3-Dichloropropene		95.1	97.1		%	2.1	25	23-DEC-19
Cyclohexane		101.3	102.6		%	1.3	25	23-DEC-19
Dibromochloromethane		93.6	97.7		%	4.3	25	23-DEC-19
Dichlorodifluoromethane		100.7	102.8		%	2.0	25	23-DEC-19
Ethyl acetate		98.0	109.1		%	11	25	23-DEC-19
Ethylbenzene		96.1	97.9		%	1.8	25	23-DEC-19
Freon 113		98.1	99.7		%	1.6	25	23-DEC-19
Freon 114		105.6	109.3		%	3.5	25	23-DEC-19
Hexachlorobutadiene		109.1	116.7		%	6.8	25	23-DEC-19
Isooctane		97.2	100.1		%	3.0	25	23-DEC-19
Isopropyl alcohol		90.0	91.5		%	1.7	25	23-DEC-19
Isopropylbenzene		99.4	104.0		%			23-DEC-19

Quality Control Report

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 R4952666								
WG3246686-3 LCSD		**WG3246686-2**						
Isopropylbenzene		99.4	104.0		%	4.5	50	23-DEC-19
m&p-Xylene		102.0	107.6		%	5.4	25	23-DEC-19
Methyl ethyl ketone		97.7	100.8		%	3.1	25	23-DEC-19
Methyl isobutyl ketone		96.6	100.3		%	3.8	25	23-DEC-19
Methylene chloride		97.1	99.6		%	2.6	25	23-DEC-19
MTBE		95.2	101.4		%	6.3	25	23-DEC-19
n-Heptane		99.0	101.3		%	2.3	25	23-DEC-19
n-Hexane		95.1	98.1		%	3.1	25	23-DEC-19
o-Xylene		102.7	106.2		%	3.4	25	23-DEC-19
Propylene		94.6	103.0		%	8.4	25	23-DEC-19
Styrene		102.4	104.9		%	2.4	25	23-DEC-19
Tetrachloroethylene		97.7	101.7		%	4.0	25	23-DEC-19
Tetrahydrofuran		98.3	101.9		%	3.6	25	23-DEC-19
Toluene		95.4	99.7		%	4.4	25	23-DEC-19
trans-1,2-Dichloroethene		96.8	99.0		%	2.2	25	23-DEC-19
trans-1,3-Dichloropropene		102.5	106.6		%	3.9	25	23-DEC-19
Trichloroethylene		98.8	103.1		%	4.3	25	23-DEC-19
Trichlorofluoromethane		98.7	101.1		%	2.4	25	23-DEC-19
Vinyl acetate		101.3	100.9		%	0.5	25	23-DEC-19
Vinyl bromide		97.4	101.2		%	3.8	25	23-DEC-19
Vinyl chloride		98.8	97.4		%	1.5	25	23-DEC-19
WG3246686-1 MB								
1,1,1-Trichloroethane			<0.20		ppb(V)		0.2	20-DEC-19
1,1,2,2-Tetrachloroethane			<0.20		ppb(V)		0.2	20-DEC-19
1,1,2-Trichloroethane			<0.20		ppb(V)		0.2	20-DEC-19
1,1-Dichloroethane			<0.20		ppb(V)		0.2	20-DEC-19
1,1-Dichloroethene			<0.20		ppb(V)		0.2	20-DEC-19
1,2,4-Trichlorobenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,2,4-Trimethylbenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,2-Dibromoethane			<0.20		ppb(V)		0.2	20-DEC-19
1,2-Dichlorobenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,2-Dichloroethane			<0.20		ppb(V)		0.2	20-DEC-19
1,2-Dichloropropane			<0.20		ppb(V)		0.2	20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-1 MB								
1,3,5-Trimethylbenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,3-Butadiene			<0.20		ppb(V)		0.2	20-DEC-19
1,3-Dichlorobenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,4-Dichlorobenzene			<0.20		ppb(V)		0.2	20-DEC-19
1,4-Dioxane			<0.20		ppb(V)		0.2	20-DEC-19
2-Hexanone			<1.0		ppb(V)		1	20-DEC-19
4-Ethyltoluene			<0.20		ppb(V)		0.2	20-DEC-19
Acetone			<0.50		ppb(V)		0.5	20-DEC-19
Allyl chloride			<0.20		ppb(V)		0.2	20-DEC-19
Benzene			<0.20		ppb(V)		0.2	20-DEC-19
Benzyl chloride			<0.20		ppb(V)		0.2	20-DEC-19
Bromodichloromethane			<0.20		ppb(V)		0.2	20-DEC-19
Bromoform			<0.20		ppb(V)		0.2	20-DEC-19
Bromomethane			<0.20		ppb(V)		0.2	20-DEC-19
Carbon Disulfide			<0.20		ppb(V)		0.2	20-DEC-19
Carbon Tetrachloride			<0.20		ppb(V)		0.2	20-DEC-19
Chlorobenzene			<0.20		ppb(V)		0.2	20-DEC-19
Chloroethane			<0.20		ppb(V)		0.2	20-DEC-19
Chloroform			<0.20		ppb(V)		0.2	20-DEC-19
Chloromethane			<0.20		ppb(V)		0.2	20-DEC-19
cis-1,2-Dichloroethene			<0.20		ppb(V)		0.2	20-DEC-19
cis-1,3-Dichloropropene			<0.20		ppb(V)		0.2	20-DEC-19
Cyclohexane			<0.20		ppb(V)		0.2	20-DEC-19
Dibromochloromethane			<0.20		ppb(V)		0.2	20-DEC-19
Dichlorodifluoromethane			<0.20		ppb(V)		0.2	20-DEC-19
Ethyl acetate			<0.20		ppb(V)		0.2	20-DEC-19
Ethylbenzene			<0.20		ppb(V)		0.2	20-DEC-19
Freon 113			<0.20		ppb(V)		0.2	20-DEC-19
Freon 114			<0.20		ppb(V)		0.2	20-DEC-19
Hexachlorobutadiene			<0.20		ppb(V)		0.2	20-DEC-19
Isooctane			<0.20		ppb(V)		0.2	20-DEC-19
Isopropyl alcohol			<1.0		ppb(V)		1	20-DEC-19
Isopropylbenzene			<0.20		ppb(V)		0.2	20-DEC-19

