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VAPOUR INTRUSION ASSESSMENT AND ENVIRONMENTAL MONITORING REPORT
MONTFORT LANDFILL
RED DEER, ALBERTA

Prepared for:

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ES 1. EXECUTIVE SUMMARY

XCG Consulting Limited (XCG) was retained by the City of Red Deer (City) to implement a vapour intrusion assessment and environmental monitoring program at the Montfort Landfill (Site), as per XCG's proposals dated August 23, 2016 and November 7, 2016 and proposed investigation program dated April 11, 2017.

The Montfort Landfill, legally described as NE 20-38-27 W4M, and Lot S1, Plan 3762NY and Block Z, Plan 982 0142, is reported to have been in operation in 1968 and 1969, accepting municipal solid waste from the City.

XCG understands that the objective of this vapour intrusion assessment and environmental monitoring program was to address the environmental recommendations in the previously completed reports, and to ascertain the current condition of the Site and delineate any impact / risk to indoor air receptors. The recommendations listed in the previously completed reports include:

- Additional groundwater elevations and soil vapour data on a quarterly basis for one hydrogeological cycle; and
- A second data set of soil vapour and groundwater chemistry, groundwater elevations, and headspace measurements during winter conditions.

The following activities were included in the scope of work for this vapour intrusion assessment and environmental monitoring program:

- XCG installed an additional eight monitoring wells (MWs) and an additional nine soil vapour probes (SVPs) on and adjacent to the Site in December of 2016. These monitoring wells and soil vapour probes were installed to better delineate the extent of the previously reported groundwater and soil vapour quality impacts in the vicinity of the Montfort Landfill.
- Hydraulic monitoring to record the depth to groundwater for groundwater monitoring wells and soil vapour probes was conducted on a quarterly basis to confirm groundwater flow direction and seasonal fluctuations.
- Soil vapour field monitoring on a quarterly basis in conjunction with the hydraulic monitoring.
- Groundwater sampling and laboratory analysis of 13 groundwater samples in the first quarter (March) of 2017 (in frozen conditions).
- Soil vapour sampling and laboratory analysis from 12 soil vapour probes in the first quarter (March) of 2017 (in frozen conditions).
- Indoor air quality monitoring at select residential properties adjacent to the Site in the first quarter (March) of 2017 (in frozen conditions).
- Development of site specific vapour screening levels and health based indoor air criteria.

- Data review, determination of extent and/or location of groundwater impacts from the Site, and assessment of potential risks (hazard quotients) associated with vapour inhalation.

The following conclusions are based on the information and data generated during XCG's investigation described herein:

- The 2017 hydraulic monitoring results indicate that there is evidence of a perched groundwater table located above the clay layer beneath the Site and a separate shallow groundwater unit present deeper in the clay. The monitoring wells located northwest of the Site show a groundwater flow direction from north to south in the shallow groundwater unit located within the clay, which is consistent with local topography. The groundwater elevations in the shallow monitoring wells installed on top of the clay show a radial flow outwards from the landfill with a southerly trend at the southeast corner and a northerly trend at the north side of the Site.
- Over the course of the four quarterly monitoring events, seven of the 14 soil vapour probes had methane detected in them on at least one occasion during 2017. Based on the results of the quarterly soil vapour monitoring, methane was found to be present in soil vapour probes located on-Site within the limits of waste. Methane was also detected to the north of the Site (outside the limit of waste) adjacent to the residential homes on Hermary Street, and south of the Site (outside the limit of waste) on the west side between the Site and the multi-tenant residential dwelling of Montfort Heights.
- Groundwater concentrations at monitoring well XCG-14(MW), located northwest of the landfill, were all less than the 2016 Tier 1 SGRG with the exception of total dissolved solids (TDS) and dissolved manganese which exceeded the 2016 Tier 1 SGRG. This monitoring well is considered to represent background groundwater quality at the Site in the shallow groundwater unit based on its location up gradient of the Site. Given the radial flow outwards from the landfill in the perched water table, there is no monitoring location up gradient that represents background groundwater quality in the perched groundwater unit. Groundwater quality at monitoring points within the limit of waste were found to be impacted by parameters consistent with leachate characteristics.
- Groundwater quality results indicate that monitoring well XCG-5(MW), located south of the landfill and screened in the perched groundwater unit, is not impacted by landfill leachate. Since no analyzed parameters exceeded the 2016 Tier 1 SGRG at XCG-5(MW), it appears that the perched groundwater is attenuating by the time it reaches this monitoring point located approximately 35 metres south of the limit of waste. Monitoring well XCG-6(MW), located south of the landfill and screened in the perched groundwater unit, is impacted by leachate, as indicated by the elevated concentrations of TDS, dissolved nitrate, and dissolved manganese, all of which were above the 2016 Tier 1 SGRG. Monitoring well XCG-13(MW), located adjacent to the north limit of waste and screened in the perched groundwater, is impacted by leachate, as indicated by the elevated concentrations of TDS, dissolved chloride, and dissolved manganese, all of which were above the 2016 Tier 1 SGRG. The extent of the perched groundwater impacts down gradient

(south and east), and up gradient (north) of the site have not been fully delineated. However, the leachate-related parameters in perched groundwater appear to attenuate within approximately 35 metres of the landfill, as indicated by the groundwater quality results from samples collected from well XCG-5(MW) that is located south of the landfill. Because there are no other wells located outside the limits of waste that are screened in the perched groundwater, it cannot be confirmed that the quality of perched groundwater improves away from the Site in all other directions. However, it is likely that the leachate-related parameters do attenuate in the same rate in all directions away from the Site.

- Groundwater quality results indicate that monitoring wells XCG-1(MW) and XCG-2(MW), located adjacent to the west of the landfill and screened in the shallow groundwater unit (within the clay layer), are not impacted by leachate. Monitoring well XCG-12(MW), located adjacent to the north limit of the landfill and screened in the shallow groundwater unit, is likely impacted by leachate as indicated by the presence of dissolved metals and nutrients above the 2016 Tier 1 SGRG and background groundwater quality.
- Soil vapour results from the 12 samples collected during frozen conditions (March 2017) indicated the presence of methane, vinyl chloride (VC), and cis-1,2-dichloroethylene (cis-1,2-DCE) at concentrations that exceeded the derived soil vapour screening criteria at four locations. Two locations were within the limit of waste (at the southeast and southwest corners) and the remaining two were outside the limit of waste to the north, and south of the Site. The extent of soil vapour impacts north, east, west and south of the site have not been fully delineated.
- The indoor air quality at the 10 residences located north, east, west and south of the Site did not have detectable concentrations of methane, VC, or cis-1,2-DCE. The laboratory reportable detection limits (RDLs) were set below the Health Based Indoor Air Criteria. Based on the above, it is unlikely that soil vapour impacted by the Site is migrating into the indoor air of the residences adjacent to the Site.
- Risk characterization completed for residential, institutional, and commercial receptors based on groundwater to indoor air and soil vapour to indoor air exposure pathways confirmed potential risks above acceptable levels for each of these receptors and pathways. However, risk characterization completed based on the worst case (frozen ground condition) direct measured indoor air sampling results, confirmed that risks were well within acceptable risk values.
- Risk characterization based on worst case soil vapour concentrations of VC and cis-1,2-DCE were determined to represent a potential risk to utility workers exposed to trench air.
- Due to the presence of methane detected in soil vapour probes XCG-13(SVP) and XCG-6(SVP) located outside the limit of waste and XCG-4(SVP) located within the limit of waste (nearest monitoring point to residences located east of the Site), it is recommended that select soil vapour probes [XCG-1(SVP), XCG-2(SVP), XCG-4(SVP), XCG-5(SVP), XCG-6(SVP), XCG-9(SVP), XCG-10(SVP), XCG-12(SVP), and XCG-13(SVP)] be monitored twice annually in September (due to

methane concentrations recorded during the 2017 September monitoring event) and March (under frozen conditions to represent the worst case scenario/highest potential for LFG migration) using a handheld LFG analyzer. If methane volumes of 2.5 % v/v (50% LEL) are detected at any of the monitoring locations, it is then recommended that an indoor air sample be collected at the nearest residence/building to the monitoring location. It is also recommended that hydraulic monitoring be conducted in conjunction with the LFG monitoring events in order to aid in determining if soil vapour probes are blinded and to monitor groundwater flow across the Site and further confirm the presence of a perched groundwater unit at the Site. This semi-annual LFG and hydraulic monitoring program should be implemented for a period of three years, followed by a review of all results to determine the best approach going forward.

- Due to the potential risk for vapour inhalation identified for the construction/utility worker exposed to trench air, health and safety precautions (i.e. use of a four gas meter) should be taken when entering any trench. Personal protective equipment should be worn, as appropriate depending on monitoring results.
- Additionally, it is recommended that monitoring wells that were previously installed by others with screens straddling the waste, the clay layer and the underlying sand (i.e. MW-01, MW-03, and MW-04) be decommissioned. These wells should be decommissioned, because they hydraulically connect the leachate-impacted perched groundwater within the waste to the deeper shallow groundwater unit.

ES 1.1 Additional Consideration

The surface topography at the Site has subsided leaving a slightly irregular surface. This has produced a number of lower-lying surface areas throughout the site, which often become water-saturated/flooded following rainfall. Repeated ponding of storm water makes these surfaces even more susceptible to infiltration and percolation of water into the underlying landfill material, generating leachate. Therefore, as a future consideration in conjunction with any future maintenance of the sports field on the site, would be to fill these low areas to reduce ponding and leachate generation.

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1. INTRODUCTION

XCG Consulting Limited (XCG) was retained by the City of Red Deer (City) to implement a vapour intrusion assessment and environmental monitoring program at the Montfort Landfill (Site), as per XCG's proposals dated August 23, 2016 and November 7, 2016, and proposed investigation program dated April 11, 2017. The Site is legally described as NE 20-38-27 W4M, and Lot S1, Plan 3762NY and Block Z, Plan 982 0142. The Site location and approximate limit of waste are shown on Figure 1.

1.1 Purpose and Use

XCG understands that there are eight historic disposal sites located within the City limits, and that municipal solid waste was disposed in these areas prior to 1972. From 2013 to 2015, the City undertook Phase I Environmental Site Assessments (ESAs), Phase II ESAs, and Environmental Risk Management Plans (ERMPs) for the eight historic waste disposal sites, including the Site.

The Site was reportedly in operation in 1968 and 1969, accepting municipal solid waste from the City. After the Site was closed, and prior to the changes in regulation prohibiting residential encroachment to closed landfill sites, numerous residences/ buildings were developed adjacent to the Site. The results of the Phase I ESA, Phase II ESA, and ERMP for the Site indicated that additional environmental monitoring and investigations were required to determine the potential for landfill gases to impact the homes and residents neighbouring the Site. Specifically, the reports recommended additional groundwater elevations and soil vapour data be obtained on a quarterly basis for one hydrogeological cycle to better understand the local flow pattern and risks presented to groundwater. Further, the reports recommended that a second data set consisting of soil vapour and groundwater chemistry, groundwater levels, and headspace measurement be obtained during a winter period in order to illustrate the worst case for seasonal variability of soil vapours.

XCG understands that the objective of this vapour intrusion assessment and environmental monitoring program was to address the environmental recommendations in the previously completed reports, and to ascertain the current condition of the Site and delineate any impact / risk to adjacent indoor air receptors. The recommendations listed in the previously completed reports include:

- Additional groundwater elevations and soil vapour data on a quarterly basis for one hydrogeological cycle; and
- A second data set of soil vapour and groundwater chemistry, groundwater elevations, and headspace measurements during winter conditions.

The following report describes the activities conducted in 2016 and 2017 and summarizes the results, provides interpretation of the results, and the conclusions with regard to the findings.

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2. BACKGROUND

2.1 Geology

The geology underlying the Site is characterized by Tertiary bedrock units overlain by Quaternary surficial deposits of clay, silt, sand and gravel. The bedrock belongs to the Mid-Late Paleocene-aged Paskapoo Formation, and is generally located at approximately 20 metres below ground surface (bgs) in the area surrounding the Site (Stantec, 2006). The Paskapoo Formation is comprised of alternating layers of mudstone, siltstone and sandstone. According to Tiamat Environmental Consultants (Tiamat), the structural integrity of the Paskapoo Formation in this area is closely related to the formation of the Rocky Mountains, which generated regional stresses and subsequent fracturing of the Paskapoo Formation (Tiamat, 2013). Reportedly, these fracture patterns are predominantly oriented perpendicular to the trend of the Rocky Mountains, and are expressed as southwest to northeast-trending vertical fractures (Tiamat, 2013), and the vertical fracture patterns may also be accompanied by sub-horizontal fractures (Bachu & Michael, 2002). Directly overlying the bedrock in the Red Deer River valley is pre-glacial gravel and sand. These gravel sediments reportedly range in thickness from 6 to 12 metres (Tiamat, 2013) and are a known groundwater resource.

Analysis of the local surficial soils was conducted by Tiamat (2013). This report described the surficial soils as being mostly poorly to moderately sorted sand, silt and gravel with varying amounts of clay. Bedding planes in these sediments were difficult to differentiate.

XCG conducted shallow monitoring well and borehole drilling on Site and at properties immediately adjacent to the Site in 2016, which provided additional information regarding the local shallow geology. Most of these boreholes ranged from approximately 2 to 10 metres bgs. The boreholes generally intersected a top-down sequence of imported or regular topsoil, followed by clay, clayey silt/silty clay, and/or sand. Imported soils that were intersected in the drilling program consisted of dry topsoil with clay contents. The regular topsoil intervals were predominantly dark brown with silt and sand contents, and occasional occurrence of pockets of red oxidation. The clay intervals were characterized as being high plasticity, and dark brown/black with occasional blue (reduced) pockets. Clayey silt and silty clay intervals were medium to dark brown. Sandy intervals are generally medium brown and fine to very fine with silt contents, as well as some redox (red and blue) striations. Some boreholes intersected municipal solid waste consisting of wood debris or plastic bags. Moisture levels generally increase with depth towards the water table. None of these boreholes were drilled to sufficient depths to contact gravel deposits or bedrock.

Stratigraphic logs for the monitoring wells and soil vapour probes installed by XCG are included as Appendix A. Figures 2, 3, 4, 5, and 6 illustrate cross sections along the north perimeter of the Site, the south portion of the Site, the west perimeter of the Site, and through the east portion of the Site, based on the stratigraphy recorded in the borehole logs during drilling activities completed by Tiamat in 2013 and XCG in 2016.

2.2 Topography

The Site is located at the top of an upland area overlooking the Red Deer River Valley to the south. Topography decreases more rapidly to the south of the Site towards the incised Red Deer River, which lies approximately 31 metres below the Site. The Site topography is defined by generally mild slopes. Maximum topographic relief within the Site is less than 2 metres.

A figure showing the topography of the Site and surrounding area from the 2013 Phase I ESA conducted by Tiamat in 2013 is provided in Appendix B.

2.3 Drainage

The Site's nearest permanent surface water feature is the Red Deer River, located approximately 800 metres to the southeast. The Red Deer River is also the area's primary drainage system. As shown in Appendix B, the Red Deer River traverses the southeastern portion of the mapped area, approximately 550 metres south of the site. The Red Deer River flows from the south to the northeast through the mapped area, as it travels from its source in the Rocky Mountains to converge with the South Saskatchewan River near the Saskatchewan border.

Since the original landscaping and flattening of the Site to be used as a recreational field, the surface topography at the Site has subsided, leaving a slightly irregular surface. According to Tiamat, this differential settlement has produced a number of lower-lying surface areas throughout the site, which often become water-saturated following rainfall (Tiamat, 2014). Reportedly, the ponding of storm water in the low-lying areas results in additional infiltration though the cap of the landfill, and ultimately results in the generation of more leachate (Tiamat, 2014 ERMP).

2.4 Hydrogeology

Regional groundwater appears to generally follow the trend of the bedrock topography. According to Tiamat, the Site itself lies in an area of recharge with a downward flow component (Tiamat, 2014 ERMP). Based on the topographic map in Appendix B, this indicates that the regional groundwater flows in a general east-southeast direction, towards the topographically-low Red Deer River Valley (Tiamat, 2014 ERMP). Regionally, the groundwater table reportedly has a gradient of approximately 0.004 to 0.011 m/m towards the southeast (Tiamat, 2014 ERMP).

Local groundwater levels and flow pathways are however, governed mostly on a combination of local geology, topography, water source wells, and land development, and as such, may fluctuate considerably from the regional patterns (Tiamat, 2013). Seasonal variations also influence the local groundwater flow and levels in this area. For example, flow conditions in the Red Deer River (July to August) reportedly tend to release bank water storage in the gravel deposits (Tiamat, 2013).

The Red Deer Area hosts two major, distinguishable aquifers (Gabert, 1975). According to Tiamat, the upper aquifer is a combination of sandstones of the Paskapoo Formation and permeable overburden glacial drift deposits (Tiamat, 2013). The lower aquifer reportedly belongs to the lower Paskapoo Formation sandstone, but it is generally confined from the upper aquifer by thick layers of shale and less permeable clays/silts (Tiamat, 2013).

There is a large, approximately 21-metre deep buried valley aquifer that trends northeastward through the map area. The gravels surrounding the Red Deer River are a known source of groundwater. In addition to the Red Deer River, there are also a number of other nearby surface water features in and around Red Deer, including Hazlett Lake, Waskasoo Creek, Gaetz Lakes, and the Bower Ponds.

Based on the depths of the wells installed and the groundwater elevations measured during the four quarterly monitoring events completed during 2017, there is evidence of a perched groundwater table located above the clay and a separate shallow groundwater unit present deeper in the clay. The monitoring wells located in the northwest corner of the Site show a groundwater flow direction from north to south in the shallow groundwater unit located within the clay, which is consistent with the local topography. The groundwater elevations in the shallow monitoring wells installed on top of the clay show a radial flow outwards from the landfill with a southerly trend at the southeast corner of the Site and a northerly trend at the north side of the Site (see Section 7.1).

2.5 Groundwater and Surface Water Resource Usage

Reportedly, the groundwater in the Red Deer Area is predominantly carbonate and sodium bicarbonate-type (Le Breton, 1971). Sodium sulfate-type groundwater is present in considerable quantities, and very minor quantities of chloride water have also been reported (Le Breton, 1971). Reportedly, potable groundwater is typically found at depths of up to 300 metres in west Red Deer, and up to 90 metres in the east (Le Breton, 1971; Tiamat, 2013).

The ERMP completed by Tiamat in 2014 suggests that groundwater is not used at any locations directly down gradient (southeast) from the Site. Figure 7 summarizes information and data obtained from public records for the surface water and groundwater usage within a 300-metre radius of the Site. According to this, no water wells have been drilled down gradient of the Site. The Red Deer River, located approximately 800 metres southeast of the Site, has been used for municipal water supply purposes by the City since 1909; therefore, groundwater in the vicinity of the Site is not used for potable water purposes.

2.6 Potential Sources of Contamination

According to the Phase I ESA completed by Tiamat in 2013, there are no obvious activities on adjacent lands that are interpreted as an environmental concern relative to the Site. The land surrounding the Site is predominantly residential, with commercial and light industrial land (grocery stores, restaurants, etc.) located to the northeast of the Site. No major industrial buildings (factories), gas stations, or other potential contaminant contributors are found in the immediate vicinity of the Site.

The leachate and landfill gas contamination associated with the Site are the only known source of contamination in the area of, and adjacent to the Site. The Phase I and II ESAs completed by Tiamat in 2013 and 2014, respectively, assert that there were no other sources of contamination identified at the Site and in the vicinity of the Site.

Common landfill-sourced contaminants in groundwater include benzene, ethylbenzene, 1,4-dichlorobenzene, tetrachloroethene (PCE), trichloroethene (TCE), and (vinyl chloride) VC. Landfill-sourced contaminants in soil vapour include volatile organic compounds (VOCs) (aliphatics, aromatics, chlorinated, non-chlorinated, alcohols, oxygenated, and ketones) (Tiamat 2014, ERMP).

2.7 Potential Receptors

The ERMP completed by Tiamat in 2014 found that generally, the primary pathways of landfill contaminants are via groundwater and landfill gas (LFG). According to Tiamat, the biotic and soil contact pathways were not deemed to be of considerably high risk to the public (Tiamat, 2014 ERMP). Reportedly, there was no visual evidence of contamination impact in the surrounding flora and fauna (Tiamat, 2014 ERMP). The ERMP completed by Tiamat in 2014 identified a number of potential ecological and landfill soil gas receptors in the area surrounding the site.

2.7.1 Groundwater and Surface Water Receptors

As discussed in Section 2.5 above, there are no down gradient groundwater and surface water resource uses located within 300 metres of the Site. The most sensitive groundwater and surface water receptor is the Red Deer River, which is located approximately 800 metres southeast of the Site. This is because the Red Deer River is used for municipal water supply purposes for the City.

2.7.2 Ecological Receptors

Figure 8 displays the identified ecological receptors within 300 metres of the Site (i.e. surface water courses, wetlands), which includes greenspace areas that are zoned A2 – Environmental Preservation District under the City's Land Use Bylaw 3357/2006. Ecological receptors located down gradient and cross-gradient of the site include the greenspace located within 200 metres to the west and south of the Site.