Quality Control Report

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 R4952666								
WG3246686-1 MB								
m&p-Xylene			<0.40		ppb(V)		0.4	20-DEC-19
Methyl ethyl ketone			<0.20		ppb(V)		0.2	20-DEC-19
Methyl isobutyl ketone			<0.20		ppb(V)		0.2	20-DEC-19
Methylene chloride			<0.20		ppb(V)		0.2	20-DEC-19
MTBE			<0.20		ppb(V)		0.2	20-DEC-19
n-Heptane			<0.20		ppb(V)		0.2	20-DEC-19
n-Hexane			<0.20		ppb(V)		0.2	20-DEC-19
o-Xylene			<0.20		ppb(V)		0.2	20-DEC-19
Propylene			<0.20		ppb(V)		0.2	20-DEC-19
Styrene			<0.20		ppb(V)		0.2	20-DEC-19
Tetrachloroethylene			<0.20		ppb(V)		0.2	20-DEC-19
Tetrahydrofuran			<0.20		ppb(V)		0.2	20-DEC-19
Toluene			<0.20		ppb(V)		0.2	20-DEC-19
trans-1,2-Dichloroethene			<0.20		ppb(V)		0.2	20-DEC-19
trans-1,3-Dichloropropene			<0.20		ppb(V)		0.2	20-DEC-19
Trichloroethylene			<0.20		ppb(V)		0.2	20-DEC-19
Trichlorofluoromethane			<0.20		ppb(V)		0.2	20-DEC-19
Vinyl acetate			<0.50		ppb(V)		0.5	20-DEC-19
Vinyl bromide			<0.20		ppb(V)		0.2	20-DEC-19
Vinyl chloride			<0.20		ppb(V)		0.2	20-DEC-19
Surrogate: 4-Bromofluorobenzene			94.7		%		50-150	20-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

Quality Control Report

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**						
D4(CVMS)		117.6	121.2		%	3.0	50	18-DEC-19
D5(CVMS)		127.7	131.7		%	3.1	50	18-DEC-19
D6(CVMS)		121.6	125.5		%	3.2	50	18-DEC-19
MM(LVMS)		122.0	94.5		%	25	50	18-DEC-19
MDM(LVMS)		124.9	123.7		%	0.9	50	18-DEC-19
MD2M(LVMS)		118.9	116.5		%	2.0	50	18-DEC-19
MD3M(LVMS)		114.1	106.2		%	7.2	50	18-DEC-19
WG3242059-1 MB								
D3(CVMS)			<10		ng		10	18-DEC-19
D4(CVMS)			<10		ng		10	18-DEC-19
D5(CVMS)			<10		ng		10	18-DEC-19
D6(CVMS)			<10		ng		10	18-DEC-19
MM(LVMS)			<10		ng		10	18-DEC-19
MDM(LVMS)			<10		ng		10	18-DEC-19
MD2M(LVMS)			<10		ng		10	18-DEC-19
MD3M(LVMS)			<10		ng		10	18-DEC-19
Surrogate: 4-Bromofluorobenzene			100.4		%		50-150	18-DEC-19

Quality Control Report

Workorder: L2393575 Report Date: 24-DEC-19

Client: TETRA TECH CANADA INC.
110, 140 Quarry Park Blvd SE
Calgary AB T2C 3G3
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
DLA	Detection Limit adjusted for required dilution
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

B191119.112	01400-0480	Vinyl Chloride	<0.02	ppb(V)	21-Nov-19	DT1
B191119.112	01400-0480	4-Bromofluorobenzene	103.1	%	21-Nov-19	DT1

APPENDIX E

HISTORICAL ANALYTICAL RESULTS

Table 1
Groundwater Monitoring and Soil Vapour Well Elevations

Test Location	Well Depth (m)	Elevations				Screen Length (m)
		Ground (m)	Top of Pipe (m)	Screen Interval		
				Bottom	Top	
GW-01	5.6	883.693	884.788	878.093	883.193	5.1
GW-02	12.0	883.679	884.674	871.679	883.279	11.6
GW-03	6.1	877.577	878.182	871.477	876.977	5.5
MW-01	4.6	876.982	877.785	872.382	874.482	2.1
MW-02	4.6	877.851	878.281	873.251	875.351	2.1
MW-03	10.7	877.169	878.135	866.469	869.569	3.1
MW-04	8.7	876.013	876.986	867.313	870.413	3.1
MW-05	7.5	872.454	873.306	864.954	868.054	3.1
MW-06	9.2	877.914	878.754	868.714	871.814	3.1
MW-07	6.1	877.413	878.174	871.313	875.913	4.6
VW-01	2.6	877.333	- -	874.733	875.033	0.3
VW-02	4.3	877.190	- -	872.890	873.190	0.3
VW-03	2.7	872.690	- -	869.990	870.290	0.3
VW-04	2.4	877.445	- -	875.045	875.345	0.3
VW-05	2.4	877.724	- -	875.324	875.624	0.3
TH-01	NA	877.319	- -	- -	- -	- -
TH-05	NA	877.163	- -	- -	- -	- -
TH-09	NA	877.869	- -	- -	- -	- -
TH-10	NA	876.835	- -	- -	- -	- -
TH-11	NA	878.046	- -	- -	- -	- -
TH-12	NA	877.927	- -	- -	- -	- -
TH-13	NA	877.941	- -	- -	- -	- -
TH-14	NA	878.119	- -	- -	- -	- -
TH-15	NA	878.554	- -	- -	- -	- -
TH-16	NA	877.755	- -	- -	- -	- -
TH-17	NA	876.876	- -	- -	- -	- -
TH-18	NA	877.253	- -	- -	- -	- -
TH-19	NA	878.104	- -	- -	- -	- -
TH-20	NA	876.195	- -	- -	- -	- -

Notes:

1) Geodetic elevations are determined from multiple datums, ASCM Nos. 269191, 376673 and 384792. Refer to ASCM Information in Appendix A.
2) GW - soil vapour well installed by others.
3) MW - groundwater monitoring well. MW-01 to MW-06 installed Dec. 1999 by others. MW-07 installed Jun. 2013.
4) VW - soil vapour well installed Jun 2013.
3) TH - testhole, no instrumentation installed .
4) - - no applicable elevation.