2.7.3 Landfill Gas (LFG) Receptors

LFG is created as a by-product of waste decomposition. Common components of LFG include methane, carbon dioxide, as well as minor amounts of nitrogen, oxygen and VOCs. LFG's typically travel vertically through the waste pile to escape into the atmosphere. It is most risky, however, when LFG is trapped by a less permeable surface material. In this case, the LFG's will travel laterally, increasing the potential that they come in contact with underground LFG receptors. According to Tiamat, the most sensitive receptors of contamination that were identified at this Site are the developments that are located nearby and adjacent to the Site, including (Tiamat, 2014 ERMP):

- A shopping mall (Village Mall) located less than 100 metres to the northeast of the Site;
- Multi-tenant residential dwellings including Wedgewood Gardens located adjacent to the east of the site, Village Park Estates located adjacent to the

southeast of the Site, Montfort Heights located adjacent to the south of the Site, and The Views at St. Joseph located approximately 130 metres south of the Site;

- The administration offices for Montfort Centre Red Deer Catholic Schools located adjacent to the south of the Site; and
- Detached residential dwellings with basements located adjacent to the north and west of the Site.

Utility corridors, including a gas line located adjacent to the north and west of the Site, a water line located adjacent to the west of the Site, a sanitary line located along the west side of the limit of waste, and a storm line located along the west side of the Site and limit of waste, can act as preferential pathways for LFG migration to potential receptors. During the installation of additional groundwater monitoring wells and soil vapour probes (further discussed in Section 5), XCG observed that the utility corridor located near the northwest corner of the Site appeared to be backfilled with native clay material, and therefore is unlikely to act as a preferential pathway (see stratigraphic log for XCG-9(SVP) in Appendix A).

The lack of a low permeability cap on the Site means that most of the LFG will likely escape via venting. Soil vapour intrusion is the primary route of exposure for LFG. Figure 9 shows the locations of above-listed potential LFG receptors and utility corridors in relation to the Site.

3. SCOPE OF WORK

The vapour intrusion assessment and environmental monitoring program described herein was based on the scope of work previously described in detail in the XCG proposals dated August 23, 2016 and November 7, 2016 and proposed investigation program dated April 11, 2017.

The main tasks and activities completed as part of the vapour intrusion assessment and environmental monitoring program included:

- Installation of an additional eight monitoring wells (MWs) and an additional nine soil vapour probes (SVPs) on and adjacent to the Site in December of 2016. These monitoring wells and soil vapour probes were installed to better delineate the extent of the previously reported groundwater and soil vapour quality impacts in the vicinity of the Site.
- Hydraulic monitoring, on a quarterly basis, of groundwater monitoring wells and soil vapour probes to record the depth to groundwater to confirm groundwater flow direction and seasonal elevation fluctuations;
- Soil vapour field monitoring on a quarterly basis in conjunction with the hydraulic monitoring;
- Groundwater sampling and laboratory analysis of 13 groundwater samples collected from all accessible monitoring wells in the first quarter (March) of 2017 (in frozen conditions);
- Soil vapour sampling and laboratory analysis from 12 soil vapour probes in the first quarter (March) of 2017 (in frozen conditions);
- Indoor air quality monitoring at select residential properties adjacent to the Site in the first quarter (March) of 2017 (in frozen conditions);
- Development of site specific vapour screening levels and health based indoor air criteria; and
- Data review, determination of extent and/or location of groundwater impacts from the Site, and assessment of potential risks (hazard quotients) associated with vapour inhalation.

4. REGULATORY SETTING

The Site has been inactive for about 47 years, and is considered to be a non-operating municipal landfill. According to Tiamat there is no regulatory requirement to remediate or decommission/remove the waste material from its present location (Tiamat 2014).

Below is a description of the assessment criteria used to evaluate the results of the various monitoring activities undertaken for this vapour intrusion assessment and environmental monitoring program.

4.1 Assessment Criteria

4.1.1 Groundwater Criteria

The groundwater quality was assessed with respect to the Alberta Environment and Parks (AEP) 2016 Tier 1 and Tier 2 Soil and Groundwater Remediation Guidelines (2016 Tier 1 and Tier 2 SGRG). The 2016 Tier 1 SGRG are based on the assumption that all exposure pathways and receptors are present on-site, and the lowest criteria for all pathways/receptors is selected as the generic guideline value for the parameters of concern. The 2016 Tier 2 SGRG are based on site-specific conditions that allows exclusion of potential human and/or ecological exposure pathways not present/ relevant to the Site.

Given that the Site and surrounding area is zoned either multiple family or low density residential, parks and recreation, or public service (institutional or government) (The City of Red Deer Interactive Map), the groundwater samples were assessed with respect to the 2016 Tier 1 and 2 SGRG criteria for residential/parkland land use. Because grain size analysis was not historically completed for the Site, the groundwater samples were assessed with respect to the most conservative 2016 Tier 1 and Tier 2 SGRG criteria for either fine or coarse-grained soil.

4.1.2 Indoor Air Quality Criteria

Indoor Air Quality Criteria were derived for each Contaminant of Concern (COC) based on Toxicity Reference Values (TRV) as published in Table A-7 Human TRVs of the Alberta Tier 2 Guidelines. For COCs that did not have TRVs published in the Alberta Tier 2 Guidelines and for contaminants with more recent toxicological data, conservative TRVs were selected from Canadian Council of Ministers of the Environment (CCME) or United States Environmental Protection Agency (USEPA) Integrated Risk Information System (IRIS). The selected TRVs are summarized in Appendix C (Table C1) and were discussed with AEP and Alberta Health Services (AHS) personnel prior to finalizing the list.

The allowable health based indoor air concentration was calculated for each COC using the selected TRV for that contaminant. In order to be conservative, and as directed by AEP, exposure pro-rating was not utilized to adjust the allowable limits. Candidate indoor air concentrations were calculated for both threshold and non-threshold effects and the lowest risk level was selected as the allowable health based indoor air concentration (see Table C2 in Appendix C).

Methane in indoor air was assessed based on the "Draft Soil and Building Methane Gas Management Guide," dated October 2013 and prepared by AHS (AHS, 2013). A trigger value of between 2,500 and <5,000 parts per million by volume (ppmv) [5.0 to <10.0 % lower explosive limit (LEL)] was selected for indoor air. As recommended in Table 7 of the AHS 2013 document, indoor methane concentrations detected in this range (2,500 and <5,000 ppmv) require a detailed indoor air monitoring program be completed throughout the building, and methane mitigation strategies be implemented (sealing cracks, service entry points, etc.). Concentrations >5,000 ppmv (>10 % LEL) will require building evacuation and ventilation to remove explosion hazard.

4.1.3 Soil Vapour Criteria

The following section provides the rationale for the site specific vapour criteria developed for the Site. The derivation of the criteria is illustrated in Tables C1 to C3 in Appendix C.

Soil Vapour Screening Levels (SVSLs) were derived from current TRVs in accordance with the CCME document entitled "A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours," dated 2014 (CCME, 2014). A SVSL was derived for the contaminants of concern identified in groundwater and soil vapour in the previous environmental assessment completed by Tiamat, as reported in the "Environmental Risk Management Plan, Historic Waste Disposal Site, Montfort Landfill Site, The City of Red Deer," dated November 21, 2014 (Tiamat, 2014). In addition, petroleum hydrocarbon (PHC) fractions F1 and F2 are also identified as COCs based on the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) parameters in soil and groundwater.

The TRVs selected were those published in Table A-7 Human Toxicity Reference Values of the Alberta Environment publication entitled "Alberta Tier 2 Soil and Groundwater Remediation Guidelines," dated February 2, 2016 (Alberta Tier 2 Guidelines). For contaminants of concern that did not have TRVs published in the Alberta Tier 2 Guidelines and for contaminants with more recent toxicological data, conservative TRVs were selected from CCME or the USEPA IRIS. The selected TRVs are summarized in Appendix C1 and have been reviewed and accepted by AEP and Alberta Health Services (AHS). It should be noted that some of the contaminants of concern identified by Tiamat did not have available published TRVs and as such, no SVSLs were derived for these parameters.

An allowable health based indoor air concentration was calculated for each contaminant of concern using the selected TRV for that contaminant. In order to be conservative, and as directed by AEP, exposure pro-rating was not utilized to adjust the allowable limits. Candidate indoor air concentrations were calculated for both threshold and non-threshold effects and the lowest risk level was selected as the allowable health based indoor air concentration (see Table C2, Appendix C).

SVSLs were developed conservatively by assuming a soil vapour attenuation factor of 0.01 as the default attenuation (as directed by AEP) for all locations, regardless of actual soil probe depth and soil type. This attenuation factor is typically applied to represent attenuation across the building foundation from the soil vapour immediately beneath with no additional attenuation.

Methane in soil vapour was also assessed in accordance with the AHS 2013 document. Based on this guidance document a soil vapour screening level for soil methane adjacent to a building is between 1,000 and 5,000 ppm at soil gas pressures between 0.10 to <0.50 psi. As recommended in Table 6 of the AHS 2013 document, further investigation and site characterization is recommended when methane is detected in these ranges.

COCs for which there are no published TRVs were assessed qualitatively.

4.1.3.1 Soil Vapour De minimis Screening

Soil vapour results were screened using a de minimis approach, meaning that the SVSL was set to be so conservative as to represent a negligible risk. A default soil vapour attenuation coefficient of 0.01 was applied in order to conservatively screen soil vapour concentrations as follows:

$$Csv_{De\ Minimis} = \frac{Cair}{alpha}$$

where

CsvDe minimis = De minimis Concentration of Soil Vapour

Cair = Health Based Indoor Air Criteria (as discussed in 4.1.2 above)

alpha = De minimis vapour attenuation coefficient 0.01 (as directed by AEP).

The de minimis vapour attenuation coefficient of 0.01 is considered conservative for calculation of vapour organic compound transport into a building.

The de minimis soil vapour criteria calculations are shown in Table C3, Appendix C. As discussed above, if a parameter was detected in soil vapour at a concentration exceeding the de minimis soil vapour screening criteria, analyses in indoor air was required for the parameter. If a parameter was detected in soil vapour at a concentration that did not exceed the de minimis soil vapour criteria, then that parameter was not analyzed for in indoor air even if it was detected in soil vapour. Soil vapour concentrations detected below the de minimis soil vapour criteria were considered to have negligible risk.

Methane in soil vapour was also assessed in accordance with the AHS 2013 document. Based on this guidance document a soil vapour screening level for soil methane adjacent to a building is between 1,000 and 5,000 ppm at soil gas pressures between 0.10 to <0.50 psi. As recommended in Table 6 of the AHS 2013 document, further investigation and site characterization is recommended when methane is detected in these ranges.

Screening values for soil vapour for propane, ethane and ethylene were derived based on NIOSH REL as listed in Table C3 Appendix C. The soil vapour screening values for these parameters were derived assuming that no vapour attenuation occurs.

4.1.4 Additional Considerations Based on Groundwater Data

It should be noted that in addition to the consideration of the de minimis soil vapour calculations, 1,3,5-trichlorobenzene was detected in groundwater at monitoring well location MW-06 at a concentration of 0.73 µg/L. This compound is not part of the standard laboratory VOC analyses package for vapour as it exists as a solid at standard temperature and pressure. 1,3,5-trichlorobenzene was not detected at this location during previous sampling events, and was not detected anywhere else on the Site.

Borehole logs for MW-06 are not available, but given the groundwater quality and both the odour and colour of the groundwater at this location, it is assumed that this monitoring well is situated within the limit of waste. Calculations using Henry's Law to determine what the maximum soil vapour concentration would be based on the known groundwater concentration partitioning into soil vapour resulted in a calculated concentration of 56.7 µg/m^3. The calculated soil vapour screening value for 1,3,5-trichlorobenzene is 72 µg/m^3. As a result of the fact that this monitoring well is likely within the limit of waste as well as the fact that the soil vapour value immediately above the groundwater-vapour interface was calculated to be less than the soil vapour screening value, XCG elected not to request 1,3,5-trichlorobenzene data for indoor air. The Henry's Law calculations are provided at the bottom of Table 14.

5. INSTALLATION OF ADDITIONAL GAS PROBES AND MONITORING WELLS

Based on a review of historic reports and monitoring data, as well as discussions with City personnel, XCG installed an additional eight MWs and an additional nine SVPs on and adjacent to the Site in December of 2016. These monitoring wells and soil vapour probes were installed to better delineate the extent of the previously reported groundwater and soil vapour quality impacts in the vicinity of the Site. The locations for the existing and newly installed monitoring wells and soil vapour probes are illustrated on Figure 10. Stratigraphic logs for the additional monitoring wells and soil vapour probes are included as Appendix A.

- Seven of the monitoring wells and soil vapour probes were installed in pairs, side-by-side, as follows:
    - Two sets, XCG-1(MW)/(SVP) and XCG-2(MW)/(SVP), along the west property boundary, between the Site and the residential properties located to the west;
    - One set, XCG-4(MW)/(SVP), adjacent to the east property boundary, along 52nd Avenue, in line with 62nd Street;
    - One set, XCG-5(MW)/(SVP), on the Montfort Centre Red Deer Catholic Regional Schools property, between the Site and the office building;
    - One set, XCG-6(MW)/(SVP), on the Montfort Heights property, between the Site and the Montfort Heights duplexes; and
    - Two sets, XCG-12(MW)/(SVP) and XCG-13(MW)/(SVP), within the backyards of two private residences located north of the Site.
- An additional soil vapour probe, XCG-9(SVP), was installed in the vicinity of the utility corridor associated with the sanitary sewer, storm sewer, and potable water located along the western edge of the Site.
- An additional soil vapour probe, XCG-10(SVP), was installed adjacent to existing monitoring well MW-02.
- An up gradient monitoring well, XCG-14(MW), was installed northwest of the Site to better characterize background groundwater quality for the Site.
- An additional three boreholes (BH1, BH2, BH3) were drilled along the eastern edge of the Site, along 52nd Avenue. These were backfilled with soil cuttings and bentonite.
- Another additional borehole (BH4) was installed between the Site and the Montfort Heights duplexes. This was backfilled with soil cuttings and bentonite.

By installing the above infrastructure, there are now a total of 15 on-site monitoring wells, including the seven monitoring wells which were previously installed. In addition, there are 13 soil vapour probes, including the four intact soil vapour probes which already existed on-site (reportedly VW-02 has historically been damaged).

The four additional boreholes (BH1, BH2, BH3, and BH4) which were completed were not used to install either monitoring wells or soil vapour probes as municipal waste was observed in these locations. These boreholes were drilled to a depth where municipal waste was no longer observed to ensure that the limits of waste were vertically delineated at these locations. The boreholes were then backfilled with soil cuttings and bentonite to surface.

The following monitoring wells and soil vapour probes that were included in the proposed scope of work, were not installed:

- A soil vapour probe (XCG-11(SVP) was not installed in the northeast corner of the Site because of access limitations for the daylighting truck and the drill rig due to overhead power lines along 52nd Avenue.
- A soil vapour probe and monitoring well (XCG-3) nest was not installed along the eastern boundary of the Site north of 62nd Street because municipal waste was encountered. It was not possible to relocate this well closer to 52nd Avenue because of the aforementioned overhead power lines. Boreholes BH1, BH2, and BH3 represent the three attempts to find a suitable location for this monitoring well / soil vapour probe nest.
- The proposed scope of work included installation of three soil vapour probes [XCG-7(SVP), XCG-8(SVP), and XCG-9(SVP)] in utility corridors in the northwest corner of the Site. Once the area was investigated, it was determined that one vapour probe would be sufficient to investigate this area due to the utility corridor being much smaller than anticipated. The single vapor probe was installed in the originally proposed location for XCG-9(SVP).

Soil vapour probes consisted of a single probe at each location. The screen depth of each probe depended on the depth to groundwater, the immediate surrounding topography, the proximity to any buildings or utility trenches and the geological conditions encountered at each borehole location. It was anticipated that the probes would be screened in soils of higher permeability soil (e.g. in sand rather than silt or clay).

During drilling activities it was observed that the Site was covered with a layer of topsoil ranging in thickness from 0.3 to 1.8 metres. In areas where monitoring wells and soil vapour probes were installed (i.e. not boreholes), the topsoil was underlain by clay or clayey-silt with the exception of the southern areas adjacent to the Site. Topsoil around XCG-5 and XCG-6 was underlain by a very fine silty-sand. In addition, granular bedding material, typical of most utility trenches, was not encountered around any of the utility pipes which were exposed.

During the drilling activities in the utility corridor area at the northwest corner of the Site, a gas line was uncovered at an approximate depth of 1.5 metres bgs, and a storm sewer was uncovered at an approximate depth of 6 metres bgs near the northwest corner of the Site. Both of these pipes were found in trenches filled with clay consistent with the native clay encountered across the rest of the Site. Based on field observations, the in-situ clay had been excavated and subsequently re-used as backfill around the pipes. The sanitary sewer and the water lines were not located/exposed via daylighting. As previously mentioned, a single probe, XCG-9(SVP), was installed in the area of the utility corridor near the northwest corner of the Site. This probe was screened at the depth of the gas line, which is connected to lateral gas lines entering the rear of each residence to the north and to the west of the Site. The gas lines enter the residences above ground. Additional information is available in the borehole logs provided in Appendix A.

Each soil vapour probe was constructed of 0.63-centimetre diameter Teflon tubing connected to a 15-centimetre long stainless steel mesh screen. The Teflon tubing was cut to the required lengths to suspend the stainless steel mesh screens within the augered boreholes, with the screened interval located above the groundwater table. Silica Sand (#3) was placed around the screens. Bentonite was placed in the augered boreholes in 15 to 20-centimetre hydrated lifts above the screened interval. Swagelok ball valves were placed at the ground surface end of the Teflon tubing, and tucked into a flush-mount protective casing set into a concrete collar at grade. Flush-mounted lids were installed to protect the ball valves.

The monitoring wells were constructed using 50.8-millimetre (2.0-inch) diameter Schedule 40 PVC pipe. The monitoring wells were equipped with 10-slot, 1.5- or 3.0-metre (5- or 10-foot) long screens with a clean silica (10/20) sand filter pack placed around each screen and a bentonite seal placed above the filter pack to backfill the remaining borehole annulus to surface. The monitoring wells were completed with a slip cap at the bottom, j-plug well caps at the top, and flush-mounted or monument protective casings set into concrete collars at grade. Additional details are provided in the borehole logs attached in Appendix A.

The XCG Standard Operating Procedures (SOPs) for Borehole Drilling, Monitoring Well Installation, and Soil Gas Probe Installation are included as Appendix D.

6. MONITORING AND ASSESSMENT PROGRAMS

As per the historic reports, recommendations for environmental monitoring included the following:

- Hydraulic monitoring of the groundwater wells and existing soil vapour probes;
- Soil vapour monitoring;
- Groundwater monitoring; and
- Indoor air monitoring.

A summary of the groundwater, soil vapour, and indoor air monitoring program is included as Table 1.

6.1 Hydraulic Monitoring

XCG recorded the depth to groundwater in the 15 groundwater monitoring wells and four existing soil vapour probes on a quarterly basis to confirm groundwater flow direction and seasonal fluctuations. Depth to groundwater measurements were not collected from any of the new soil vapour probes installed in 2016. This is because the soil vapour probes installed in 2016 were installed above water table and were constructed with a smaller diameter tubing, which has been proven to produce more accurate soil vapour data. Sections 4.1.2 and 4.1.3 of the XCG SOP for Groundwater Sampling outline the procedures for hydraulic monitoring activities. The XCG SOP for Groundwater Sampling is included in Appendix D.

The following protocols were adhered to for the hydraulic monitoring:

- Groundwater levels were measured, using an electronic water level detector from a permanent measurement location (i.e. top of pipe); and
- The electronic water level detector was decontaminated following each measurement (to prevent cross-contamination).

6.2 Soil Vapour Monitoring

Soil vapour monitoring was undertaken at the 14 soil vapour probes on a quarterly basis, in conjunction with the hydraulic monitoring. The XCG SOP for Soil Gas Monitoring is included in Appendix D.

The following protocols were adhered to for soil vapour monitoring:

- Atmospheric conditions were recorded at the commencement of field activities;
- Soil vapour pressure was measured and recorded;
- The soil vapour probe was purged a minimum of three well volumes to ensure that the sampled gas is representative of the subsurface soil gas matrix;
- Soil vapour concentrations (methane, carbon dioxide, and oxygen) were measured and recorded; and
- Water level measurements were collected to determine the depth to the groundwater in the probe or in a nearby monitoring well. As stated above, the

probes installed in December 2016 were constructed with smaller diameter tubing, which has been proven to produce more accurate soil vapour data. This is because probes constructed using smaller tubing have a better seal between the ambient surface and the probe screen, and require less purging.

A digital manometer was used to measure the soil vapour pressure, and a Landtech GEM 2000 infrared landfill gas analyzer was used to measure matrix gas concentrations.