Table 2
Site Monitoring Results

Test Location	Elevation		Groundwater Elevation (m)		Headspace Vapour				Notes
	Ground (m)	Top of Pipe (m)	08/13-14/2013		08/13-14/2013				
					Combustible	Volatile	Combustile	Volatile	
GW-01	883.693	884.788	damaged		410	ND			Unable to remove slip cap
GW-02	883.679	884.674	ND		- -	- -			
GW-03	877.577	878.182	875.913		80	ND			cap missing, aerated
MW-01	876.982	877.785	damaged		- -	- -			blockage
MW-02	877.851	878.281	damaged		- -	- -			unable to remove slip cap
MW-03	877.169	878.135	872.281		2,450	89			
MW-04	876.013	876.986	869.991		45	4			
MW-05	872.454	873.306	870.386		230	ND			
MW-06	877.914	878.754	875.122		ND	ND			
MW-07	877.413	878.174	874.658		ND	ND			
VW-01	877.333	NA	NA		- -	- -			Screen submerged in water
VW-02	877.190	NA	NA		- -	- -			Screen submerged in water
VW-03	872.690	NA	NA		480	1			instrument alarm <19% O_2
VW-04	877.445	NA	NA		50	1			instrument alarm <19% O_2
VW-05	877.724	NA	NA		- -	- -			Screen submerged in water

Notes:

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

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	8.56	8.14	8.28	2-12.5
Flash Point (°C)	30.0	>75	>75	>75	>61
Paint Filter Test	-	PASS	PASS	PASS	PASS
Total Organic Carbon	0.10	NT	NT	1.04	- -
TCLP Hydrocarbons					
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	0.0194	ND	0.5
TCLP Metals					
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 Managment Facility.
2) Units in mg/L, unless otherwise stated.
3) ND - Not Detected, less than the limit of method detection.
4) NT - Not Tested.
5) Soil bags were sampled on Monday, June 24, 2013 and Saturday, June 29, 2013.
6) For further laboratory 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-10 @ 3.0 m	TH-19 @ 4.9 m	TH-20 @ 8.8 m	Tier 1 Guideline
			06/29/2013	07/10/2013		
Chloride (Cl)	mg/kg	41958	146	38	47	- -
Nitrate-N	mg/kg	0.53 - 0.73	ND	ND	ND	- -
Nitrite-N	mg/kg	0.53 - 0.73	ND	ND	ND	- -
Total Metals						
Antimony (Sb)	mg/kg	0.20	0.55	0.44	0.63	20
Arsenic (As)	mg/kg	0.20	7.40	6.55	8.38	17
Barium (Ba)	mg/kg	5.0	273	164	295	500
Beryllium (Be)	mg/kg	1.0	ND	ND	ND	5
Cadmium (Cd)	mg/kg	0.50	ND	ND	ND	10
Chromium (Cr)	mg/kg	0.50	26.6	18.3	26.9	64
Cobalt (Co)	mg/kg	1.0	11.5	7.9	8.5	20
Copper (Cu)	mg/kg	2.0	28.3	16.0	21.1	63
Lead (Pb)	mg/kg	5.0	20.1	9.0	12.8	140
Mercury (Hg)	mg/kg	0.050	0.059	ND	0.054	6.6
Molybdenum (Mo)	mg/kg	1.0	1.0	ND	1.4	4
Nickel (Ni)	mg/kg	2.0	33.0	22.6	27.9	50
Selenium (Se)	mg/kg	0.50	ND	0.74	ND	1.0
Silver (Ag)	mg/kg	1.0	ND	ND	ND	20
Thallium (Tl)	mg/kg	0.50	ND	ND	ND	1.0
Tin (Sn)	mg/kg	2.0	ND	ND	ND	5
Uranium (U)	mg/kg	2.0	ND	ND	ND	23
Vanadium (V)	mg/kg	1.0	42.5	32.0	45.8	130
Zinc (Zn)	mg/kg	10	82	60	78	200
Hexavalent Chromium	mg/kg	0.10	ND	ND	ND	0.4
Boron (B), Hot Water Ext.	mg/kg	0.10	0.49	0.26	0.51	2

Notes:

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

Table 3C
Analytical Results - Soil - VOCs

Parameter	Detection Limit	TH-10 @ 3.0 m	TH-19 @ 4.9 m	TH-20 @ 8.8 m	Tier 1 Guideline
		06/29/2013	07/10/2013		
Hydrocarbons					
F1 (C_6-C_{10})	10	**47**	ND	ND	24
F2 (C_{10}-C_{16})	25	ND	ND	ND	130
F3 (C_{16}-C_{34})	50	159	ND	ND	300
F4 (C_{34}-C_{50})	50	ND	ND	ND	2,800
Total Hydrocarbons (C_6-C_{50})	50	206	ND	ND	--
Volatile Organic Compounds					
Benzene	0.0050	0.0058	ND	ND	0.073
Bromobenzene	0.010	ND	ND	ND	--
Bromochloromethane	0.010	ND	ND	ND	--
Bromodichloromethane	0.010	ND	ND	ND	--
Bromoform	0.010	ND	ND	ND	--
Bromomethane	0.10	ND	ND	ND	--
n-Butylbenzene	0.010 - 0.05	ND	ND	ND	--
sec-Butylbenzene	0.010 - 0.20	ND	ND	ND	--
tert-Butylbenzene	0.010	ND	ND	ND	--
Carbon tetrachloride	0.010	ND	ND	ND	0.00056
Chlorobenzene	0.010	ND	ND	ND	0.018
Dibromochloromethane	0.010	ND	ND	ND	0.27
Chloroethane	0.10	ND	ND	ND	--
Chloroform	0.010	**0.062**	ND	ND	0.001
Chloromethane	0.10	ND	ND	ND	--
2-Chlorotoluene	0.010 - 0.75	ND	ND	ND	--
4-Chlorotoluene	0.010	ND	ND	ND	--
1,2-Dibromo-3-chloropropane	0.010	ND	ND	ND	--
1,2-Dibromoethane	0.010	ND	ND	ND	--
Dibromomethane	0.010	ND	ND	ND	--
1,2-Dichlorobenzene	0.010	ND	ND	ND	0.18
1,3-Dichlorobenzene	0.010	ND	ND	ND	--
1,4-Dichlorobenzene	0.010	ND	ND	ND	0.098
Dichlorodifluoromethane	0.010	ND	ND	ND	--
1,1-Dichloroethane	0.010	ND	ND	ND	--
1,2-Dichloroethane	0.010	ND	0.087	ND	--
1,1-Dichloroethene	0.010	ND	ND	ND	0.021
cis-1,2-Dichloroethene	0.010	0.231	0.207	1.04	--
trans-1,2-Dichloroethene	0.010	ND	ND	0.048	--
Methylene chloride	0.010	**0.101**	0.012	0.015	0.095
1,2-Dichloropropane	0.010	ND	ND	ND	--
1,3-Dichloropropane	0.010	ND	ND	ND	--
2,2-Dichloropropane	0.010	ND	ND	ND	--
1,1-Dichloropropene	0.010	ND	ND	ND	--
cis-1,3-Dichloropropene	0.010	ND	ND	ND	--
trans-1,3-Dichloropropene	0.010	ND	ND	ND	--
Ethylbenzene	0.015	**1.04**	ND	ND	0.21
Hexachlorobutadiene	0.010	ND	ND	ND	0.0067
Isopropylbenzene	0.010	0.214	ND	ND	--
p-Isopropyltoluene	0.010	0.813	ND	ND	--
n-Propylbenzene	0.010	0.858	ND	ND	--
Styrene	0.010 - 0.050	ND	ND	ND	0.80
1,1,1,2-Tetrachloroethane	0.010	ND	ND	ND	--
1,1,2,2-Tetrachloroethane	0.050 - 0.50	ND	ND	ND	--
Tetrachloroethene	0.010	ND	ND	ND	0.16
Toluene	0.050	0.048	ND	ND	0.49
1,2,3-Trichlorobenzene	0.010	ND	ND	ND	0.26
1,2,4-Trichlorobenzene	0.010	ND	ND	ND	0.23
1,1,1-Trichloroethane	0.010	ND	ND	ND	--
1,1,2-Trichloroethane	0.010	ND	ND	ND	--
Trichloroethene	0.010	ND	ND	ND	0.012
Trichlorofluoromethane	0.010	ND	ND	ND	--
1,2,3-Trichloropropane	0.020 - 0.10	ND	ND	ND	--
1,2,4-Trimethylbenzene	0.010	7.72	ND	0.015	--
1,3,5-Trimethylbenzene	0.010	2.01	ND	ND	--
Vinyl chloride	0.20	ND	ND	ND	0.00034
Xylenes	0.10	7.28	ND	ND	12

Notes:

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

Table 4A
Groundwater Indices at Time of Sampling

Monitoring Well	pH	Electrical Conductivity (µS/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)	Total Dissolved Solid (mg/L)	Redox Potential (±mV)
GW-01	- -	- -	- -	- -	- -	- -
GW-02	- -	-	- -	- -	- -	- -
GW-03	7.81	868	9	1.69	812.50	+9.1
MW-01	- -	- -	- -	- -	- -	- -
MW-02	- -	- -	- -	- -	- -	- -
MW-03	7.58	2,103	8.6	2.08	2,002.00	-104.0
MW-04	7.46	3,209	8.8	2.23	3,016.00	-100.6
MW-05	7.67	1,786	8.2	1.3	1,657.50	-98.6
MW-06	- -	- -	- -	- -	- -	- -
MW-07	7.49	841	8.3	4.69	799.50	+39.9

Notes:

1) Groundwater indices measured by YSI Pro Plus multi-meter.
2) GW-03, MW-04 and MW-05 sampled on Wednesday, August 14, 2013
3) MW-03 sampled on Wednesday, August 14 and Friday, August 16, 2013
4) MW-07 sampled on Tuesday, August 13, 2013
5) - - Not Monitored, well not selected for sampling groundwater.