Due to inconsistencies noted in the results from the first soil vapour monitoring event using a hand held landfill gas analyzer and the soil vapour sampling results, which involved collecting samples of soil vapour in canisters and submitting to the laboratory for analyses, conducted in March 2017, the remaining soil vapour monitoring events were conducted using carbon filters in line with the Landtech GEM 2000, as per the manufacturer's recommendations to eliminate any hydrocarbon interferences that may have affected the LFG readings. Select soil vapour concentrations were also collected without the carbon filter in line in order to compare the results from both methods. Additionally, a confirmatory soil vapour sample was collected in a canister from XCG-4(SVP) during the June 2017 monitoring event and submitted to the laboratory for analysis of oxygen, methane, and carbon dioxide.

6.3 Groundwater Sampling

XCG collected groundwater samples from the 13 groundwater monitoring wells in March of 2017. The XCG SOP for Groundwater Sampling is included in Appendix D. The depth to groundwater was recorded prior to sampling to verify the previously determined groundwater flow direction. The wells were then purged and sampled using a low flow/low volume peristaltic pump. Prior to sampling, the wells were purged for approximately 15 minutes and field parameters were measured using a multi-parameter portable meter. Stabilization of pH, specific conductance, and temperature parameters were achieved prior to sample collection. Purged water was contained in a drum and left on-site pending receipt of the analytical results and the determination of the appropriate disposal option. The drums were then removed from the site after analytical results were received from the lab.

One groundwater sample from each groundwater monitoring well plus two quality assurance and quality control (QA/QC) groundwater samples (blind field duplicate and field blank) were collected under established XCG SOPs (total 15 samples). All samples were collected directly into laboratory-supplied containers. The samples were submitted under chain-of-custody protocols to Maxxam Analytics Inc. (Maxxam), a Canadian Association of Laboratory Accreditation Inc. (CALA)-accredited laboratory for chemical analysis of VOCs.

6.4 Soil Vapour Sampling (Summa® Canisters and TD Tubes)

XCG collected soil vapour samples from 12 soil vapour probes in March of 2017. The soil vapour samples were collected in accordance with XCG's SOP for Soil Vapour Sampling Using Summa® Canisters (Appendix D).

Prior to commencing sampling activities, the soil vapour probes and sampling apparatus were leak checked using shut-in tests and tracer gas checks. The probes were purged a minimum of three probe volumes before sampling and field screening was completed to ensure stable readings were obtained. Subsequently, ambient air at each soil vapour probe was field screened for the presence of total organic vapours (TOVs) using a photo ionization detector (PID). Soil vapour samples were collected using 1.4-litre Summa® canisters with a regulator to control the sampling rate. The samples in the Summa® canisters (including a trip blank and blind field duplicate) were submitted under Chain of Custody to Maxxam for chemical analyses of VOCs and fixed gases (carbon monoxide, carbon dioxide, methane, and nitrogen).

- Given the low concentrations of volatile organic silicon compounds (VOSCs) previously detected in probes installed directly in the waste, XCG recommended that only select probes be sampled for VOSCs based on in-situ field readings of 'worst case' methane and TOVs. A total of six vapour probes [XCG-1(SVP), XCG-2(SVP), XCG-4(SVP), XCG-6(SVP), XCG-10(SVP), and XCG-13(SVP)] located outside of the limit of waste were sampled and analyzed for VOSCs in addition to the three existing probes [VW-01, VW-03, and VW-05].
- Once the Summa® canister was filled at the locations selected for VOSCs, an additional soil vapour sample was collected using a dedicated tedlar bag and the lung box set-up used previously to purge the vapour probe. The contents of the tedlar bag were immediately transferred through a thermodesorption tube using the pump, and submitted to the laboratory for chemical analyses of VOSCs.

During the sampling period, meteorological conditions and outdoor air temperature were recorded. Information on barometric pressure during the sample collection period was obtained from the nearest Environment Canada (or other) weather station.

One blind field duplicate and one trip blank were collected and submitted for analysis with the collected vapour samples.

Due to inconsistencies noted in the results from the first soil vapour monitoring event using a hand held landfill gas analyzer and the laboratory results for soil vapour samples collected using canisters in March 2017, a confirmatory soil vapour sample was collected using a canister from XCG-4(SVP) during the June 2017 monitoring event. This sample was submitted to the laboratory for analysis of oxygen, methane, and carbon dioxide.

6.5 Indoor Air Quality Assessment

XCG understands that the City offered to complete indoor air quality monitoring to all residents living within a 100-metre radius of the Site. Reportedly, 22 residents requested that indoor air monitoring be completed on their properties.

XCG recommended implementing a phased approach to assessing indoor air, as described in the Proposed Investigation Program provided to The City of Red Deer, dated April 11, 2017. The phased approach included, assessing indoor air quality at 11 of the above-noted 22 properties that are located immediately adjacent to the Site. These 11 properties are shown in Figure 11. Although included in the 11 proposed testing locations, indoor air quality testing was not conducted at one residence on 53rd

Avenue because the resident was away for an extended period of time and the property was not accessible. Therefore, the first phase of monitoring was designed to establish whether there is evidence of Site-related impacts at 10 of the 11 above-mentioned adjacent properties. The remaining properties were identified as potential locations for a second phase of sampling, to be scheduled if necessary pending the results of the first phase.

The indoor air quality assessment program was designed to measure the concentrations of select VOCs, in samples of whole air collected in the basements of residential dwellings located adjacent to the Site. The XCG SOP for Indoor Air Sampling is included in Appendix D.

The design of the investigation was developed, in part, using information contained within the following guidance manuals:

- Alberta Environment and Parks (AEP), "Alberta Tier 2 Soil and Groundwater Remediation Guidelines," dated 2016.
- CH2M Gore & Storrie Limited, "Guidance Document on the Management of Methane Gas Adjacent to Landfills," dated December 1999.
- Canadian Council of Ministers of the Environment (CCME), "A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapours," dated 2014.
- Alberta Health Services, "Draft Soil and Building Methane Gas Management Guide," dated October 2013.
- Health Canada, "Federal Contaminated Site Risk Assessment in Canada, Part VII – Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites," dated 2010.

6.5.1 Pre-Sampling Surveys

Prior to commencing indoor air sampling on March 13, 2017, XCG personnel completed pre-sampling site visits/surveys in all of the residential dwellings to be sampled. During the pre-sampling site visits, XCG personnel were accompanied by the residential property owners and/or occupants. The pre-sampling surveys were completed to identify potential background sources of chemicals and to assess building conditions that may influence indoor air quality. The building surveys were conducted a minimum of 48 hours prior to the start of the indoor air sampling. This allowed XCG personnel to identify any potential in-situ sources of indoor air COCs which could potentially bias the indoor air sampling results, and to make recommendations regarding the elimination of these sources (to the extent practical).

The pre-sampling surveys also allowed XCG personnel to confirm the sample locations with the property owners/occupants ahead of the scheduled sampling day.

Pertinent key observations made in the basements of the on-site dwellings and recommendations made during the preliminary inspections are summarized in Table 2.

In addition, the following general notes were made for all residences:

- All residential windows were closed prior to and during the sampling events. Minimal traffic occurred through the doors. Sample locations were not directly connected to exterior access points.
- All residences are connected to a garage.
- All residences have fireplaces, either gas or wood-burning.
- The floor slabs were not completely visible in any of the basements due to obstructions or flooring materials.

6.5.2 Sampling Activities

The indoor and outdoor (ambient) air sample collection was completed over a period of 24 hours commencing on March 13, 2017. The sampling was completed in general accordance with the Proposed Investigation Program following XCG's Standard Operating Procedure (SOP) for Indoor Air Quality Sampling using Summa® Canisters. During the commencement of sampling activities on March 13, 2017, XCG was accompanied on-site by the property owners or their appointed representatives.

The sampling locations are shown on Figure 11. The field observations pertinent to the sampling activities are summarized in Appendix E.

The following summarizes the sampling activities conducted between March 13 and March 14, 2017:

- It was ensured that any recommended actions outlined in Table 2 had been completed.
- The indoor air sampling was conducted using Summa® Canisters. One Summa® Canister was deployed in the basement of each of the residences, with the exception of one residence on Hermary Street (identified as Residence C). Two Summa® Canisters (a primary sample and a blind field duplicate) were deployed in the basement of the Residence C dwelling. This location was randomly selected for the blind field duplicate.
- An outdoor (ambient) air sample was collected by deploying one Summa® Canister on the back porch of the dwelling identified as Residence I on 53rd Ave (considered to be upwind at the time of sampling).
- All samples were collected using laboratory supplied Summa® Canisters with pre-calibrated 24-hour flow regulators.
- The indoor air Summa® Canisters were placed at heights ranging between approximately 1.0 to 1.5 metres above the basement floors.
- The ambient air Summa® Canisters were placed at a height of approximately 2.0 metres above the ground surface.
- The air samples were collected over a period of approximately 24 hours.
- The heating systems were running as normal at all of the locations with the exception of the dwelling identified as Residence G located on 62nd Street because the homeowners were away and had turned the thermostat down a few degrees.

- The concentrations of TOVs in the basements were measured using a handheld PID RKI Eagle 2, and ranged between 0 and 3 parts per million (ppm).
- The concentrations of methane, oxygen and carbon dioxide in the basements were measured using a Landtech GEM-2000 Gas Analyzer. Methane concentrations ranged between 0 and 0.1 % (v/v), oxygen concentrations ranged between 20.8 and 21.6 % (v/v) and carbon dioxide concentrations consistently measured 0.1% (v/v).
- Appendix E contains the field notes for the sample collection, which provide details related to additional observations, meteorological conditions, sampling time, and canister vacuums at the commencement and upon completion of the sampling activities.
- The trip blank canister was used to evaluate both the indoor air and soil vapour results, as all of the canisters (i.e. both soil vapour and indoor air samples) were shipped together and kept together for the duration of the sampling and while in transit.
- The canisters containing the indoor and outdoor air samples were submitted under Chain of Custody protocol on March 15, 2017 to Maxxam. Samples were placed on hold until the analytical results for both the groundwater and soil vapour samples were reviewed to determine the list of parameters which would be investigated in the indoor air and ambient air samples. Once the preliminary sampling results for groundwater and soil vapour were received, the list of parameters for analyses in the indoor air samples was updated based on the results from soil vapour probes and groundwater monitoring wells, further discussed in Section 7.4. The indoor air samples were analyzed for VC, cis-1,2-dichloroethylene (cis-1,2-DCE), and methane.

6.6 Quality Assurance and Quality Control (QA/QC)

XCG followed standard QA/QC protocols when collecting groundwater, soil vapour, and indoor air samples. QA/QC protocols included, where appropriate, cleaning and decontamination of sampling equipment, dedicated sampling equipment, wearing clean gloves between each new sample being collected, minimizing aeration and air contact of groundwater samples, sample preservation, unique sample identification, and completing chain of custody, recording observations in field notes, keeping groundwater samples cool (4˚C) and in the dark as soon as they were collected, securing groundwater samples with ice pack to maintain internal temperatures in shipping containers for storage and transport, shipping samples to the laboratory as soon as possible after collection, noting the recommended maximum holding times, and collecting the appropriate number of blind field duplicate, field blank, and trip blank samples. A blind field duplicate (groundwater, soil vapour, and indoor air) consists of an additional sample collected from a randomly selected sample location, which is submitted to the laboratory blindly under a unique sample ID in order to compare the results of the two samples collected from the same location for QA/QC purposes. A field blank (groundwater) consists of filling sample containers with distilled water under the same field conditions as the other samples are collected, and submitting this sample to the lab in order to determine if field conditions are affecting the sample results. A trip blank (soil vapour and indoor air) consists of transporting a canister, identical to what is used to collect the samples, with the samples throughout the sampling and shipping processes and analyzing the contents of the canister in order to determine if the shipping conditions may have affected the results of the samples that were collected.

7. RESULTS AND DISCUSSION

7.1 Hydraulic Monitoring

Groundwater levels were measured in March, June, September, and December 2017 to determine the depth to the water table, water table elevation, and the approximate direction of groundwater flow beneath the Site. Table 3 provides a summary of the water level elevations measured at the Site. As shown in the Cross Sections illustrated on Figures 2, 3, 4, 5, and 6, the monitoring wells located in the northwest corner of the Site, including XCG-1(MW), XCG-2(MW), XCG-12(MW), and XCG-14(MW), were installed to depths of approximately 8 metres bgs and screened in clay. The monitoring wells located in the east and south portions of the Site, including XCG-13(MW), XCG-6(MW), XCG-5(MW), XCG-4(MW), MW-02, MW-03, and MW-04, were installed to depths of approximately 4 metres bgs and screened in top soil/sand and/or municipal waste on top of clay. Based on the depths of the wells and the groundwater elevations calculated during the four quarterly monitoring events completed during 2017, there is evidence of a perched groundwater table located above the clay and a separate shallow groundwater unit present deeper in the clay.

The monitoring wells located in the northwest corner of the Site, including XCG-1(MW), XCG-2(MW), XCG-12(MW), and XCG-14(MW), show a groundwater flow direction from north to south in the shallow groundwater unit located within the clay, which is consistent with the local topography. The groundwater elevations in the shallow monitoring wells installed on top of the clay, including XCG-13(MW), XCG-6(MW), XCG-5(MW), XCG-4(MW), MW-02, MW-03, and MW-04, show a radial flow outwards from the landfill with a southerly trend at the southeast corner of the Site and a northerly trend at the north side of the Site. Figures 12, 13, 14, and 15 show the groundwater elevations and approximate directions of groundwater flow in both the shallow groundwater unit and the perched groundwater unit during each monitoring event.

Overall, the average groundwater elevation fluctuation at all groundwater monitoring wells included in the quarterly monitoring was approximately 0.23 metres, the majority of the lowest elevations occurred in March and December, and the majority of the highest elevations occurred in June and September.

Table G1 in Appendix G includes a summary of the historical groundwater elevations from the already existing groundwater monitoring wells collected in 2013 as well as the groundwater elevations collected in all groundwater monitoring wells in 2017. The August 2013 groundwater elevation reported by Tiamat in MW-01 was approximately three metres higher than the groundwater elevations measured in 2017; the August 2013 groundwater elevation reported by Tiamat in MW-02 was approximately one metre higher than the groundwater elevations measured in 2017; the August 2013 groundwater elevation reported by Tiamat in MW-03 was approximately two metres lower than the groundwater elevations collected in 2017; the August 2013 groundwater elevation reported by Tiamat in MW-04 was approximately three metres lower than the groundwater elevations measured in 2017; the August 2013 groundwater elevation reported by Tiamat in MW-06 was consistent with the groundwater elevations measured in 2017; and the August 2013 groundwater elevation reported by Tiamat in MW-07 was approximately one metre higher than the groundwater elevations collected in 2017.

7.2 Soil Vapour Monitoring Results

Soil vapour monitoring using a hand held landfill gas analyzer in the field was undertaken at the 14 soil vapour probes on a quarterly basis, in conjunction with the hydraulic monitoring. As discussed in Section 6.2, due to inconsistencies noted in the results from the first soil vapour monitoring event and the soil vapour sampling events conducted in March 2017, the remaining soil vapour monitoring events were conducted using carbon filters in line with the Landtech GEM 2000, as per the manufacturer's recommendations to eliminate any hydrocarbon interferences that may have affected the readings. Select soil vapour concentrations were also collected without the carbon filter in line in order to compare the results from both methods. The quarterly soil vapour monitoring results are presented in Table 4, and the results are discussed below. Figure 16 illustrates the quarterly results in terms of presence and absence of methane.

Over the course of the four quarterly monitoring events, seven of the 14 soil vapour probes monitored [VW-02, VW-03, VW-05, XCG-4(SVP), XCG-5(SVP), XCG-6(SVP), and XCG-13(SVP)] had methane detected in them on at least one occasion. Soil vapour probes VW-02, VW-03, VW-05, and XCG-4(SVP) are located in the limit of waste, as such, elevated methane concentrations are expected at these locations.

Soil Vapour probe XCG-13(SVP) is located to the north of the Site (outside the limit of waste) in a residential backyard, and XCG-5(SVP), and XCG-6(SVP) are located to the south of the Site (outside the limit of waste) and located in an exterior area of the property occupied by the Montfort Centre Red Deer Catholic Reginal Schools, and an exterior area of the Montfort Heights residential buildings. These probes located to the north [XCG-13(SVP)] and south [XCG5-(SVP) and XCG-6(SVP)] of the Site indicate potential migration of vapour off-Site. As well, the presence of elevated methane at probe location XCG-4(SVP), located within the limit of waste, indicates the potential for vapour migration at the east side of the Site. As further discussed in Section 7.5, indoor air sampling was conducted at select residential properties surrounding the Site in order to investigate the potential risk of LFG migration to the surrounding residential properties located adjacent to the Site.

The specific findings at each soil vapour probe location are discussed below.

VW-01 is located along the north limit of waste on the west side of the Site. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe using both monitoring methods, with and without a carbon filter, during the four monitoring events. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

VW-02 is located along the north limit of waste near the centre. Methane was detected at a concentration of 39.8 % without a carbon filter and 38.8 % with a carbon filter during the September monitoring event, and 29.2 % without a carbon filter and 31.4% with a carbon filter during the December monitoring event. Data from the March monitoring event was not reported due to a damaged cap on the soil vapour probe and the readings were unable to stabilize. No data was collected during the June monitoring events due to there not being a cap on the soil vapour probe. A new vapour probe cap was placed on this soil vapour probe on June 16, 2017.

VW-03 is located along the north limit of waste on the east side of the Site. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe using both monitoring methods, with and without a carbon filter, during the March, June, and September monitoring events. Methane was not detected without the carbon filter, but was detected at 0.1 % with the carbon filter during the December monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

VW-04 is located in the limit of waste on the southeast portion of the Site. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe using both monitoring methods, with and without a carbon filter, during the monitoring events. It is noted that no field data or canister sample, were collected during the March field monitoring event due to not being able to locate the soil gas probe under the snow.

VW-05 is located in the limit of waste on the southwest portion of the Site. The field monitoring results did not indicate the presence of methane in this soil gas probe during the March monitoring event. No field data was collected during the June monitoring event due a broken cap (likely from ice damage) on the probe at the time of monitoring, and a new soil vapour probe cap was installed after the monitoring event on June 16, 2017. Methane was detected at a concentration of 3.8 % without a carbon filter and 3.6 % with a carbon filter during the September monitoring event. Methane was detected at a concentration of 1.9 % without a carbon filter and 2.0 % with a carbon filter during the December monitoring event. The September and December soil vapour monitoring results for this location are an order of magnitude higher than the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration of 0.3 %.

XCG-1(SVP) is located adjacent to the west side of the limit of waste. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the four monitoring events. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-2(SVP) is located adjacent to the west side of the limit of waste. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the four monitoring events. It is noted that a soil vapour reading was only taken with a carbon filter during the

June monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.3 %.

XCG-4(SVP) is located in the limit of waste on the east side of the Site. Methane was detected at a concentration of 0.7 % in the field during the March monitoring event. The field monitoring results did not indicate the presence of methane in this soil vapour probe with and without a carbon filter, during the June and September monitoring events. Methane was not detected without the carbon filter, but was detected at 0.1 % with the carbon filter during the December monitoring event. These results are significantly lower than the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration of 5.7 %. However, these results are similar to the second confirmatory soil vapour sample collected using a canister in June, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-5(SVP) is located south of the Site on the east side. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the March, June, and September monitoring events. Methane was not detected without the carbon filter, but was detected at 0.1 % with the carbon filter during the December monitoring event. It is noted that a soil vapour reading was only taken with a carbon filter during the June monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-6(SVP) is located south of the Site on the west side. Methane was detected at a concentration of 1 % during the March monitoring event, 0.9 % without the carbon filter and 0.0 % with the carbon filter during the June monitoring event, 2.5 % without the carbon filter and 2.5 % with the carbon filter during the September monitoring event, and 1.0 % without the carbon filter and 1.0 % with the carbon filter during the December monitoring event. These results are similar to the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration of 1.2 %.

XCG-9(SVP) is located near the northwest corner of the limit of waste. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the four monitoring events. It is noted that a soil vapour reading was only taken with a carbon filter during the June monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-10(SVP) is located along the north limit of waste on the east side of the Site. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the four monitoring events. It is noted that a soil vapour reading was only taken with a carbon filter during the June monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-12(SVP) is located adjacent to the north limit of waste. The field monitoring results for the reporting period did not indicate the presence of methane in this soil gas probe with and without a carbon filter, during the four monitoring events. It is noted that a soil vapour reading was only taken with a carbon filter during the June monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration below the laboratory RDL of 0.2 %.

XCG-13(SVP) is located adjacent to the north limit of waste. Methane was detected at a concentration of 0.7 % during the March monitoring event, 5.6 % without a carbon filter and 0.0 % with a carbon filter during the June monitoring event, 0.4 % without a carbon filter and 1.9 % with a carbon filter during the September monitoring event, and 0.0 % without a carbon filter and 0.2 % with a carbon filter during the December monitoring event. These results are consistent with the soil vapour sample collected using a canister and submitted to the laboratory for analysis (further discussed in Section 7.4) in March, which had a methane concentration of 1.1 %, with the exception of the 5.6 % methane concentration detected without a filter during the June monitoring event. There is also a discrepancy between the methane concentration with and without a filter for this monitoring event.

7.2.1 Summary

Based on the results of the quarterly soil vapour monitoring events described above, soil vapour probes VW-01, VW-03, VW-04, XCG-1(SVP), XCG-2(SVP), XCG-5(SVP), XCG-9(SVP), XCG-10(SVP), and XCG-12(SVP) do not appear to be impacted by LFG. Soil vapour probe XCG-4(SVP), which is located within the limit of waste on the east side of the Site, appears to possibly be impacted by LFG. Soil vapour probe VW-02 and XCG-13(SVP), located on the north site of the Site (VW-02 along the north limit of waste and XCG-13(SVP) adjacent to the north limit of waste) between the Site and the detached residential homes located adjacent to the Site, appear to be impacted by LFG, with VW-02 the most impacted. Soil vapour probe VW-05, located within the limit of waste near the southwest corner, appears to be impacted by LFG. Soil vapour probe XCG-6(SVP), located south of the Site on the west side between the Site and the multi-tenant residential dwelling of Montfort Heights, also appears to be impacted by LFG.

It should be noted that there appears to be some discrepancies between using the carbon filters and not using the carbon filters in line with the landfill gas analyzer. For the most part, using the carbon filters appears to be more accurate with generally lower methane concentrations detected (i.e. less interference of other hydrocarbons); however, in some cases, using the carbon filter either gave a higher methane concentration (such as at XCG-13(SVP) that had a methane concentration of 0.4 % without the carbon filter and 1.9 % with the carbon filter during the September monitoring event) or lower methane concentrations [such as at XCG-13(SVP) that had a methane concentration of 5.6 % without the carbon filter and 0.0 % with the carbon filter during the June monitoring event].

7.3 Groundwater and Leachate Sampling Results

7.3.1 General

The groundwater laboratory analytical data was assessed with respect to the 2016 Tier 1 SGRG for residential/parkland use and coarse grained soil. Field pH was outside of the 2016 Tier 1 SGRG approved range (6.5-8.5) for multiple monitoring wells; however, the laboratory reported pH were within the acceptable range. Therefore, the pH meter used during field monitoring activities appears to have been malfunctioning; therefore, field pH readings from the field were not considered representative, and so have not been considered in the interpretation of the data.

The groundwater analytical data was also assessed with respect to background water quality and leachate quality. Based on the north to south direction of shallow groundwater flow at the northwest corner of the site monitoring well XCG-14(MW), located to the northwest (up gradient) of the Site, represents background groundwater quality for the Site in the shallow groundwater unit.

Given the radial flow outwards from the landfill in a southerly direction at the southeast corner of the Site and a northerly direction at the north side of the Site in the perched water table located on top of the clay, there is no monitoring location up gradient that represents background groundwater quality in the perched groundwater unit.

The groundwater field parameter data compiled during the reporting period is presented in Table 5. The analytical results for the groundwater wells are presented in Tables 6 to 10. Figure 17 shows the location of exceedences of the 2016 Tier 1 SGRG in the groundwater to illustrate the extent of contamination at the Site. Historical monitoring results are presented in Appendix G, and Certificates of Laboratory Analyses are presented in Appendix H.

7.3.2 Background Groundwater Quality – Shallow Groundwater Unit

The March 2017 analytical results for monitoring well XCG-14(MW) indicate the following:

- Total dissolved solids exceeded the 2016 Tier 1 SGRG criterion (500 mg/L) with a concentration of 570 mg/l; and
- Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.26 mg/L).

7.3.3 Leachate Quality

Leachate quality for the landfill is represented by monitoring wells MW-01, MW-02, MW-03, MW-06, MW-07, and XCG-4(MW), which are located in the waste.

The March 2017 analytical data for leachate quality indicates the following:

Monitoring Well MW-01

Monitoring well MW-01 is located within the limit of waste near the northwest corner.

Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.089 mg/L.

Compared to the historical monitoring results from August 2013 reported by Tiamat (presented in Appendix G), the concentration of dissolved cadmium has increased from 0.033 µg/L to 0.29 µg/L, while the concentrations other dissolved metals including dissolved cobalt, dissolved copper, dissolved nickel, and dissolved uranium appear to have decreased slightly. The concentration of total cadmium has also increased from 0.4 µg/L to 1.9 µg/L, while the concentrations of other total metals including total arsenic, total barium, total cobalt, total lead, and total sulphur appear to have decreased slightly. All other parameters that were analyzed during both monitoring events had similar concentrations or were below the laboratory RDL.

Monitoring Well MW-02

Monitoring well MW-02 is located in the northeast corner of the site within the limit of waste.

Total dissolved solids (TDS) and dissolved chloride exceeded the 2016 Tier 1 SGRG criteria (500 mg/L and 120 mg/L, respectively) with concentrations of 660 mg/L and 160 mg/L, respectively.

Compared to the historical monitoring results from August 2013 reported by Tiamat (presented in Appendix G), the concentration of PCE decreased from 1.4 µg/L to less than the laboratory RDL of 0.50 µg/L, and the concentration of TCE decreased from 1.6 µg/L to less than the laboratory RDL of 0.50 µg/L. The concentration of dissolved nitrate decreased from 10 mg/L to 1.4 mg/L, the concentration of total nitrogen decreased from 11 mg/L to 1.8 mg/L, and the concentration of TKN decreased from 3.4 mg/L to 0.00061 mg/L. The concentration of total aluminum decreased from 10 mg/L to 0.18 mg/L, the concentration of total barium decreased from 1.10 mg/L to 0.68 mg/L, the concentration of total iron decreased from 43 mg/L to 0.46 mg/L, the concentration of total magnesium decreased from 130 mg/L to 54 mg/L, the concentration of total manganese decreased from 1.10 mg/L to 0.0061 mg/L, the concentration of total phosphorous decreased from 2.20 mg/L to less than the laboratory RDL of 0.10 mg/L, and the concentration of total silver decreased from 39 mg/L to 8.8 mg/L. All other parameters that were analyzed during both monitoring events had similar concentrations or were below the laboratory RDL.

Monitoring Well MW-03

Monitoring well MW-03 is located within the northeast portion of the limit of waste.

- VC exceeded the 2016 Tier 1 SGRG criterion (1.1 µg/L) during the March monitoring event with a concentration of 16 µg/L;
- TDS exceeded the 2016 Tier 1 SGRG criterion (500 mg/L) with a concentration of 990 mg/L; and
- Dissolved Manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.49 mg/L.

Compared to the historical monitoring results from August 2013 reported by Tiamat (presented in Appendix G), the concentration of cis-1,2-DCE increased from 4.5 µg/L to 20 µg/L, and the concentration of VC increased from 10 µg/L to 16 µg/L. The concentration of total organic carbon (TOC) decreased significantly from 16.0 mg/L to 8.1 mg/L. The concentration of total cadmium decreased from 0.25 µg/L to 0.089 µg/L. All other parameters that were analyzed during both monitoring events had similar concentrations or were below the laboratory RDL.

Monitoring Well MW-06

Monitoring well MW-06 is located within the limit of waste on the east side.

- 1,4-dichlorobenzene and VC exceeded the 2016 Tier 1 SGRG criteria (1 µg/L and 1.1 µg/L, respectively) with concentrations of 1.2 µg/L and 8.4 µg/L, respectively;
- TDS and total ammonia exceeded 2016 Tier 1 SGRG criteria (500 mg/L and 10 mg/L, respectively) with concentrations of 1,500 mg/L and 69 mg/L, respectively;
- Dissolved iron and dissolved manganese exceeded the 2016 Tier 1 SGRG criteria (0.3 mg/L and 0.05 mg/L, respectively) with concentrations of 29 mg/L and 0.49 mg/L, respectively; and
- Benzene, ethylbenzene, and xylenes exceeded the 2016 Tier 1 SGRG criteria (5 µg/L, 1.6 µg/L, and 20 µg/L, respectively) with concentrations of 4.8 µg/L, 58 µg/L, and 45 µg/L, respectively.

Compared to the historical monitoring results from August 2013 reported by Tiamat (presented in Appendix G), several changes were observed as discussed below.

VOCs were observed to have changed, specifically:

- The concentration of 1,2 dichlorobenzene decreased from 2.3 µg/L to 1.2 µg/L;
- The concentration of cis-1,2-DCE increased from 2.6 µg/L to 18 µg/L;
- The concentration of 1,2,4-trimethylbenzene decreased from 39 µg/L to 14 µg/L;
- The concentration of 1,3,5-trimethylbenzene decreased from 9 µg/L to 3.8 µg/L; and
- The concentration of VC decreased from 15 µg/L to 8.4 µg/L.

The concentration of dissolved iron increased significantly from 9.2 mg/L to 29 mg/L. The concentrations of all total metals decreased, with the most significant decreases being:

- Total cadmium from 33.0 µg/L to 0.77 µg/L;
- Total aluminum from 360 mg/L to 11 mg/L; total barium from 27 mg/L to 1.5 mg/L;
- Total calcium from 9,300 mg/L to 280 mg/L;
- Total iron from 1,800 mg/L to 68 mg/L;
- Total magnesium from 2,800 mg/L to 120 mg/L;

- Total potassium from 130 mg/L to 38 mg/L;
- Total silicon from 740 mg/L to 36 mg/L;
- Total vanadium from 1.8 mg/L to 0.031 mg/L; and
- Total zinc from 6.1 mg/L to 0.099 mg/L.

The following changes were observed in nutrients at this location:

- The concentration of dissolved sulphate decreased from 5 mg/L to below the laboratory RDL of 1.0 mg/L;
- Dissolved chloride decreased from 100 mg/L to 83 mg/L;
- Total ammonia decreased from 96 mg/L to 69 mg/L;
- Total phosphorous decreased significantly from 14 mg/L to 1.1 mg/L;
- Biochemical oxygen demand (BOD) decreased significantly from 130 mg/L to 22 mg/L; and
- Chemical oxygen demand (COD) decreased significantly from 1,800 mg/L to 330 mg/L.

The concentration of PHC F1 decreased from 150 µg/L to less than the laboratory RDL of 100 µg/L.

All other parameters that were analyzed during both monitoring events had similar concentrations or were below the laboratory RDL.

Monitoring Well MW-07

Monitoring well MW-07 is located within the limit of waste along the north boundary.

- TCE and VC exceeded the 2016 Tier 1 SGRG criteria (5 µg/L and 1.1 µg/L, respectively) with concentrations of 7.4 µg/L and 39 µg/L, respectively;
- TDS and dissolved chloride exceeded the 2016 Tier 1 SGRG criteria (500 mg/L and 120 mg/L, respectively) with concentrations of 1,300 mg/L and 260 mg/L, respectively; and
- Dissolved barium, dissolved iron, and dissolved manganese exceeded the 2016 Tier 1 SGRG criteria (1 mg/L, 0.3 mg/L, and 0.05 mg/L, respectively) with concentrations of 1.1 mg/L, 12 mg/L, and 1.8 mg/L, respectively.

Compared to the historical monitoring results from August 2013 reported by Tiamat (presented in Appendix G), the following changes were observed:

VOCs:

The concentration of VC increased from 26 µg/L to 39 µg/L. General Chemistry:

- The concentration of dissolved sulphate decreased from 10 mg/L to 7.2 mg/L;
- The concentration of total ammonia decreased from 2.4 mg/L to 0.87 mg/l;
- The concentration of total nitrogen decreased significantly from 88 mg/L to 1.9 mg/L;

- The concentration of total phosphorous decreased significantly from 53 mg/L to 0.030 mg/L;
- The concentration of TKN decreased significantly from 88 mg/L to 1.9 mg/L;
- The concentration of BOD decreased from 25 mg/L to 7.8 mg/L; and
- The concentration of COD decreased significantly from 1,600 mg/L to 64 mg/L.

Metals

The concentrations of most total metals decreased, with the most significant decreases being:

- Total cadmium from 5.40 µg/L to 0.25 µg/L;
- Total aluminum from 110 mg/L to 0.39 mg/L;
- Total barium from 49 mg/L to 1.2 mg/L;
- Total calcium from 22,000 mg/L to 240 mg/L;
- Total iron from 3,300 mg/L to 19 mg/L, total magnesium from 6,400 mg/L to 130 mg/L;
- Total manganese from 110 mg/L to 1.8 mg/L;
- Total phosphorous from 120 mg/L to less than the laboratory RDL of 0.10 mg/L; and
- Total selenium from 130 mg/L to 3.7 mg/L, and total silicon from 1,200 mg/L to 12 mg/L.

All other parameters that were analyzed during both monitoring events had similar concentrations or were below the laboratory RDL.

Monitoring Well XCG-4(MW)

Monitoring well XCG-4(MW) is located within the limit of waste on the east side;

- TDS exceeded the 2016 Tier 1 SGRG criterion (500 mg/L) with a concentration of 580 mg/L; and
- Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.29 mg/L.

Summary

The above-noted elevated concentrations of nutrients (dissolved chloride, TDS, and total ammonia), VOCs (VC, 1,4-dichlorobenzene, and TCE), dissolved metals (iron, manganese, and barium), benzene, ethylbenzene, and xylenes above the 2016 Tier 1 SGRG in the leachate quality monitoring wells are consistent with the typical characteristics of landfill leachate. Generally, an improving trend was observed in the current leachate quality compared to the 2013 results.

7.3.4 Perched Groundwater Unit Monitoring Wells (Outside of Limit of Waste)

Monitoring wells XCG-5(MW), XCG-6(MW), and XCG-13(MW) are screened in the perched groundwater unit and located outside the limit of waste.

The March 2017 analytical results for monitoring wells XCG-5(MW), XCG-6(MW), and XCG-13(MW) indicate the following:

XCG-5(MW) – south of the landfill, on the east side

No parameters analyzed exceeded the 2016 Tier 1 SGRG, which indicates that this monitoring location is not impacted by landfill leachate. This also indicates that groundwater within the perched groundwater unit is attenuating by the time it reaches this monitoring point, which is located approximately 35 metres south of the limit of waste on the east side of the Site.

XCG-6(MW) – south of the landfill

- TDS exceeded the 2016 Tier 1 SGRG criterion (500 mg/L) with a concentration of 1,000 mg/l;
- Dissolved nitrate exceeded the 2016 Tier 1 SGRG criterion (3 mg/L) with a concentration of 56 mg/L; and
- Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.15 mg/L).

The presence of TDS, dissolved nitrate, and dissolved manganese elevated above the 2016 Tier 1 SGRG indicates that monitoring well XCG-6(MW) is impacted by leachate.

XCG-13(MW) - adjacent to the north limit of waste

- VC exceeded the 2016 Tier 1 SGRG criteria (1.1 µg/L) with a concentration of 21 µg/L;
- TDS and dissolved chloride exceeded the 2016 Tier 1 SGRG criteria (500 mg/L and 120 mg/L, respectively) with concentrations of 1,100 mg/L and 200 mg/L, respectively; and
- Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.71 mg/L.

The presence of TDS, dissolved chloride, and dissolved manganese above the 2016 Tier 1 SGRG indicate that monitoring well XCG-13(MW) is impacted by leachate.

7.3.5 Shallow Groundwater Unit Monitoring Wells

Monitoring wells XCG-1(MW), XCG-2(MW), and XCG-12(MW) are screened within the shallow groundwater unit located within the clay.

The March 2017 analytical results for monitoring wells XCG-1(MW), XCG-2(MW), and XCG-12(MW) indicate the following:

XCG-1(MW) - adjacent to the west limit of waste

Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.28 mg/L.

Dissolved manganese was elevated above the 2016 Tier 1 SGRG criterion in the background groundwater sample collected from monitoring well XCG-14(MW), and therefore, this indicates that monitoring XCG-1(MW) is not impacted by landfill leachate.

XCG-2(MW) - adjacent to the west limit of waste

Dissolved manganese exceeded the 2016 Tier 1 SGRG criterion (0.05 mg/L) with a concentration of 0.50 mg/L.

Dissolved manganese was elevated above the 2016 Tier 1 SGRG criterion in the background groundwater sample collected from monitoring well XCG-14(MW), and therefore, this indicates that monitoring well XCG-2(MW) is not impacted by landfill leachate.

XCG-12(MW) - adjacent to the north limit of waste

- TDS exceeded the 2016 Tier 1 SGRG criterion (500 mg/L) with a concentration of 580 mg/l;
- Dissolved arsenic, dissolved barium, and dissolved manganese exceeded the 2016 Tier 1 SGRG criteria (0.005 mg/L, 1 mg/L, and 0.05 mg/L, respectively) with concentrations of 0.019 mg/L, 1.2 mg/L, and 0.61 mg/L, respectively;
- BOD, COD, and TOC were elevated compared to the background groundwater quality (<2.0 mg/L, 85 mg/L, and < 5.0 mg/L, respectively) with concentrations of 8.3 mg/L, 110 mg/L, and 16 mg/L, respectively; and
- Dissolved potassium was elevated compared to the background groundwater quality (2.5 mg/L) with a concentration of 7.7 mg/L.

The presence of elevated dissolved metals (arsenic, barium, and potassium), BOD, COD, and TOC above the 2016 Tier 1 SGRG and background groundwater levels indicate that monitoring well XCG-12(MW) is likely impacted by leachate.

Summary

Groundwater quality results indicate that monitoring well XCG-5(MW), located south of the landfill and screened in the perched groundwater unit, is not impacted by landfill leachate. Since no analyzed parameters exceeded the 2016 Tier 1 SGRG at this well, it appears that groundwater within the perched groundwater is attenuating by the time it reaches this monitoring point located approximately 35 metres south of the limit of waste.

Monitoring well XCG-6(MW), located south of the landfill and screened within the perched groundwater, is impacted by leachate, as indicated by the presence of elevated concentrations of TDS, dissolved nitrate, and dissolved manganese, all of which were above the 2016 Tier 1 SGRG.

Monitoring well XCG-13(MW), located adjacent to the north limit of waste and screened within the perched groundwater, is impacted by leachate, as indicated by the presence of elevated concentrations of TDS, dissolved chloride, and dissolved manganese, all of which were above the 2016 Tier 1 SGRG.

Groundwater quality results indicate that monitoring wells XCG-1(MW) and XCG-2(MW), located adjacent to the west of the landfill and screened in the shallow groundwater unit, are not impacted by leachate.

Monitoring well XCG-12(MW), located adjacent to the north limit of the landfill and screened in the shallow groundwater unit, is impacted by leachate as indicated by the presence of dissolved metals (arsenic, barium, and potassium), BOD, COD, and TOC at concentrations above the 2016 Tier 1 SGRG and above the background groundwater concentrations.

Figure 17 highlights the parameters that exceeded the 2016 Tier 1 SGRG at each groundwater monitoring location in order to show the extents of groundwater impacts from the Site.

7.4 Soil Vapour Sampling Results

The analytical results for the soil vapour sampling are summarized in Tables 11, 12, 13, and 14. Copies of the Laboratory Certificates of Analysis are provided in Appendix H. The soil vapour sampling field notes are included in Appendix F. Soil vapour samples were not collected in March 2017 from VW-02, due to there not being a cap on the soil vapour probe at the time of sampling, nor VW-04 because it was under a pile of snow and could not be located at the time of the monitoring event.

The parameters detected in soil vapour were screened (using a de minimis approach) to determine which parameters had the potential to impact indoor air (see Section 7.5 below) based on concentrations present in the soil vapour. Parameters detected in soil vapour that exceeded the de minimis soil vapour criteria were identified as potential COCs in indoor air. Both soil vapour and indoor air sampling activities were conducted while the ground was frozen (i.e. while natural venting from the ground is limited), to assess worst case scenario concentrations of landfill gases.

Soil vapour results for fixed gases and petroleum hydrocarbons, VOCs, and siloxanes are tabulated in Tables 11, 12, and 13, respectively. Worst case concentrations of each parameter detected in the soil vapour were tabulated to compare to the calculated de minimis soil vapour screening criteria as illustrated in Table 14. Based on the comparison, only methane, VC and cis-1,2-DCE exceeded the de minimis soil vapour screening criteria and were requested for analyses in the indoor and ambient air samples. The soil vapour results are illustrated in Figure 18.The concentration of methane in soil vapour probes VW-01, VW-03, XCG-1(SVP), XCG-2(SVP), XCG-5(SVP), XCG-9(SVP), XCG-10(SVP), and XCG-12(SVP) were below the laboratory RDL of 0.2-0.3 % v/v.

The concentration of methane at VW-05 and XCG-4(SVP), located within the limit of waste at the southwest and southeast corners of the Site, were 0.3 % v/v and 5.7 % v/v, respectively. Based on the AHS 2013 document (further discussed in Section 4.1.3) further site characterization is recommended when methane is detected in these ranges adjacent to a building if the soil gas is under pressure. At the time of the March 2017 sampling, none of the soil gas probes were measured to be under pressure. As well, these probes are both located within the limit of waste, and are not adjacent to buildings.

The methane concentration in soil vapour probe XCG-6(SVP), which is located south of the Site on the west side and screened in fine sand with silt, was 1.2 % v/v. The methane concentration in soil vapour probe XCG-13(SVP), located adjacent to the north of the Site and screened in clay, was 1.1 % v/v. The methane concentrations in soil vapour probes XCG-6(SVP), and XCG-13(SVP) are between 0.5 % v/v and 5 % v/v and based on the AHS document require further investigation and development of mitigation or monitoring plan if the soil gas is under pressure. As noted above, at the time of the March 2017 sampling, none of the soil gas probes were measured to be under pressure. Soil vapour probes XCG-6(SVP) and XCG-13(SVP) are located in close proximity to residential dwellings. Therefore indoor air samples were collected at the nearest residences in order to further monitor landfill gas in these areas. The results of the indoor air sampling are discussed in Section 7.5.