Table 4B
Analytical Results - Groundwater - General Water Quality

Parameter	Unit	Detection Limit	GW-03	MW-03	MW-04	MW-05	MW-07	Tier 1 Guideline
			08/14/2013	08/16/2013	08/14/2013		08/13/2013	
General Water Quality								
Biochemical Oxygen Demand	mg/L	2.0 - 10	ND	14	35	41	ND	- -
Total Chemical Oxygen Demand	mg/L	5.0	35	110	240	220	25	- -
Conductivity	µS/cm	1.0	1,300	1,000	4,900	2,600	1,300	- -
pH	Unitless	0.1	7.48	7.76	7.11	6.92	7.54	6.5 - 8.5
Total Organic Carbon (C)	mg/L	0.50 - 10	9.4	21	68	58	10	- -
Dissolved Cadmium (Cd)	µg/L	0.0050 - 0.025	0.048	ND	ND	ND	0.032	- -
Total Cadmium (Cd)	µg/L	0.0050 - 0.013	**0.37**	**11**	**0.10**	**0.59**	**1.7**	0.060*
Alkalinity ($CaCO_3$)	mg/L	0.50	620	530	1,700	1,100	610	- -
Bicarbonate (HCO_3)	mg/L	0.50	750	650	2,000	1,400	750	- -
Carbonate (CO_3)	mg/L	0.50	ND	ND	ND	ND	ND	- -
Hydroxide (OH)	mg/L	0.50	ND	ND	ND	ND	ND	- -
Sulphate (SO_4)	mg/L	1.0	66	ND	ND	ND	170	- -
Chloride (Cl)	mg/L	1.0 - 5.0	45	19	770	200	16	- -
Total Ammonia (N)	mg/L	0.050 - 2.5	ND	1.3	**22**	**77**	ND	1.37*
Total Phosphorus (P)	mg/L	0.015 - 0.30	0.74	24	0.65	0.6	1.3	- -
Total Nitrogen (N)	mg/L	0.050	5.2	15	23	73	1.3	- -
Total Kjeldahl Nitrogen	mg/L	0.050 - 2.5	1.2	15	23	73	1.2	- -
Nitrite (N)	mg/L	0.0030 - 0.015	0.025	0.0086	ND	ND	ND	- -
Nitrate (N)	mg/L	0.0030 - 0.015	3.9	0.036	0.065	0.055	0.072	- -
Nitrate plus Nitrite (N)	mg/L	0.0030 - 0.015	3.9	0.044	0.065	0.055	0.072	- -
Trace Organics								
Acetic Acid	mg/L	50	ND	NT	ND	ND	ND	- -
Formic Acid	mg/L	50	ND	NT	ND	ND	ND	- -
Propionic Acid	mg/L	50	ND	NT	ND	ND	ND	- -
Adsorbable Organic Halogens	mg/L	0.004 - 0.01	0.083	NT	1.22	2.41	0.012	- -

Notes:

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

Table 4C
Analytical Results - Groundwater - Metals

Parameter	Detection Limit	GW-03	MW-03	MW-04	MW-05	MW-07	Tier 1 Guideline
		08/14/2013	08/16/2013	08/14/2013		08/13/2013	
Total Metals							
Aluminum (Al)	0.0030 - 0.0075	**3.8**	**120**	**0.20**	**2.0**	**25**	0.1*
Antimony (Sb)	0.00060 - 0.0015	0.00081	ND	ND	ND	0.0015	0.006
Arsenic (As)	0.00020 - 0.00050	**0.0057**	**0.37**	**0.048**	**0.0077**	**0.074**	0.005
Barium (Ba)	0.010 - 0.10	0.32	**11**	**1.7**	0.87	**1.4**	1
Beryllium (Be)	0.0010 - 0.0025	ND	0.015	ND	ND	0.0036	--
Boron (B)	0.020	0.19	0.11	0.37	0.40	0.041	1.5
Calcium (Ca)	0.30 - 3.0	180	1,200	210	160	250	--
Chromium (Cr)	0.0010 - 0.0025	**0.0087**	**0.47**	**0.0027**	**0.0069**	**0.071**	0.001*
Cobalt (Co)	0.00030 - 0.00075	0.0086	0.23	0.0052	0.011	0.065	--
Copper (Cu)	0.00020 - 0.0010	**0.012**	**0.68**	0.0023	**0.0077**	**0.12**	0.003*
Iron (Fe)	0.060 - 0.60	**15**	**740**	**54**	**68**	**12**	0.3
Lead (Pb)	0.00020 - 0.0010	**0.0048**	**0.34**	0.0016	**0.092**	**0.081**	0.004*
Lithium (Li)	0.020	0.17	0.33	0.057	0.033	0.085	--
Magnesium (Mg)	0.20	92	320	280	130	120	--
Manganese (Mn)	0.0040	**2.2**	**13**	**0.34**	**0.56**	**2.5**	0.05
Molybdenum (Mo)	0.00020 - 0.0010	0.0019	0.027	0.0016	0.0020	0.0042	--
Nickel (Ni)	0.00050 - 0.0025	0.027	**0.66**	0.046	0.028	**0.15**	0.11*
Phosphorus (P)	0.10	0.50	15	0.72	0.78	0.71	--
Potassium (K)	0.30	3.7	34	10	35	11	--
Selenium (Se)	0.00020 - 0.0010	0.00047	**0.0049**	ND	ND	**0.0022**	0.001
Silicon (Si)	0.10 - 1.0	16	200	24	21	25	--
Silver (Ag)	0.00010 - 0.00050	ND	**0.0042**	ND	ND	**0.00075**	0.0001*
Sodium (Na)	0.50	72	54	470	120	27	--
Strontium (Sr)	0.020	1.3	2.2	3.0	1.7	1.1	--
Sulphur (S)	0.20	21	22	3.5	2.2	53	--
Thallium (Tl)	0.00020 - 0.0010	0.00025	0.0019	ND	ND	0.00052	--
Tin (Sn)	0.0010 - 0.0050	0.0010	0.0043	ND	0.031	0.0014	--
Titanium (Ti)	0.0010 - 0.0050	0.23	1.1	0.0076	0.053	0.44	--
Uranium (U)	0.00010 - 0.00050	**0.094**	**0.022**	ND	0.0017	0.017	0.02
Vanadium (V)	0.0010 - 0.0050	0.015	0.57	0.0033	0.0071	0.13	--
Zinc (Zn)	0.0030 - 0.015	0.027	**1.7**	0.017	**0.081**	**0.48**	0.03
Dissolved Metals							
Aluminum (Al)	0.0030 - 0.015	ND	ND	ND	ND	ND	--
Antimony (Sb)	0.00060 - 0.0030	ND	ND	ND	ND	ND	--
Arsenic (As)	0.00020 - 0.0010	0.00037	0.014	0.044	0.0043	0.00031	--
Barium (Ba)	0.010	0.13	1.5	1.4	0.78	0.29	--
Beryllium (Be)	0.0010 - 0.0050	ND	ND	ND	ND	ND	--
Boron (B)	0.020	0.094	0.048	0.38	0.39	0.030	--
Calcium (Ca)	0.30	120	120	200	150	160	--
Chromium (Cr)	0.0010 - 0.0050	ND	ND	ND	ND	ND	--
Cobalt (Co)	0.00030 - 0.0015	ND	0.0031	0.0042	0.0085	ND	--
Copper (Cu)	0.00020 - 0.0010	0.0044	0.0024	ND	ND	0.0023	--
Iron (Fe)	0.060	ND	1.9	40	56	0.17	--
Lead (Pb)	0.00020 - 0.0010	ND	ND	ND	ND	ND	--
Lithium (Li)	0.020	0.13	ND	0.058	0.031	0.059	--
Magnesium (Mg)	0.20	63	45	260	120	90	--
Manganese (Mn)	0.0040	0.0041	1.0	0.30	0.36	0.0084	--
Molybdenum (Mo)	0.00020 - 0.0010	0.00089	0.0055	0.0016	ND	0.00088	--
Nickel (Ni)	0.00050 - 0.0025	0.0017	0.0044	0.044	0.020	0.0015	--
Phosphorus (P)	0.10	ND	ND	0.35	0.45	ND	--
Potassium (K)	0.30	2.1	6.8	9.5	31	8.5	--
Selenium (Se)	0.00020 - 0.0010	0.00032	ND	ND	ND	0.00061	--
Silicon (Si)	0.10	7.2	7.8	21	16	8.1	--
Silver (Ag)	0.00010 - 0.00050	ND	ND	ND	ND	ND	--
Sodium (Na)	0.50	56	51	450	110	25	--
Strontium (Sr)	0.020	1.1	0.74	2.9	1.7	0.88	--
Sulphur (S)	0.20	17	0.78	2.9	1.6	49	--
Thallium (Tl)	0.00020 - 0.0010	ND	ND	ND	ND	ND	--
Tin (Sn)	0.0010 - 0.0050	ND	ND	ND	0.0078	ND	--
Titanium (Ti)	0.0010 - 0.0050	ND	ND	ND	ND	ND	--
Uranium (U)	0.00010 - 0.00050	0.086	0.00092	ND	ND	0.014	--
Vanadium (V)	0.0010 - 0.0050	ND	ND	ND	ND	ND	--
Zinc (Zn)	0.0030 - 0.015	0.0035	ND	ND	ND	0.0054	--

Notes:

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

Table 4D
Analytical Results - Groundwater - VOCs

Parameters	Detection Limit	GW-03	MW-03	MW-04	MW-05	MW-07	Tier 1 Guideline
		08/14/2013	08/16/2013	08/14/2013		08/13/2013	
Volatile Organic Compounds							
Benzene	0.00040	ND	ND	**0.011**	**0.037**	ND	0.005
Toluene	0.00040	ND	ND	0.0033	**0.040**	ND	0.024
Ethylbenzene	0.00040	ND	ND	0.0015	**0.046**	ND	0.0024
Xylenes (Total)	0.00080	ND	ND	0.0062	0.260	ND	0.3
F1 (C_6-C_{10})	0.10	ND	ND	0.12	**1.4**	ND	0.81
F2 (C_{10}-C_{16})	0.10	ND	0.15	ND	**2.3**	ND	1.1
Total Trihalomethanes	0.0020	ND	ND	ND	ND	ND	0.1
Bromodichloromethane	0.00050	ND	ND	ND	ND	ND	- -
Bromoform	0.00050	ND	ND	ND	ND	ND	- -
Bromomethane	0.0020	ND	ND	ND	ND	ND	- -
Carbon tetrachloride	0.00050	ND	ND	ND	ND	ND	0.00056
Chlorobenzene	0.00050	ND	ND	ND	0.00097	ND	0.0013
Chlorodibromomethane	0.0010	ND	ND	ND	ND	ND	- -
Chloroethane	0.0010	ND	ND	0.045	0.0055	ND	- -
Chloroform	0.00050	ND	ND	ND	ND	ND	0.0018
Chloromethane	0.0020	ND	ND	ND	ND	ND	- -
1,2-dibromoethane	0.00050	ND	ND	ND	ND	ND	- -
1,2-dichlorobenzene	0.00050	ND	ND	**0.0025**	**0.0067**	ND	0.0007
1,3-dichlorobenzene	0.00050	ND	ND	ND	ND	ND	- -
1,4-dichlorobenzene	0.00050 - 0.00055	ND	ND	ND	**0.002**	ND	0.001
1,1-dichloroethane	0.00050	ND	ND	ND	ND	ND	- -
1,2-dichloroethane	0.00050	ND	ND	**0.0094**	ND	ND	0.005
1,1-dichloroethene	0.00050	ND	ND	ND	ND	ND	0.014
cis-1,2-dichloroethene	0.00050 - 0.010	ND	0.0017	1.7	3.0	ND	- -
trans-1,2-dichloroethene	0.00050	ND	ND	ND	ND	ND	- -
Dichloromethane	0.0020	ND	ND	0.0078	ND	ND	0.05
1,2-dichloropropane	0.00050 - 0.0010	ND	ND	ND	ND	ND	- -
cis-1,3-dichloropropene	0.00050	ND	ND	ND	ND	ND	- -
trans-1,3-dichloropropene	0.00050	ND	ND	ND	ND	ND	- -
Methyl methacrylate	0.00050	ND	ND	ND	ND	ND	0.47
Methyl-tert-butylether (MTBE)	0.00050	ND	ND	ND	ND	ND	0.015
Styrene	0.00050	ND	ND	ND	ND	ND	0.072
1,1,1,2-tetrachloroethane	0.0020	ND	ND	ND	ND	ND	- -
1,1,2,2-tetrachloroethane	0.0020	ND	ND	ND	ND	ND	- -
Tetrachloroethene	0.00050	ND	ND	ND	ND	ND	0.03
1,2,3-trichlorobenzene	0.0010	ND	ND	ND	ND	ND	0.008
1,2,4-trichlorobenzene	0.0010	ND	ND	ND	ND	ND	0.015
1,3,5-trichlorobenzene	0.00050	ND	ND	ND	ND	ND	0.014
1,1,1-trichloroethane	0.00050	ND	ND	ND	ND	ND	- -
1,1,2-trichloroethane	0.00050	ND	ND	ND	ND	ND	- -
Trichloroethene	0.00050	ND	ND	0.00077	0.00062	ND	0.005
Trichlorofluoromethane	0.00050	ND	ND	ND	ND	ND	- -
1,2,4-trimethylbenzene	0.00050	ND	ND	0.00059	0.089	ND	- -
1,3,5-trimethylbenzene	0.00050	ND	ND	ND	0.017	ND	- -
Vinyl chloride	0.00050	ND	ND	**0.011**	**0.47**	ND	0.0011