As discussed in Section 6.4, due to inconsistencies noted in the results from the first soil vapour monitoring even using a hand held landfill gas analyzer and the soil vapour samples collected in canisters and submitted for laboratory analyses in March 2017, a confirmatory soil vapour sample was collected in a canister from XCG-4(SVP) during the June 2017 monitoring event and submitted to the laboratory for analysis of oxygen, methane, and carbon dioxide. This sample had a methane concentration less than the laboratory RDL of 0.2 %, which is consistent with the concentration of methane detected in the field using the hand held landfill gas analyzer of 0 %. The result of the June 2017 monitoring event is included in Table 11.

As discussed in Section 7.5 indoor air sampling was completed at properties surrounding the landfill to further investigate the potential for vapour intrusion.

7.5 Indoor Air Quality Results

The analytical results for the indoor and outdoor air samples are summarized in Table 15. Copies of the Laboratory Certificates of Analysis are provided in Appendix H. The following sections provide the summary and the assessment of the sampling results.

7.5.1 Background (Ambient) Air Quality

Concentrations of methane, VC, and cis-1,2-DCE were not detected in ambient air above the laboratory RDLs, which were set below the Health Based Indoor Air Criteria.

7.5.2 Indoor Air Quality

Concentrations of methane, VC, and cis-1,2-DCE were not detected in indoor air above the laboratory RDLs in any of the indoor air samples collected from any of the 10 basements. The laboratory RDLs were set below the Health Based Indoor Air Criteria. The sample locations are shown on Figure 11.

Given this information, it is highly unlikely that soil vapour impacted by LFG is migrating into the indoor air of the residences adjacent to the Site.

7.5.3 Quality Assurance/Quality Control (QA/QC) Results

XCG reviewed the laboratory sample results and QA/QC samples to evaluate whether data quality objectives were met. The analytical data are considered to be representative, reliable, and complete, and have a documented accuracy and precision.

The laboratory sample spikes and QC standard samples analyzed by the laboratory did not reveal any anomalous results.

For the fieldwork program, XCG followed standard QA/QC field protocols, which included cleaning and calibration of sampling equipment, dedicated sampling equipment, unique sample identification and completing chains of custody, recording observations in field notes, and shipping samples to the laboratory as soon as possible after collection, noting the recommended maximum holding times. The soil vapour blind field duplicate had a calculated relative percent difference (RPD) of 92 percent for toluene. No other RPD were calculated for either soil vapour or indoor air as the concentration in the sample or the blind field duplicate was too low to permit a reliable RPD (one or both samples were less than five times the laboratory RDL).

8. HAZARD ASSESSMENT

As part of the 2014 ERMP, Tiatmat Environmental Consultants Ltd. completed a PQRA for the Site following Health Canada guidance. Hazard Quotients (HQs) were calculated for each pathway determined to represent the greatest potential risk (i.e. soil vapour intrusion) for five different possible receptor groups including:

i) residential,

ii) public institutions (schools and hospitals),

iii) food establishments,

iv) commercial developments, and

v) workers in construction and maintenance for underground utility infrastructure.

The results generated from the groundwater and soil vapour assessment were evaluated to update the hazard assessment. Risks associated with ingestion or direct contact with groundwater were not evaluated, as there are no direct groundwater receptors within the 300 m buffer from the limit of waste.

The risk characterization compares the inhalation exposure (from groundwater to indoor air, soil vapour to indoor air, and directly from indoor air) to the appropriate TRVs. For chemicals that operate via a threshold-type of dose response, the comparison most often used is termed a HQ, which is simply the ratio between estimated exposures divided by the TRV. Where predicted levels of exposure are less than acceptable limits, no adverse health outcomes would be expected for the receptors of concern. The converse is not automatically true, however. That is, when levels of exposure exceed the target risk (i.e. HQ>0.2), adverse health outcomes are not necessarily expected. Rather, there is erosion in the margin of safety between the level of exposure and the level of exposure known to cause adverse effects. Under such a situation, it is prudent to re-examine the basis of all of the assumptions used to generate the estimates of risk and exposure prior to identifying possible risk management measures. This analysis could conclude that given the conservatism of the assessment, no adverse health outcomes are expected or alternatively, that some form of risk management is required to mitigate exposure to acceptable levels.

For carcinogens that are assumed to operate via a non-threshold mechanism of action, the risk characterization identifies the incremental lifetime cancer risk (ILCR) associated with a particular exposure pathway which is calculated by multiplying the exposure dose by the TRV. Incremental lifetime cancer risks are unitless values that express the probability of developing cancer over a lifetime. The AEP considers incremental lifetime cancer risks of one in a one hundred thousand (1 x 10-5) or less as de minimis, which means that they are below a level that would be of concern.

8.1 Receptor Characteristics

The receptor characteristics used in the quantitative assessment are described below. As noted previously, these receptors were previously identified by Tiamat in the 2014 ERMP. XCG has updated the assumptions of the receptor exposure characteristics to be consistent with the 2016 AEP, “Alberta Tier 2 Soil and Groundwater Remediation Guidelines”.

8.1.1 Residents (Adults and Children)

Residents are individuals that may reside in the vicinity of the Site. The resident can be of any age (infant, toddler, child, teen, or adult) and may be exposed to inhalation of volatiles in indoor air. The exposure duration values used are consistent with the 2016 AEP, “Alberta Tier 2 Soil and Groundwater Remediation Guidelines” and are assumed to consider 24 hour per day exposure 365 days per year. An exposure prorating value of 1 is used to calculate both the threshold (non-cancer) and cancer risks.

8.1.2 Public Institutions (Schools/hospitals) (Adults and Children)

Receptors at public institutions are considered to be either adults or children. The institutional worker or visitor can be of any age (infant, toddler, child, teen, and adult) and may be exposed to inhalation of volatiles in indoor air. The exposure duration values used are consistent with the 2016 AEP, “Alberta Tier 2 Soil and Groundwater Remediation Guidelines” and are assumed to consider 24 hour per day exposure 365 days per year, similar protective of a resident. An exposure prorating value of 1 is used to calculate both the threshold (non-cancer) and cancer risks.

8.1.3 Commercial Receptors (including Food Establishments)

Commercial receptors are individuals that may work at a commercial business or visit a commercial business in the vicinity of the Site. The commercial receptor is assumed to be an adult and may be exposed to inhalation of volatiles in indoor air. The exposure duration values used are consistent with the 2016 AEP, “Alberta Tier 2 Soil and Groundwater Remediation Guidelines” and are assumed to consider an exposure scenario of 10 hour/day, 5 days/week, and 48 weeks/year. An exposure prorating value of 0.2747 [(10 hr/d x 5 d/wk x 48 wk/yr) / (24 hrs/day x 7 days/wk x 52 wk/yr) = 0.2747] is used to calculate both the threshold (non-cancer) and cancer risks.

8.1.4 Construction/Utility Workers

Construction workers or utility workers may be contracted to conduct earthworks in the vicinity of the Site. Construction workers/utility worker within onsite trenches may be exposed to volatiles through the inhalation of air within the trench. The construction worker/utility worker is assumed to be an adult. The exposure duration values used are consistent with the 2016 AEP, “Alberta Tier 2 Soil and Groundwater Remediation Guidelines” and are assumed to consider an exposure scenario of 10 hour/day, 5 days/week, and 48 weeks/year. An exposure prorating value of 0.2747 [(10 hr/d x 5 d/wk x 48 wk/yr) / (24 hrs/day x 7 days/wk x 52 wk/yr) = 0.2747] is used to calculate both the threshold (non-cancer) and cancer risks.

8.2 Exposure Estimate

Exposure pathways evaluated for each of the receptors discussed in Section 8.1 include

- Inhalation of volatiles in indoor air; and

- Inhalation of volatiles in trench air.

Estimates of exposure were developed based on modelled exposure estimates from groundwater to indoor air, groundwater to trench air, soil vapour to indoor air, and soil vapour to trench air. The equations used for each exposure estimate are described below.

8.2.1 Groundwater to Indoor Air

The groundwater to indoor air equation is based on an exposure scenario where a receptor may inhale substances that volatilize from groundwater and are transported to indoor air. The following calculation is used to estimate the exposure (dose) received by the receptor via the groundwater to indoor air pathway:

Point of Exposure Calculation (Henry's Law, with default vapour attenuation factor)

$$Cair = \frac{Cgw \; x \; H' \; x \; C}{\frac{1}{alpha}}$$

where

Cair = Concentration in indoor air (calculated exposure value) mg/m3

Cgw = Measured Maximum Concentration of Groundwater mg/L

H' = Henry's Law (unitless) – chemical specific

alpha = vapour attenuation factor = 0.01 (de minimis)

C = conversion term 10^3 convert m^3 to L

The same de minimis vapour attenuation assumption (0.01) used to develop the indoor air criteria and soil vapour screening criteria discussed in Sections 4.1.2 and 4.1.3 was used in order to determine the indoor air concentration. This value is considered appropriate due to the presence of shallow perched groundwater which may limit the attenuation zone and eliminate the potential for source depletion. This value is considered conservative and protective of receptors given the site specific conditions.

Contaminant Daily Exposure (CDE) Calculation

$$CDE = Cair\left(\frac{mg}{m^3}\right) x \; EF\left(\frac{hrs}{yr}\right) x \; ED \; (yr) x \; \frac{1}{AT \; (hrs)}$$

Where,

CDE = Contaminant daily exposure to vapours in air in units of mg/m^3, non-carcinogenic; this is a contaminant concentration in air value that is weighted according to exposure frequency and exposure duration

Cair = Point of exposure concentration of the contaminant in the air (mg/m^3) calculated from groundwater concentration based on Henry's Law, assuming default de mimimis vapour attenuation factor (accounting for shallow groundwater)

EF = Exposure Frequency

ED = Exposure Duration

AT = Averaging Period

The calculation of groundwater to indoor air point of exposure concentration and resulting contaminant daily exposure to vapours in air for each receptor group is shown in Table C4 in Appendix C.

8.2.2 Groundwater to Trench Air

The concentration of volatiles (sourced from groundwater) present in a trench were modeled using the ASTM (2002) model, commonly referred to as the Box Model, as provided below.

Concentration of Contaminant in Trench Air

C trench air = [GW] x VF

Where:

[GW] = maximum groundwater concentration

VF = volatilization factor

$$VF = \left(\frac{H'}{1+\left[\frac{U \, x \, H_T \, x \, L_{GW}}{L_{SA} \, x \, Deff}\right]}\right) \text{ x 1000 L/m3}$$

Where:

U = Wind Speed (330 cm/s as per the yearly average wind speed for Edmonton)

H_T = Mixing Height (200 cm assumed trench height)

L_{GW} = Depth to Groundwater (200 cm, site specific)

L_{SA} = Length of Source Area (1300 cm assumed, trench length)

Deff = Effective diffusion coefficient in soil (cm2/s – calculated as per below)

H' = Henry's Law Constant (dimensionless)

Effective diffusion coefficient (Deff)

$$Deff = \frac{\dfrac{Ev^{10/3} \, x \, Da \, x \, Hx \, Ew^{10/3} \, x \, Dw}{n^2}}{(\rho b \, x \, Koc \, x \, foc) + Ew + (Ev \, x \, H)}$$

Where:

D_{eff} = Effective diffusion coefficient of soil (cm^2/s)

E_v = Air-filled porosity (unitless)

D_a = Molecular diffusion constant in air (cm^2/s); chemical specific

H = Henry's Law Constant (cm^3-water/cm^3-air); chemical specific

E_w = Water-filled soil porosity (unitless)

D_w = Molecular diffusion constant in water (cm^2/s); chemical specific

n = Total soil porosity (unitless)

ρb = Dry soil bulk density (g/cm^3)

Koc = organic carbon-water sorption coefficient (cm^3-water/g-carbon); chemical specific

foc = Fraction of organic carbon

The Henry's Law constant is a chemical-specific constant describing the relative proportions of a chemical in various media at steady state. The height of the atmospheric mixing cell was assumed to be 200 cm (height of an adult), while the length of the mixing cell was 1300 cm. The mean annual wind speed is 330 cm/s which is based on the yearly average in Edmonton. Porosity values and density values used in the equation are defined in the spreadsheet included with Table C8 in Appendix C.

Contaminant Daily Exposure (CDE) Calculation

$$CDE = C\ trench\ air\left(\frac{mg}{m^3}\right)\ x\ EF\left(\frac{hrs}{yr}\right)\ x\ ED\ (yr) x\ \frac{1}{AT\ (hrs)}$$

Where,

CDE = Contaminant daily exposure to vapours in trench air in units of mg/m^3, this is a contaminant concentration in trench air value that is weighted according to exposure frequency and exposure duration

C trench air= Point of exposure concentration of the contaminant in the trench air (mg/m^3) calculated from groundwater vapour migration within the base of the trench (as discussed above)

EF = Exposure Frequency

ED = Exposure Duration

AT = Averaging Period

The calculation of groundwater to trench air point of exposure concentration and resulting contaminant daily exposure to vapours in trench air for the construction worker/utility worker receptor group is shown in Table C8 in Appendix C.

8.2.3 Soil Vapour to Indoor Air

The soil vapour to indoor air equation is based on an exposure scenario where a receptor may inhale substances present in soil vapour that are transported to indoor air (via vapour intrusion). The following calculation is used to estimate the exposure (dose) received by the receptor via the soil vapour to indoor air pathway (vapour intrusion):

Point of Exposure Calculation (with default vapour attenuation factor)

$$Cair(sv) = \frac{Csv}{\frac{1}{alpha}}$$

where

Cair(sv) = Concentration in indoor air (calculated exposure value) mg/m^3

Csv = Measured Maximum Concentration of Soil Vapour mg/m^3

alpha = vapour attenuation factor = 0.01

As discussed above, the same de minimis vapour attenuation assumption of 0.01 was used to determine the indoor air concentration. This value is considered appropriate due to the presence of shallow perched groundwater which may limit the attenuation zone and eliminate the potential for source depletion. This value is considered conservative and protective receptors given the site specific conditions.

Contaminant Daily Exposure (CDE) Calculation

$$CDE = Cair(sv)\left(\frac{mg}{m^3}\right) x\ EF\left(\frac{hrs}{yr}\right) x\ ED\ (yr) x\ \frac{1}{AT\ (hrs)}$$

Where,

CDE = Contaminant daily exposure to vapours in air in units of mg/m^3, this is a contaminant concentration in air value that is weighted according to exposure frequency and exposure duration

Cair(sv) = Point of exposure concentration of the contaminant in the air (mg/m^3) calculated from maximum soil vapour concentration assuming default de mimimis vapour attenuation factor of 0.01 (accounting for shallow groundwater). This factor does not allow for source depletion.

EF = Exposure Frequency

ED = Exposure Duration

AT = Averaging Period

The calculation of soil vapour to indoor air point of exposure concentration and resulting contaminant daily exposure to vapours in air for each receptor group is shown in Table C5 in Appendix C.

8.2.4 Soil Vapour to Trench Air

The soil vapour to trench air equation is based on an exposure scenario where a construction/utility worker receptor may inhale substances present in soil vapour are transported into a trench. The following calculation is used to estimate the exposure (dose) received by the receptor via the soil vapour to trench air pathway:

Point of Exposure Calculation (Default Attenuation Factor, Meridian, 2012)

$$C\ trench\ air(sv)\ =\ Csv\ x\ AF$$

where

C trench air (sv) = Concentration in trench air (mg/m^3)

Csv = Measured Maximum Concentration of Soil Vapour mg/m^3

AF = Conservative Attenuation Factor = 0.09 (Source, CSAP Technical Review #18, Soil Vapour Attenuation Factors for Trench Workers, prepare by Meridian Environmental Inc., dated December 2012. Assuming narrow trench and shallow soil vapour source.)

Contaminant Daily Exposure (CDE) Calculation

$$CDE =\ C\ trench\ air(sv)\left(\frac{mg}{m^3}\right)\ x\ EF\left(\frac{hrs}{yr}\right)\ x\ ED\ (yr) x\ \frac{1}{AT\ (hrs)}$$

Where,

CDE = Contaminant daily exposure to vapours in air in units of mg/m^3; this is a contaminant concentration in air value that is weighted according to exposure frequency and exposure duration

C trench air(sv) = Point of exposure concentration of the contaminant in the trench air (mg/m^3) calculated from soil vapour concentration attenuation into a narrow trench.

EF = Exposure Frequency

ED = Exposure Duration

AT = Averaging Period

The calculation of soil vapour to trench air point of exposure concentration and resulting contaminant daily exposure to vapours in trench air for the construction worker/utility worker receptor group is shown in Table C5 in Appendix C.

8.3 Risk Characterization

The risk characterization compares the inhalation exposure (from groundwater to indoor air, soil vapour to indoor air, and directly from indoor air) to the appropriate TRVs. For chemicals that operate via a threshold-type of dose response, the comparison most often used is termed a hazard quotient (HQ), which is simply the ratio between estimated exposures divided by the TRV. Where predicted levels of exposure are less than acceptable limits, no adverse health outcomes would be expected for the receptors of concern. The converse is not automatically true, however. That is, when levels of exposure exceed the target risk (i.e. HQ>0.2), adverse health outcomes are not necessarily expected. Rather, there is erosion in the margin of safety between the level of exposure and the level of exposure known to cause adverse effects. Under such a situation, it is prudent to re-examine the basis of all of the assumptions used to generate the estimates of risk and exposure prior to identifying possible risk management measures. This analysis could conclude that given the conservatism of the assessment, no adverse health outcomes are expected or alternatively, that some form of risk management is required to mitigate exposure to acceptable levels.

For carcinogens that are assumed to operate via a non-threshold mechanism of action, the risk characterization identifies the incremental lifetime cancer risk (ILCR) associated with a particular exposure pathway which is calculated by multiplying the exposure dose by the TRV. Incremental lifetime cancer risks are unitless values that express the probability of developing cancer over a lifetime. The AEP considers incremental lifetime cancer risks of one in a one hundred thousand (1 x 10-5) or less as de minimis, which means that they are below a level that would be of concern

The measured soil vapour and indoor air concentrations used in the risk characterization are from the frozen ground conditions sampling event completed in March 2017 are considered representative of worst case conditions. Risk characterization was completed for the volatile parameters detected during this worst case sampling event. Methane was also detected during the soil vapour sampling; however, methane was excluded for the hazard discussion as it has been previously assessed with regard to the AHS 2013 document which provides thresholds and recommended response actions.

8.3.1 Residential Receptors

Health risks associated with the vapour intrusion to residential dwellings and exposure of the resident occupants were assessed based on modelled indoor air exposures from measured groundwater concentrations and soil vapour concentrations, and directly from actual indoor air concentrations.

The worst case measured groundwater concentrations were determined to represent potential risk to vapour intrusion to indoor air (residential) for benzene, ethylbenzene, xylenes, trichloroethylene, and VC. As shown in Table C4 in Appendix C, the hazard quotient for each of these parameters was greater than 0.2 and the cancer risks were greater than 1 x 10^{-5}.

The worst case measured soil vapour concentrations were determined to represent potential risk to vapour intrusion to indoor air (residential) for VC and cis-1,2-DCE. The soil vapour to indoor air risk evaluation calculations are shown in Table C5 and C6 in Appendix C. Table C5 shows the risk calculations for the worst case soil vapour concentrations and Table C6 shows the risk calculations at each soil vapour probe location for the residential receptor. The resulting HQ for VC ranged from 0.002 to 0.13, which were all less than the acceptable threshold of 0.2. The resulting non-threshold risk (Cancer Risk) for VC ranged from1.92 E-6 to 1.10 E-4. The acceptable Cancer Risk criteria for VC is less than 1.0 E-5, and there were three locations with a cancer risk for VC equal to or greater than 1.0 E-5. The highest cancer risks of 1.10 E-4 and 1.36 E-5 were identified at VW-05 (located within the limit of waste) and XCG-6(SVP) (located to the south of the limit of waste), respectively. A cancer risk of 1.0 E-5 was identified at XCG-13(SVP), located to the north outside the limit of waste. The only probe location to have an unacceptable risk associated with cis-1,2-DCE was XCG-13 (VP) with a hazard quotient of 0.249, above the acceptable limit. Based on these results two probes located outside the limit of waste were identified to have risk above acceptable risk levels.

As discussed above, indoor air was only sampled for parameters detected in soil vapour at concentrations greater than the de minimis screening level. The indoor air results were all less than detection levels. In order to illustrate worst case conditions, risks were calculated for concentrations set at the detection limits for each parameter (see Table C7, Appendix C). The resulting HQ for VC was 0.0005 and for cis-1,2-DCE was 0.022, both well below the acceptable value of 0.2. The resulting non-threshold risk (Cancer Risk) for VC was 4.49E-7, well below the acceptable value of 1.00E-5. Based on the above, indoor air measurements were well within acceptable risk values.

8.3.2 Institutional Receptors

Health risks associated with vapour intrusion to institutional buildings and exposure to institutional receptors were assessed based on modelled indoor air exposures from measured groundwater concentrations and soil vapour concentrations as described in Section 8.2.

The worst case measured groundwater concentrations were determined to represent potential risk to vapour intrusion to indoor air (institutional) for benzene, ethylbenzene, xylenes, trichloroethylene, and VC. As shown in Table C4 in Appendix C, the hazard quotient for each of these parameters was greater than 0.2 and the cancer risks were greater than 1 x 10^{-5}.

The worst case measured soil vapour concentrations were determined to represent a potential risk to vapour intrusion to indoor air (institutional) for VC and cis-1,2-DCE. The soil vapour to indoor air risk evaluation calculations are shown in Table C5 in Appendix C. The resulting worst case HQ for VC was 0.13, which is less than the acceptable threshold of 0.2. The resulting worst case non-threshold risk (Cancer Risk) for VC was 1.10 E-4 which is greater than the acceptable Cancer Risk criteria of 1.0 E-5. The resulting worst case HQ for cis-1,2-DCE was 0.249, which is slightly above the acceptable limit.

8.3.3 Commercial Receptors (including Food Establishments)

Health risks associated with the vapour intrusion to commercial buildings and exposure to commercial receptors were assessed based on modelled indoor air exposures from measured groundwater concentrations and soil vapour concentrations as described in Section 8.2.

The worst case measured groundwater concentrations were determined to represent potential risk to vapour intrusion to indoor air (commercial) for xylenes, trichloroethylene, and VC. As shown in Table C4 in Appendix C, the hazard quotient for each of these parameters was greater than 0.2 and the cancer risks were greater than 1 x 10^{-5}.

The worst case measured soil vapour concentrations were determined to represent a potential risk to vapour intrusion to indoor air (commercial) for VC. The soil vapour to indoor air risk evaluation calculations are shown in Table C5 in Appendix C. The resulting worst case HQ for VC was 0.03, which is less than the acceptable threshold of 0.2. The resulting worst case non-threshold risk (Cancer Risk) for VC was 3.02 E-5 which is greater than the acceptable Cancer Risk criteria of 1.0 E-5.

8.3.4 Construction/Utility Worker Receptors

Health risks associated with the vapour intrusion into excavations and trenches and exposure to a utility worker were assessed based on modelled trench air exposures from measured groundwater concentrations and soil vapour concentrations as described in Section 8.2.

The worst case measured groundwater concentrations when volatilized into trench air were not determined to represent a potential risk to the utility worker receptor. As shown in Table C4 in Appendix C, the hazard quotient for each of these parameters was less than 0.2 and the cancer risks were less than 1×10^{-5}.

The worst case measured soil vapour concentrations were determined to represent a potential risk to vapour intrusion to trench air for VC and cis-1,2-DCE. The soil vapour to indoor air risk evaluation calculations are shown in Table C5 in Appendix C. The resulting worst case HQ for VC was 0.31, which is greater than the acceptable threshold of 0.2. The resulting worst case non-threshold risk (Cancer Risk) for VC was 2.72 E-4 which is greater than the acceptable Cancer Risk criteria of 1.0 E-5. The resulting worst case HQ for cis-1,2-DCE was 0.62, which is slightly above the acceptable limit.

8.3.5 Summary

Based on the risks characterization for each of the receptor groups the following was determined.

- Worst case groundwater concentrations of volatile compounds (xylenes, trichloroethylene, and VC) represent a potential risk to indoor air for each of the residential and institutional receptors. Similarly, worst case groundwater concentrations of xylenes, trichloroethylene, and VC represent a potential risk to indoor air for the commercial receptor.
- Worst case soil vapour concentrations represent a potential risk to indoor air for VC and cis-1,2-DCE for residential and institutional receptors and VC only for the commercial receptors.
- Worst case soil vapour concentrations of VC and cis-1,2-DCE were determined to represent a potential risk to utility workers exposed to trench air.

Although the groundwater and soil vapour concentrations indicate a potential risk for inhalation of indoor air for the residential, institutional and commercial receptors, the actual sampling results of indoor air at several of the closest residential dwellings were all less than laboratory detection levels and therefore the indoor air measurements were well within acceptable risk values.

The potential risk for vapour inhalation for the construction/utility worker in a trench should be addressed. Normal health and safety precautions (i.e. use of a four gas meter) when entering any trench should be applied. It should be noted that the risks calculated for the utility worker were based on a 10 hour exposure day, 5 days per week, and 48 weeks per year. It is unlikely that a utility worker would actually be working within a trench for this period and therefore this approach is considered very conservative.

8.3.6 *Mitigative Measures*

As part of the ERMP prepared by Tiamat in 2014, a set of generic mitigative measures were developed as a strategy for reducing the potential exposure to the identified contaminants of concern for new subdivision and developments within 300 m of the Montfort Landfill Site. The mitigative measures suggested by Tiamat were selected to provide a progressively increasing level of protection as the relative level of hazard increases. To this end, Tiamat created passive and active mitigation actions for a set of ranges of hazard quotients and proposed strategies for dealing with new subdivision and development within 100 m of the landfill, between 100 m and 200 m of the landfill and between 200 m and 300 m of the landfill.

Based upon the results presented in this report, XCG has revised the Tiamat criteria ranges for each mitigative measure category to include a Cancer Risk range to allow comparison of the Tiamat ranges with the HQ and Cancer Risks calculated by XCG (see Appendix C, Table C4, C5 and C6). The revised mitigation action ranges have been incorporated into the original Tiamat measures and are provided below.

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^{-6} cm/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.

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.

Based on the hazard assessment completed by XCG, the worst case groundwater concentrations (measured within the landfill at MW-07 and immediately north of the landfill at XCG-13(MW)) represent a potential risk of vapour intrusion to indoor air. As shown in Appendix C, Table C3, the calculated cancer risks from the worst case groundwater concentrations are greater than 2E-3, and therefore correspond with Active Mitigation Level E. However, the soil vapour to indoor air risk estimates are considered more representative of actual site conditions then the groundwater vapour to indoor air risk estimates. The risks to indoor air associated with the measured soil vapour concentrations were significantly lower than those associated with the worst case groundwater concentrations and would require only passive mitigation measures. Based on the hazard assessment completed by XCG, the worst case soil vapour concentration (measured within the limits of the landfill at VW-05) gives a cancer risk of 1E-4 which corresponds to Passive Mitigation Level B. The only soil vapour probes located outside the limit of waste with concentrations of vapour determined to represent a soil vapour to indoor air risk were XCG-6(SVP) and XCG-13(SVP), which had cancer risks of 1.4 E-5 and 1E-5, respectively, corresponding with Passive Mitigation Level A.

9. CONCLUSIONS AND LIMITATIONS

9.1 Conclusions

The following conclusions are based on the information and data generated during the vapour intrusion assessment and environmental monitoring program described herein:

- The 2017 hydraulic monitoring results indicate that there is evidence of a perched groundwater table located above the clay layer beneath the Site and a separate shallow groundwater unit present deeper in the clay. The monitoring wells located northwest of the Site show a groundwater flow direction from north to south in the shallow groundwater unit located within the clay, which is consistent with local topography. The groundwater elevations in the shallow monitoring wells installed on top of the clay show a radial flow outwards from the landfill with a southerly trend at the southeast corner and a northerly trend at the north side of the Site.
- Over the course of the four quarterly monitoring events in 2017, seven of the 14 soil vapour probes monitored [VW-02, VW-03, VW-05, XCG-4(SVP), XCG-5(SVP), XCG-6(SVP), and XCG-13(SVP)] had methane detected in them on at least one occasion. Based on the results of the quarterly soil vapour monitoring, methane was found to be present in soil vapour probes located within the limit of waste. Methane was also detected to the north of the limit of waste adjacent to the residential homes on Hermary Street, and to the south of the Site on the west side between the Site and the multi-tenant residential dwelling of Montfort Heights.
- Groundwater concentrations at monitoring well XCG-14(MW), located northwest of the landfill, were all less than the 2016 Tier 1 SGRG with the exception of total dissolved solids (TDS) and dissolved manganese which exceeded the 2016 Tier 1 SGRG. This monitoring well is considered to represent background groundwater quality at the Site in the shallow groundwater unit based on its location up gradient of the Site. Given the radial flow outwards from the landfill in the perched water table, there is no monitoring location up gradient that represents background groundwater quality in the perched groundwater unit. Groundwater quality at monitoring points within the limit of waste were found to be impacted by parameters consistent with leachate characteristics. Generally, an improving trend was observed in the current leachate quality compared to the 2013 results.
- Groundwater quality results indicate that monitoring well XCG-5(MW), located south of the landfill and screened in the perched groundwater unit, is not impacted by landfill leachate. Since no analyzed parameters exceeded the 2016 Tier 1 SGRG at XCG-5(MW), it appears that the perched groundwater is attenuating by the time it reaches this monitoring point located approximately 35 metres south of the limit of waste. Monitoring well XCG-6(MW), located south of the landfill and screened in the perched groundwater unit, is impacted by leachate, as indicated by the elevated concentrations of TDS, dissolved nitrate, and dissolved manganese, all of which were above the 2016 Tier 1 SGRG. Monitoring well XCG-13(MW), located adjacent to the north limit of waste and screened in the perched groundwater, is impacted by leachate, as indicated by the elevated concentrations of TDS, dissolved chloride, and dissolved manganese, all of which were above the 2016

Tier 1 SGRG. The extent of the perched groundwater impacts down gradient (south and east), and up gradient (north) of the site have not been fully delineated. However, the leachate-related parameters in perched groundwater appear to attenuate within approximately 35 metres of the landfill, as indicated by the groundwater quality results from samples collected from well XCG-5(MW) that is located south of the landfill. Because there are no other wells located outside the limits of waste that are screened in the perched groundwater, it cannot be confirmed that the quality of perched groundwater improves away from the Site in all other directions. However, it is likely that the leachate-related parameters do attenuate in the same rate in all directions away from the Site.

- Groundwater quality results indicate that monitoring wells XCG-1(MW) and XCG-2(MW), located adjacent to the west of the landfill and screened in the shallow groundwater unit (within the clay layer), are not impacted by leachate. Monitoring well XCG-12(MW), located adjacent to the north limit of the landfill and screened in the shallow groundwater unit, is likely impacted by leachate as indicated by the presence of dissolved metals and nutrients above the 2016 Tier 1 SGRG and background groundwater quality.
- Soil vapour results from the 12 samples collected during frozen conditions (March 2017) indicated the presence of methane, VC, and cis-1,2-DCE at concentrations that exceeded the derived soil vapour screening criteria at four locations. Two locations were within the limit of waste (at the southeast and southwest corners) and the remaining two were outside the limit of waste to the north, and south of the Site. The extent of soil vapour impacts north, east, west, and south of the site have not been fully delineated.
- The indoor air quality at the 10 residences located north, east, and south of the Site did not have detectable concentrations of methane, VC, or cis-1,2-DCE. The laboratory reportable detection limits were set below the Health Based Indoor Air Criteria. Based on the above, it is unlikely that soil vapour impacted by the Site is migrating into the indoor air of the residences adjacent to the Site.
- Risk characterization completed for residential, institutional and commercial receptors based on groundwater to indoor air and soil vapour to indoor air exposure pathways confirmed potential risks above acceptable levels for each of these receptors and pathways. However, risk characterization completed based on the worst case (frozen ground condition) direct measured indoor air sampling results, confirmed that risks were well within acceptable risk values.
- Risk characterization based on worst case soil vapour concentrations of VC and cis-1,2-DCE were determined to represent a potential risk to utility workers exposed to trench air.

9.2 Limitations

Information contained in this Vapour Intrusion Assessment and Environmental Monitoring Report is representative of conditions at the specific sampling locations, on the specific sampling dates. Sample locations selected by XCG were based on environmental investigation work previously conducted by others. Conditions at locations between or beyond the specified sampling locations at the subject property may differ from those encountered and reported. In addition, subsequent investigations at the site may reveal conditions not apparent during these investigation activities.

The scope of this report is limited to the matters expressly covered. This Vapour Intrusion Assessment and Environmental Monitoring Report was prepared for the sole use of the City of Red Deer and may not be relied upon by others without the written concurrence of XCG Consulting Limited. The scope of services performed in the execution of this investigation may not be appropriate to satisfy the needs of other users, and any use or reuse of this document (or the findings and conclusions represented herein), by parties other than the City of Red Deer, is at the sole risk of those parties.

10. RECOMMENDATIONS

Due to the presence of methane detected in soil vapour probes XCG-13(SVP) and XCG-6(SVP) located outside the limit of waste and XCG-4(SVP) located within the limit of waste (nearest monitoring point to residences located east of the Site), it is recommended that select soil vapour probes [XCG-1(SVP), XCG-2(SVP), XCG-4(SVP), XCG-5(SVP), XCG-6(SVP), XCG-9(SVP), XCG-10(SVP), XCG-12(SVP), and XCG-13(SVP)] be monitored twice annually in September (due to methane concentrations recorded during the 2017 September monitoring event) and March (under frozen conditions to represent the worst case scenario/highest potential for LFG migration) using a handheld LFG analyzer. If methane volumes of 2.5 % v/v (50% LEL) are detected at any of the monitoring locations, it is then recommended that an indoor air sample be collected at the nearest residence/building to the monitoring location. It is also recommended that hydraulic monitoring be conducted in conjunction with the LFG monitoring events in order to aid in determining if soil vapour probes are blinded and to monitor groundwater flow across the Site and further confirm the presence of a perched groundwater unit at the Site. This semi-annual LFG and hydraulic monitoring program should be implemented for a period of three years, followed by a review of all results to determine the best approach going forward.

Due to the potential risk for vapour inhalation identified for the construction/utility worker exposed to trench air, health and safety precautions (i.e. use of a four gas meter) should be taken when entering any trench. Personal protective equipment should be worn, as appropriate depending on monitoring results.

Additionally, it is recommended that monitoring wells that were previously installed by others with screens straddling the waste, the clay layer and the underlying sand (i.e. MW-01, MW-03, and MW-04) be decommissioned. These wells should be decommissioned, because they hydraulically connect the leachate-impacted perched groundwater within the waste to the deeper shallow groundwater unit.

10.1 Additional Consideration

The surface topography at the Site has subsided leaving a slightly irregular surface. This has produced a number of lower-lying and softer surface areas throughout the site, which often become water-saturated/flooded following rainfall. Repeated ponding of storm water makes these surfaces even more susceptible to infiltration and percolation of water into the underlying landfill material, generating leachate. Therefore, as a future consideration in conjunction with any future maintenance of the sports field on the site, would be to fill these low areas to reduce ponding and leachate generation.

11. REFERENCES

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8. Le Breton, E.G., "Hydrogeology of the Red Deer Area, Alberta," dated 1971.
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15. Tiamat Environmental Consultants Ltd., “Phase II Environmental Site Assessment, Historic Waste Disposal Site, Montfort Landfill, The City of Red Deer,” dated February 26, 2014.
16. Tiamat Environmental Consultants Ltd., “Environmental Risk Management Plan, Historic Waste Disposal Site, Montfort Landfill, The City of Red Deer,” dated November 21, 2014.
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19. United States Environmental Protection Agency, Integrated Risk Information System (IRIS) On-Line Database, available at www.epa.gov/iris. [Toxicity Summary for Ethylbenzene CAS RN 100-41-4 (2006)]
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21. United States Environmental Protection Agency, Integrated Risk Information System (IRIS) On-Line Database, available at www.epa.gov/iris. [Toxicity Summary for Methyl Ethyl Ketone (2-Butanone) CAS RN 78-93-3 (09/26/2003)]
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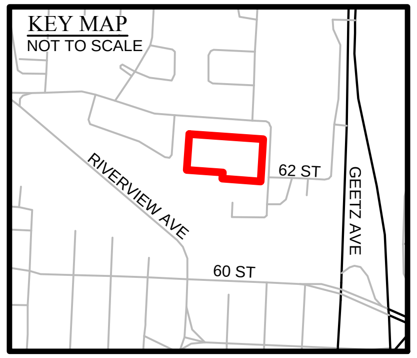
FIGURES



LEGEND:

□ APPROXIMATE LIMIT OF WASTE

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

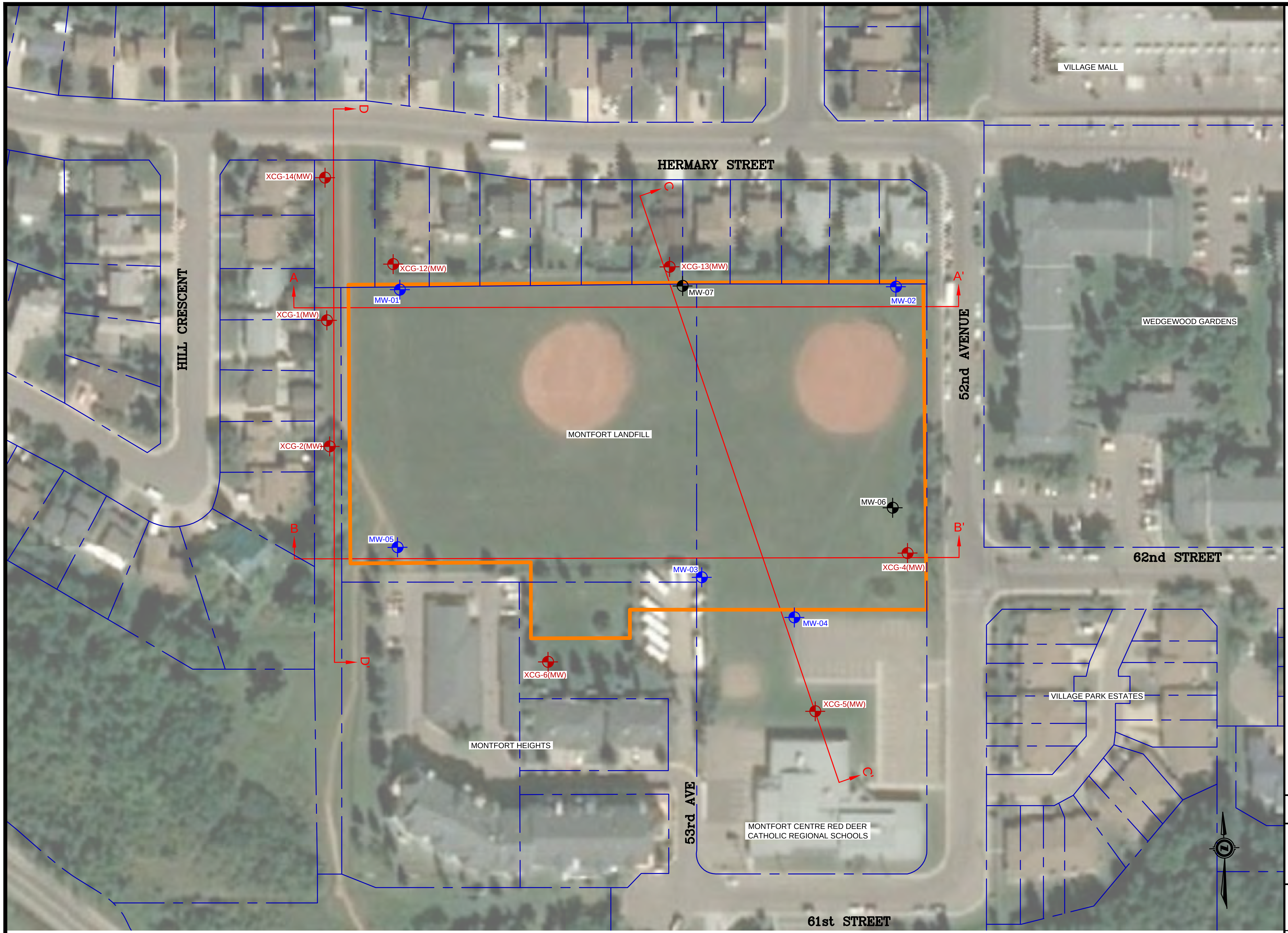
SHEET: R423520403007FIG01.pdf
FILE: R423520403007.dwg

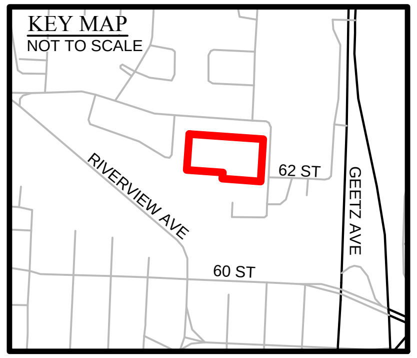
SITE LOCATION AND
EXTENT OF LANDFILL

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
Environmental Engineers & Scientists

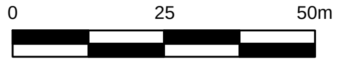
DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	1





LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⌖	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⌖	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
▲	SOIL VAPOUR MONITORING WELL
⌖	MONITORING WELL LOCATION (XCG, JAN. 2017)
▲	SOIL VAPOUR MONITORING LOCATION (XCG, JAN. 2017)
⌖	BOREHOLE LOCATION (XCG, JAN. 2017)
A ——— A'	SECTION LOCATION