Notes:

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

Table 5A
Summary of Field 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	2.6	1,317	943.3	- -	- -	- -
VW-02	25	30	4.3	2,164	943.3	- -	- -	- -
VW-03	25	30	2.7	1,388	943.3	6	15.04	15.03
VW-04	25	30	2.4	1,317	943.3	6	15.05	15.04
VW-05	25	30	2.4	1,231	943.3	- -	- -	- -

Notes:

1) Measurement of pressure by digital Cole-Parmer absolute pressure gauge.
2) Purge time is minimum elapsed time prior to the collection of a soil vapour sample.
3) Screen set at base of well.
4) Soil vapour sampling was performed on Tuesday, August 13, 2013.
5) VW-01, VW-02 and VW-05 not sampled due to submerged screen.

Table 5B
Analytical Results - Soil Vapour - General Indices

Parameters	Units	Detection Limit	VW-01	VW-02	VW-03	VW-04	VW-05
Gauge Pressure							
Following sampling	psi	- -	NT	NT	-5.0	-5.0	NT
Reported by laboratory	psi	- -	NT	NT	-4.0	-3.0	NT
Fixed Gases							
Oxygen	% v/v	0.2	NT	NT	8.0	20.7	NT
Nitrogen	% v/v	0.2	NT	NT	71.8	77	NT
Carbon Monoxide	% v/v	0.2	NT	NT	ND	ND	NT
Methane	% v/v	0.2	NT	NT	5.2	ND	NT
Carbon Dioxide	% v/v	0.2	NT	NT	15.1	2.3	NT

Notes:

1) Soil vapour sample collected on Thursday, August 13, 2013.
2) ND - Not Detected, less than the limit of method detection.
3) NT - Not Tested.
4) - - No value established in the detection limit.
5) VW-01, VW-02 and VW-05 not sampled due to submerged screen.
6) For further information, the reader should refer to the laboratory report in Appendix A.