CROSS SECTION LOCATIONS

VAPOUR INTRUSION ASSESSMENT
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

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DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

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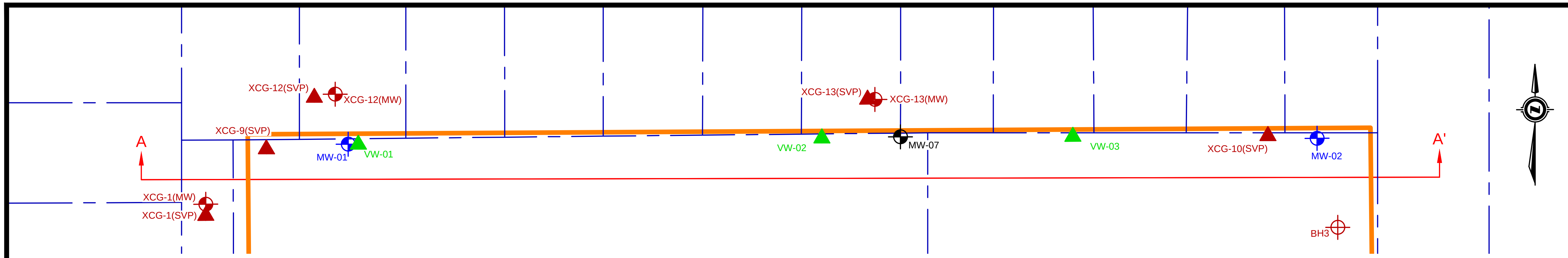
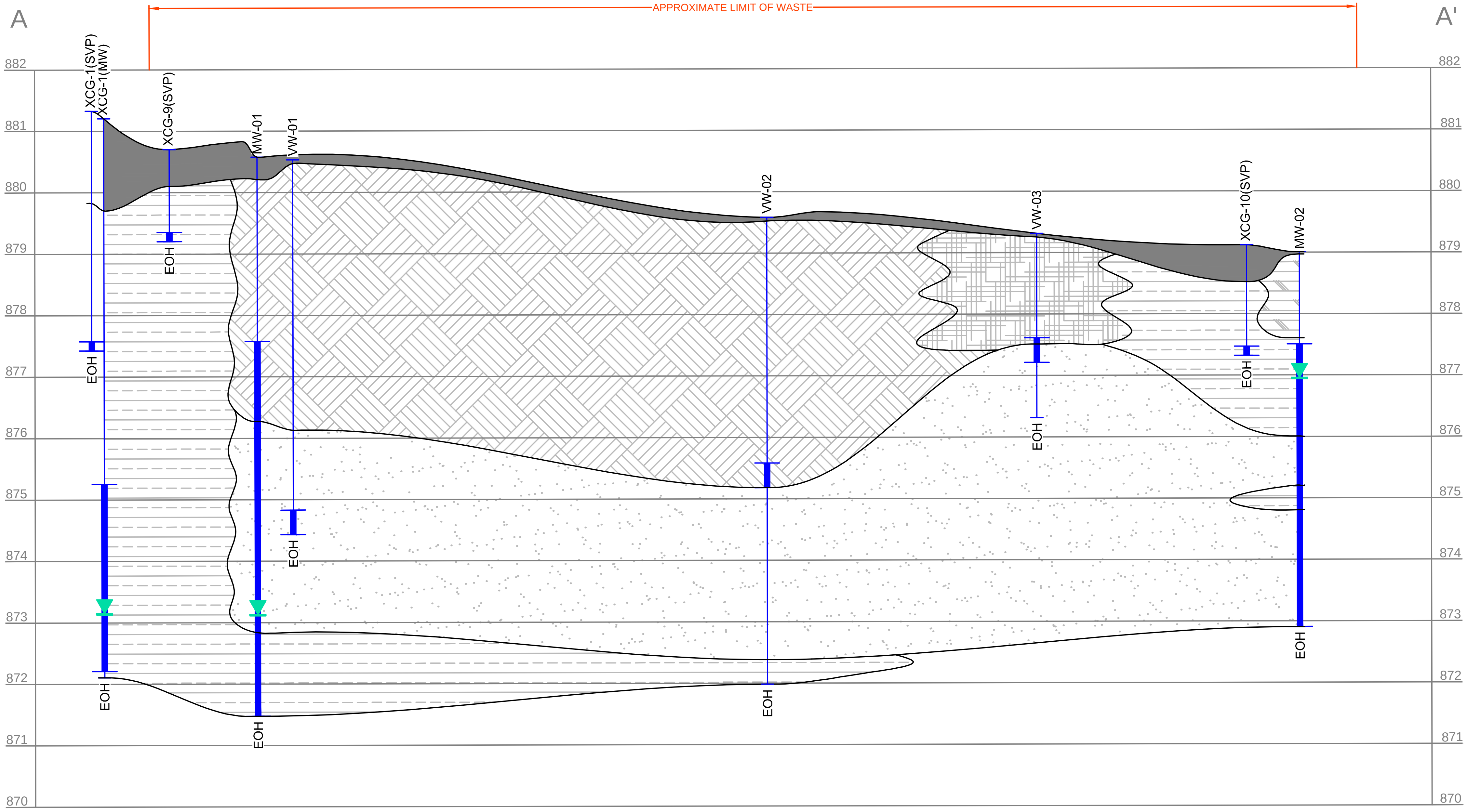
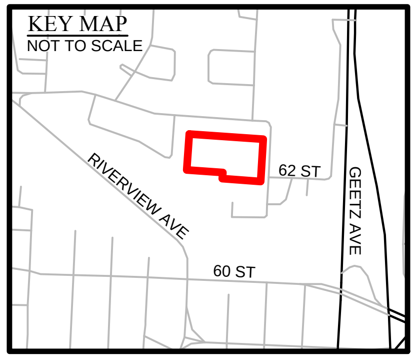
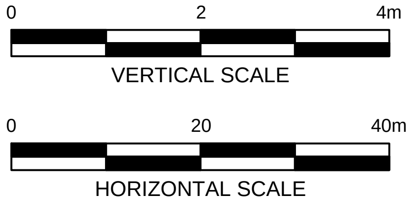






LEGEND:

│	MONITORING WELL / BOREHOLE
┃	MONITORING WELL SCREEN INTERVAL
▼	WATER LEVEL (MEASURED JUNE 2017)
■	TOPSOIL
▨	MUNICIPAL SOLID WASTE
▭	SILT FILL
▦	SAND / LOAM FILL
░	NATIVE SAND
▭	CLAY



SECTION A – A'
RESULTS

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

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DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	3

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG03.pdf
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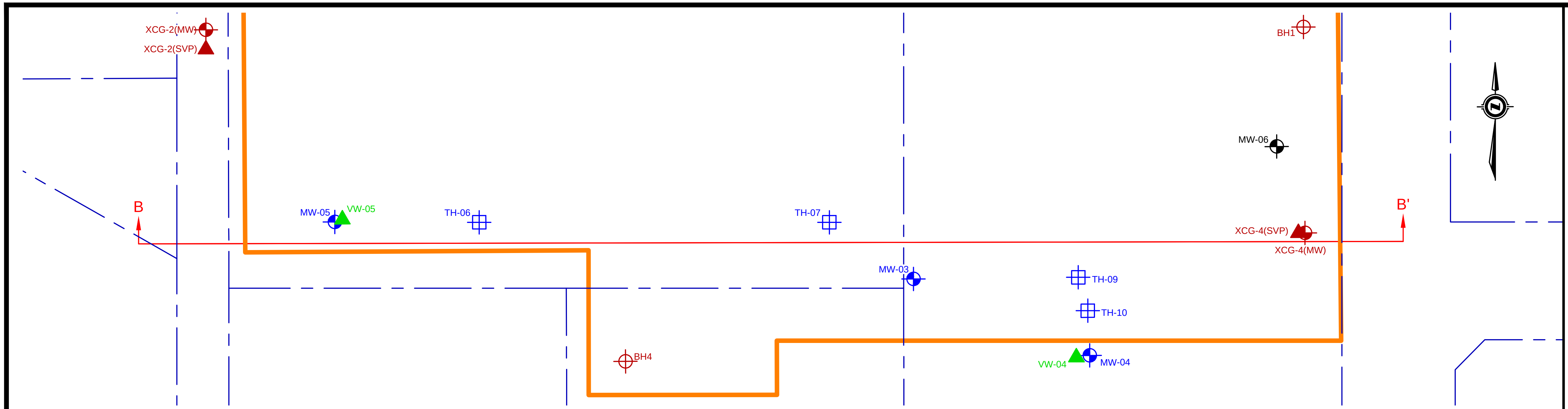
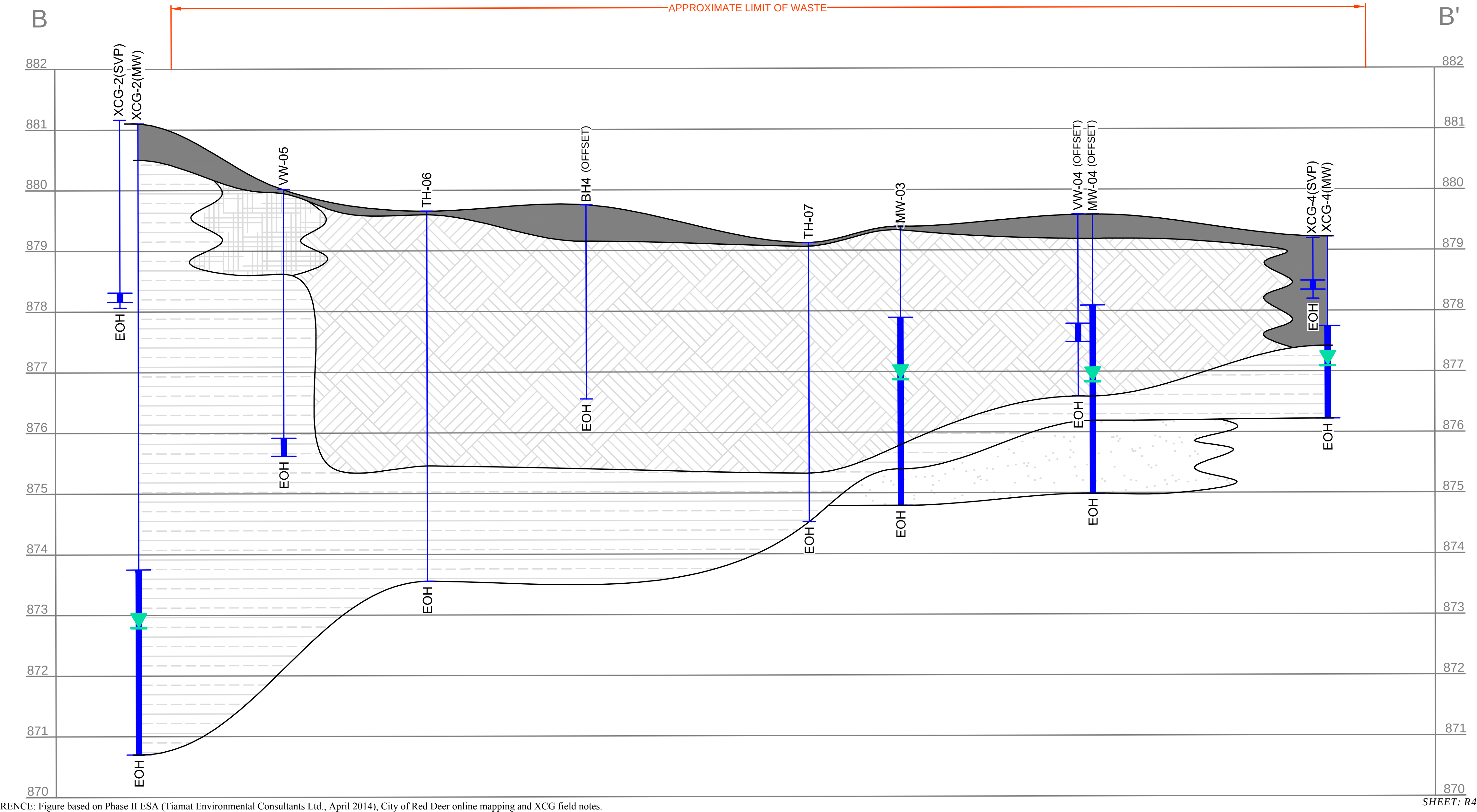
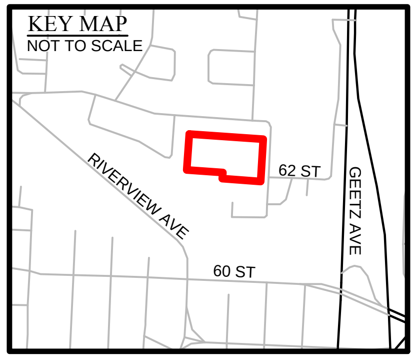




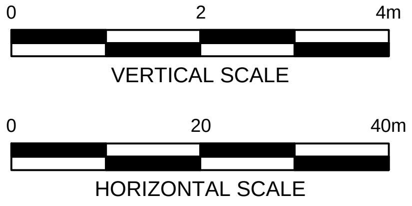
DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG04.pdf
FILE: R423520403007FIG04.dwg



LEGEND:

│	MONITORING WELL / BOREHOLE
┃	MONITORING WELL SCREEN INTERVAL
▼	WATER LEVEL (MEASURED JUNE 2017)
■	TOPSOIL
▨	MUNICIPAL SOLID WASTE
▦	SAND / LOAM FILL
░	NATIVE SAND
▤	CLAY



SECTION B – B'
RESULTS

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

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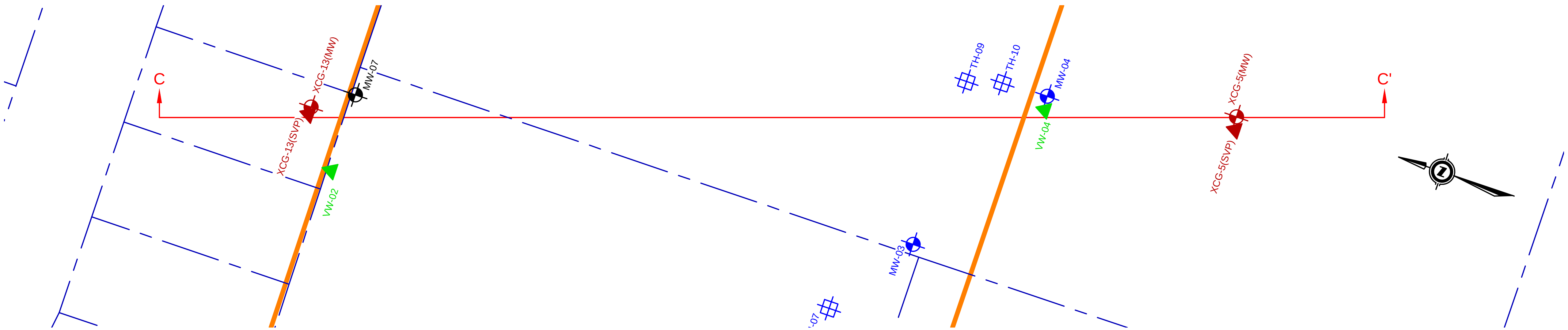
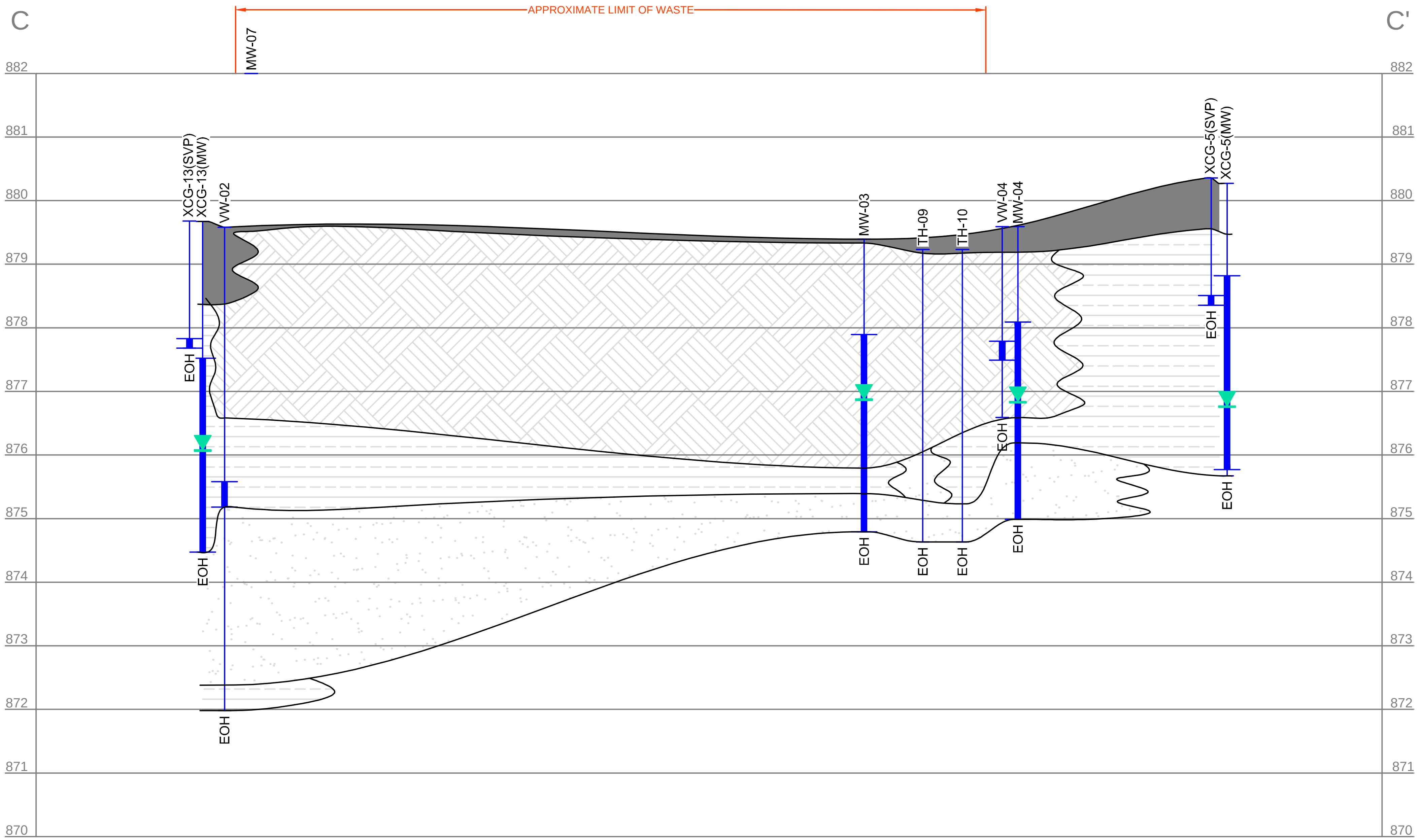
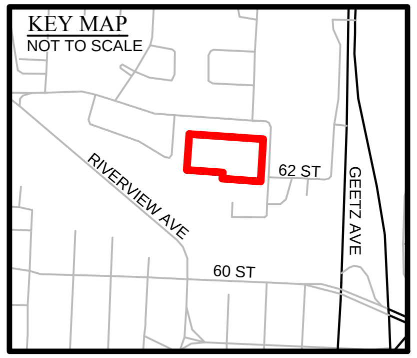
DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	4






KEY MAP
NOT TO SCALE

LEGEND:

│	MONITORING WELL / BOREHOLE
┃	MONITORING WELL SCREEN INTERVAL
▼	WATER LEVEL (MEASURED JUNE 2017)
■	TOPSOIL
▨	MUNICIPAL SOLID WASTE
☐	SILT FILL
☐	NATIVE SAND
☐	CLAY

0 2 4m
VERTICAL SCALE

0 20 40m
HORIZONTAL SCALE

SECTION C – C'
RESULTS

VAPOUR INTRUSION ASSESSMENT AND
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FORMER MONTFORT LANDFILL SITE
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DATE	JOB NO.	FIGURE NO.
APR. 2018	4–2352–04–03	5