Table 5C
Analytical Results - Soil Vapour - VOCs

Parameters	Units	Detection Limit	VW-03	VW-04
			08/13/2013	
Hydrocarbon Fractions				
Aliphatic >C_5-C_6	µg/m^3	5.0	176	15.7
Aliphatic >C_6-C_8	µg/m^3	5.0	231	59.7
Aliphatic >C_8-C_{10}	µg/m^3	5.0	68.4	36.6
Aliphatic >C_{10}-C_{12}	µg/m^3	5.0	226	95.0
Aliphatic >C_{12}-C_{16}	µg/m^3	5.0	58.6	25.3
Aromatic >C_7-C_8 (TEX Excluded)	µg/m^3	5.0	ND	ND
Aromatic >C_8-C_{10}	µg/m^3	5.0	50.7	23.9
Aromatic >C_{10}-C_{12}	µg/m^3	5.0	62.5	22.7
Aromatic >C_{12}-C_{16}	µg/m^3	5.0	ND	ND
Select Volatile Gases				
Acetylene	ppm	0.19 - 0.22	ND	ND
Ethane	ppm	0.19 - 0.22	0.38	ND
Ethylene	ppm	0.19 - 0.22	ND	ND
Methane	ppm	4.4	- -	58
n-Butane	ppm	0.38 - 0.44	ND	ND
n-Pentane	ppm	0.19 - 0.22	ND	ND
Propane	ppm	0.19 - 0.22	0.19	ND
Propene	ppm	0.19 - 0.22	ND	ND
Propyne	ppm	0.38 - 0.44	ND	ND
Volatile Organic Compounds				
Benzene	ppbv	0.18	0.69	0.65
Toluene	ppbv	0.20	2.81	2.91
Ethylbenzene	ppbv	0.20	1.31	0.96
Xylene (Total)	ppbv	0.60	8.12	4.63
Dichlorodifluoromethane (FREON 12)	ppbv	0.20	2.82	1.15
1,2-Dichlorotetrafluoroethane	ppbv	0.17	11.0	ND
Chloromethane	ppbv	0.30	3.09	1.50
Vinyl Chloride	ppbv	0.18	3.01	0.83
Chloroethane	ppbv	0.30	0.52	ND
1,3-Butadiene	ppbv	0.50	ND	ND
Trichlorofluoromethane (FREON 11)	ppbv	0.20	ND	0.59
Ethanol (ethyl alcohol)	ppbv	2.3 - 4.6	143	101
Trichlorotrifluoroethane	ppbv	0.15	ND	ND
2-propanol	ppbv	3.0	3.5	ND
2-Propanone	ppbv	0.80	25.8	21.1
Methyl Ethyl Ketone (2-Butanone)	ppbv	3.0	ND	3.5
Methyl Isobutyl Ketone	ppbv	3.2	ND	ND
Methyl Butyl Ketone (2-Hexanone)	ppbv	2.0	ND	ND
Methyl t-butyl ether (MTBE)	ppbv	0.20	ND	ND
Ethyl Acetate	ppbv	2.2	ND	ND
1,1-Dichloroethylene	ppbv	0.25	ND	ND
cis-1,2-Dichloroethylene	ppbv	0.19	1.37	0.59
trans-1,2-Dichloroethylene	ppbv	0.20	ND	ND
Methylene Chloride(Dichloromethane)	ppbv	0.80	0.97	ND
Chloroform	ppbv	0.15	ND	ND
Carbon Tetrachloride	ppbv	0.30	ND	ND
1,1-Dichloroethane	ppbv	0.20	ND	ND
1,2-Dichloroethane	ppbv	0.20	ND	ND
Ethylene Dibromide	ppbv	0.17	ND	ND
1,1,1-Trichloroethane	ppbv	0.30	ND	ND
1,1,2-Trichloroethane	ppbv	0.15	ND	ND
1,1,2,2-Tetrachloroethane	ppbv	0.20	ND	ND
cis-1,3-Dichloropropene	ppbv	0.18	ND	ND
trans-1,3-Dichloropropene	ppbv	0.17	ND	1.91
1,2-Dichloropropane	ppbv	0.40	ND	ND
Bromomethane	ppbv	0.18	ND	ND
Bromoform	ppbv	0.20	ND	ND
Bromodichloromethane	ppbv	0.20	ND	ND
Dibromochloromethane	ppbv	0.20	ND	ND
Trichloroethylene	ppbv	0.30	ND	ND
Tetrachloroethylene	ppbv	0.20	ND	ND
Styrene	ppbv	0.20	0.20	ND
4-ethyltoluene	ppbv	2.2	ND	ND
1,3,5-Trimethylbenzene	ppbv	0.50	1.38	0.54
1,2,4-Trimethylbenzene	ppbv	0.50	2.29	1.08
Chlorobenzene	ppbv	0.20	ND	ND
Benzyl chloride	ppbv	1.0	ND	ND
1,3-Dichlorobenzene	ppbv	0.40	ND	ND
1,4-Dichlorobenzene	ppbv	0.40	ND	ND
1,2-Dichlorobenzene	ppbv	0.40	ND	ND
1,2,4-Trichlorobenzene	ppbv	2.0	ND	ND
Hexachlorobutadiene	ppbv	3.0	ND	ND
Hexane	ppbv	0.30	13.8	1.83
Heptane	ppbv	0.30	2.78	1.31
Cyclohexane	ppbv	0.20	11.9	2.21
Tetrahydrofuran	ppbv	0.40	ND	ND
1,4-Dioxane	ppbv	2.0	ND	ND
Vinyl Bromide	ppbv	0.20	ND	ND
Propene	ppbv	0.30	ND	11.6
2,2,4-Trimethylpentane	ppbv	0.20	5.11	1.00
Carbon Disulfide	ppbv	0.50	1.79	37.0
Vinyl Acetate	ppbv	0.20	ND	ND

Notes:
1) Results are from sampling performed on Thursday, August 13, 2013.
2) ND - Not Detected, less than the limit of method detection.
3) 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-03		VW-04	
			08/13/2013			
	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm
Trimethylsilyl Fluoride	- -		ND	ND	ND	ND
Tetramethylsilane	0.0001	0.0001	ND	ND	ND	ND
Methoxytrimethylsilane	0.0029 - 0.0030	0.0007	ND	ND	ND	ND
Ethoxytrimethylsilane	0.0028 - 0.0029	0.0006	ND	ND	ND	ND
Trimethylsilanol	- -	- -	0.0142	0.0038	0.0102	0.0028
Isopropoxytrimethylsilane	0.0012	0.0002	ND	ND	ND	ND
Trimethoxymethyl Silane #	- -	- -	ND	ND	ND	ND
Hexamethyl Disiloxane - L2	0.0001	0.0001	ND	ND	ND	ND
Propoxytrimethylsilane	0.0032 - 0.0033	0.0006	ND	ND	ND	ND
1-Methylbutoxytrimethylsilane *	- -	- -	ND	ND	ND	ND
Butoxytrimethylsilane *	- -	- -	ND	ND	ND	ND
Trimethoxyvinyl Silane #	- -	- -	ND	ND	ND	ND
Hexamethyl Cyclotrisiloxane - D3	- -	- -	0.0317	0.0035	0.0135	0.0015
Octamethyl Trisiloxane - L3	0.0002	0.0001	ND	ND	ND	ND
Triethoxyvinyl Silane #	- -	- -	ND	ND	ND	ND
Triethoxyethyl Silane #	- -	- -	ND	ND	ND	ND
Octamethyl Cyclotetrasiloxane - D4	- -	- -	0.0276	0.0023	0.0172	0.0014
Decamethyl Tetrasiloxane - L4	0.0003	0.0001	ND	ND	ND	ND
Tetraethylsilicate #	- -	- -	ND	ND	ND	ND
Decamethyl Cyclopentasiloxane - D5	- -	- -	0.0357	0.0024	0.0246	0.0016
Dodecamethyl Pentasiloxane - L5	0.0028	0.0002	ND	ND	ND	ND
Dodecamethyl Cyclohexasiloxane - D6	- -	- -	0.2163	0.0119	0.1685	0.0093
Sum			0.3396	0.0263	0.2476	0.0189

Notes:

1) Soil vapour samples collected on Thursday, August 13, 2013.
2) ND - Not Detected, less than the limit of method detection.
3) - - No value established in the detection limit.
4) V=200 mL, where V is volume of air/gas sampled.
5) * - Semiquanititative (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.