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG05.pdf
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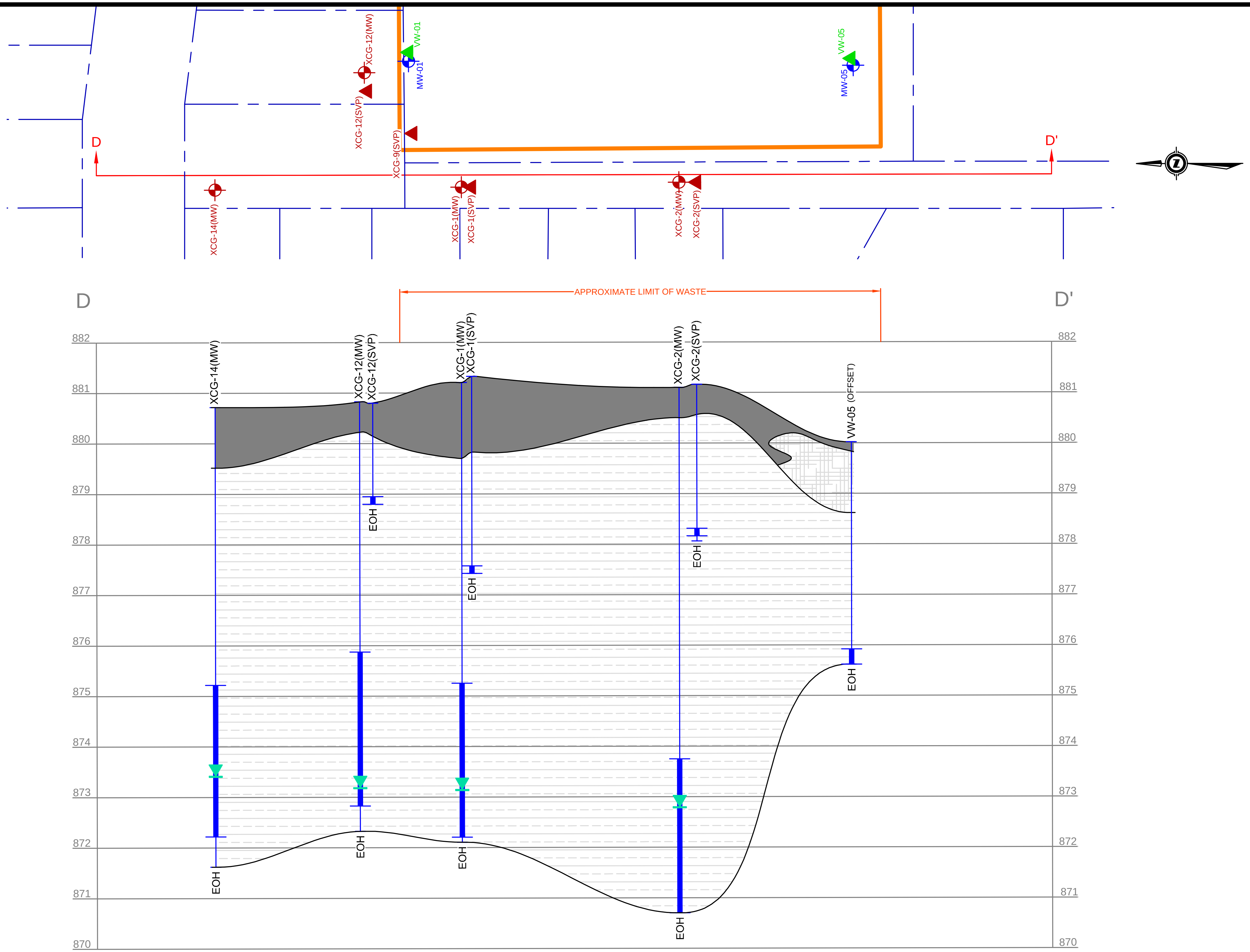

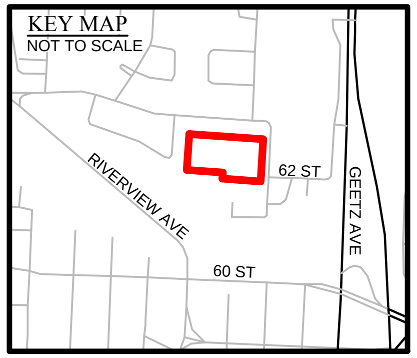

LEGEND:

│	MONITORING WELL / BOREHOLE
┃	MONITORING WELL SCREEN INTERVAL
▼	WATER LEVEL (MEASURED JUNE 2017)
■	TOPSOIL
▨	SAND / LOAM FILL
☐	CLAY

0 2 4m
VERTICAL SCALE

0 20 40m
HORIZONTAL SCALE

SECTION D – D'

VAPOUR INTRUSION ASSESSMENT AND
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DATE	JOB NO.	FIGURE NO.
APR. 2018	4–2352–04–03	6

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
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SHEET: R423520403007FIG06.pdf
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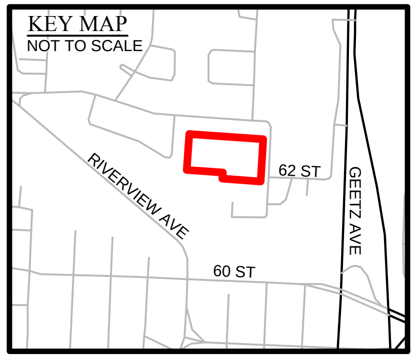

LEGEND:

🟧	APPROXIMATE LIMIT OF WASTE
○	300 METRE BUFFER FROM LIMIT OF WASTE
●	APPROXIMATE LOCATION OF WATER WELL DRILLING (ALBERTA WATER WELL DATABASE MAP)

WELL ID
YEAR OF RECORD
● 96279 (1979)

0 100 200m

SURFACE WATER AND GROUNDWATER USERS WITHIN 300km (VIA PUBLIC RECORDS)

VAPOUR INTRUSION ASSESSMENT AND
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CITY OF RED DEER, ALBERTA

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DATE	JOB NO.	FIGURE NO.
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DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG07.pdf
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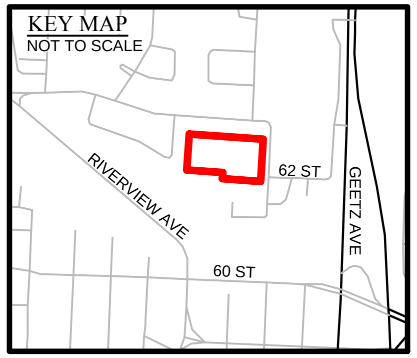

LEGEND:

🟧	APPROXIMATE LIMIT OF WASTE
○	300 METRE BUFFER FROM LIMIT OF WASTE
▨	ECOLOGICAL RECEPTOR (ENVIRONMENTAL PROTECTION DISTRICT)

0 250 500m

ECOLOGICAL RECEPTORS WITHIN 300m

VAPOUR INTRUSION ASSESSMENT AND
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DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	8

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG08.pdf
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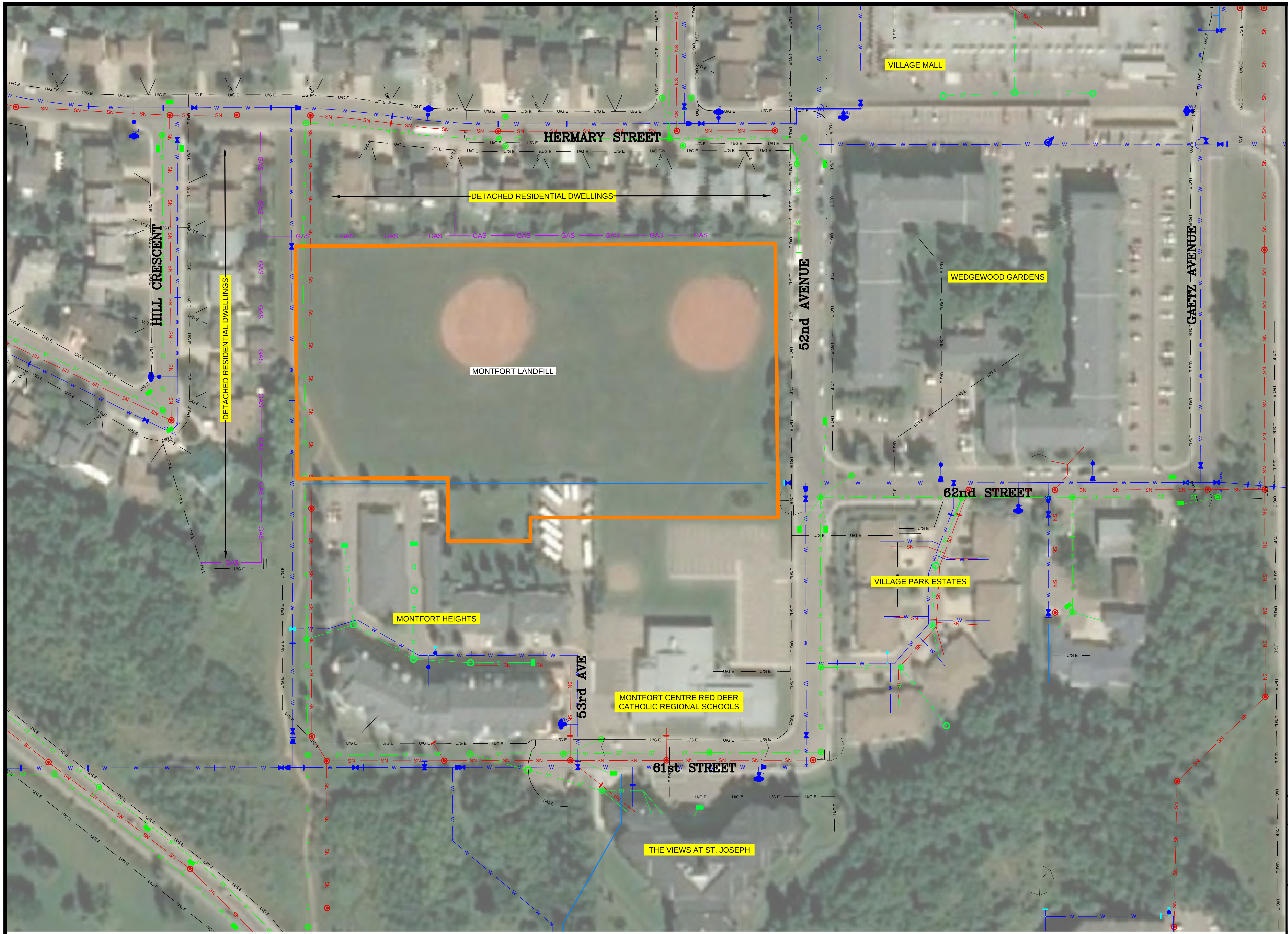

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG09.pdf
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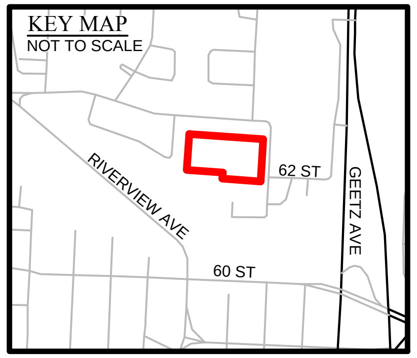
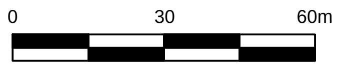


LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
VILLAGE MALL	POTENTIAL VAPOUR INTRUSION RECEPTORS



POTENTIAL LFG RECEPTORS

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

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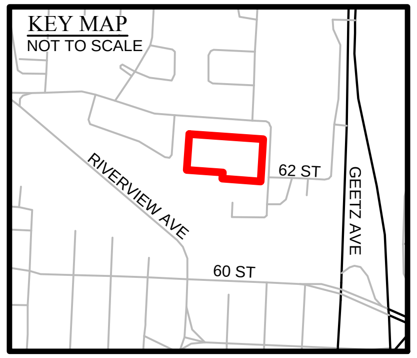
DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	9



LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⌖	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⌖	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
⊞	TEST HOLE
▲	SOIL VAPOUR MONITORING WELL
⌖	MONITORING WELL LOCATION (XCG, JAN. 2017)
▲	SOIL VAPOUR MONITORING LOCATION (XCG, JAN. 2017)
⌖	BOREHOLE LOCATION (XCG, JAN. 2017)

MONITORING WELL AND
SOIL VAPOUR PROBE LOCATIONS

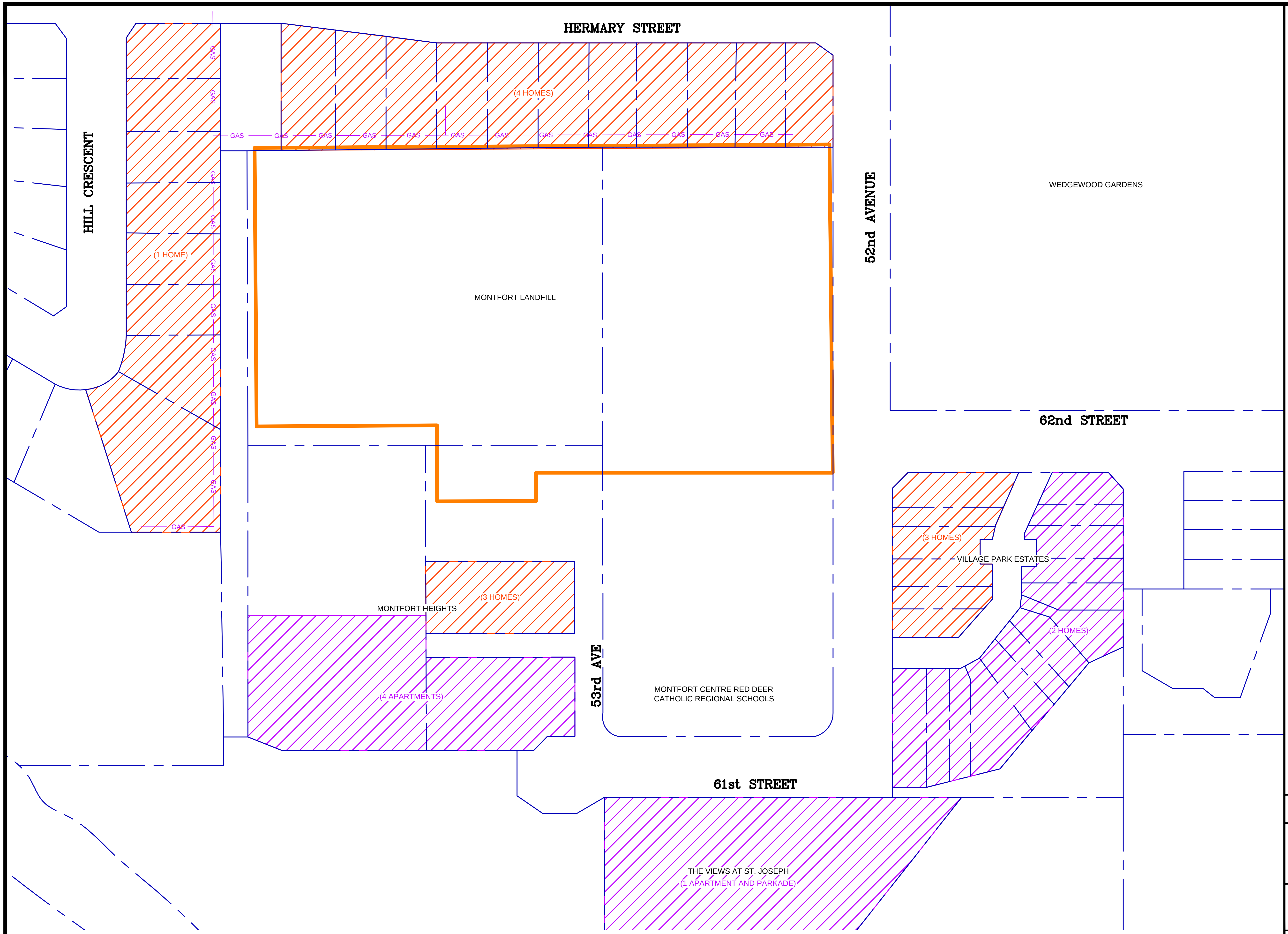
VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

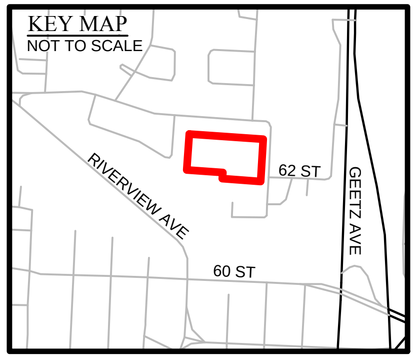
XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	10

SHEET: R423520403007FIG10.pdf
FILE: R423520403007.dwg

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.





LEGEND:

- — — APPROXIMATE PROPERTY BOUNDARIES
- ▭ APPROXIMATE LIMIT OF WASTE
- ▨ INVESTIGATION LOCATIONS (FIRST PHASE)
- ▨ INVESTIGATION LOCATIONS (PROVISIONAL PHASE)
- — GAS — GAS — GAS LINE

N

0 25 50m

INDOOR AIR QUALITY
MONITORING LOCATIONS

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	11

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
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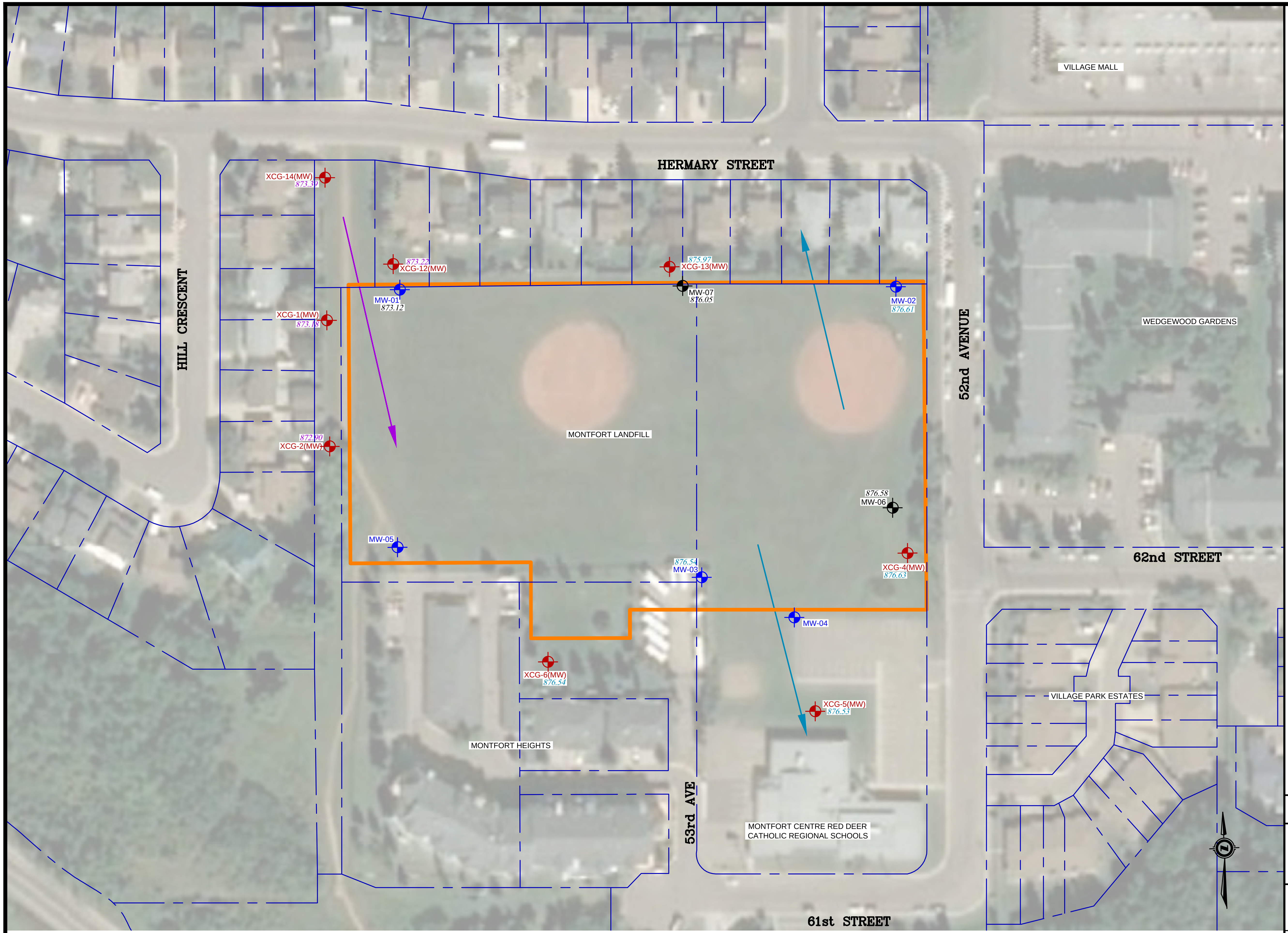
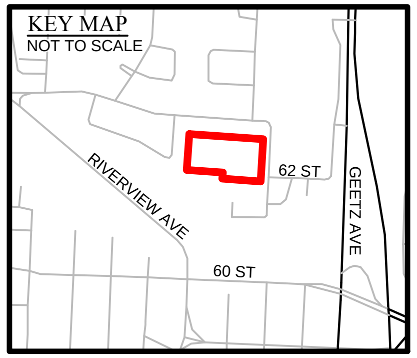
SHEET: R423520403007FIG11.pdf
FILE: R423520403007.dwg



KEY MAP
NOT TO SCALE



LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⊕	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⊕	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
⊕	MONITORING WELL LOCATION (XCG, JAN. 2017)
873.18	SHALLOW GROUNDWATER ELEVATION (M.A.S.L., MARCH 2017)
→	APPROXIMATE SHALLOW GROUNDWATER FLOW DIRECTION
876.61	PERCHED GROUNDWATER ELEVATION (M.A.S.L., MARCH 2017)
→	APPROXIMATE PERCHED GROUNDWATER FLOW DIRECTION
876.05	BOREHOLE LOG UNAVAILABLE OR ELEVATION NOT CONSIDERED IN INTERPRETATION OF GROUNDWATER FLOW

0 25 50m

GROUNDWATER ELEVATIONS
(MARCH 2017)

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

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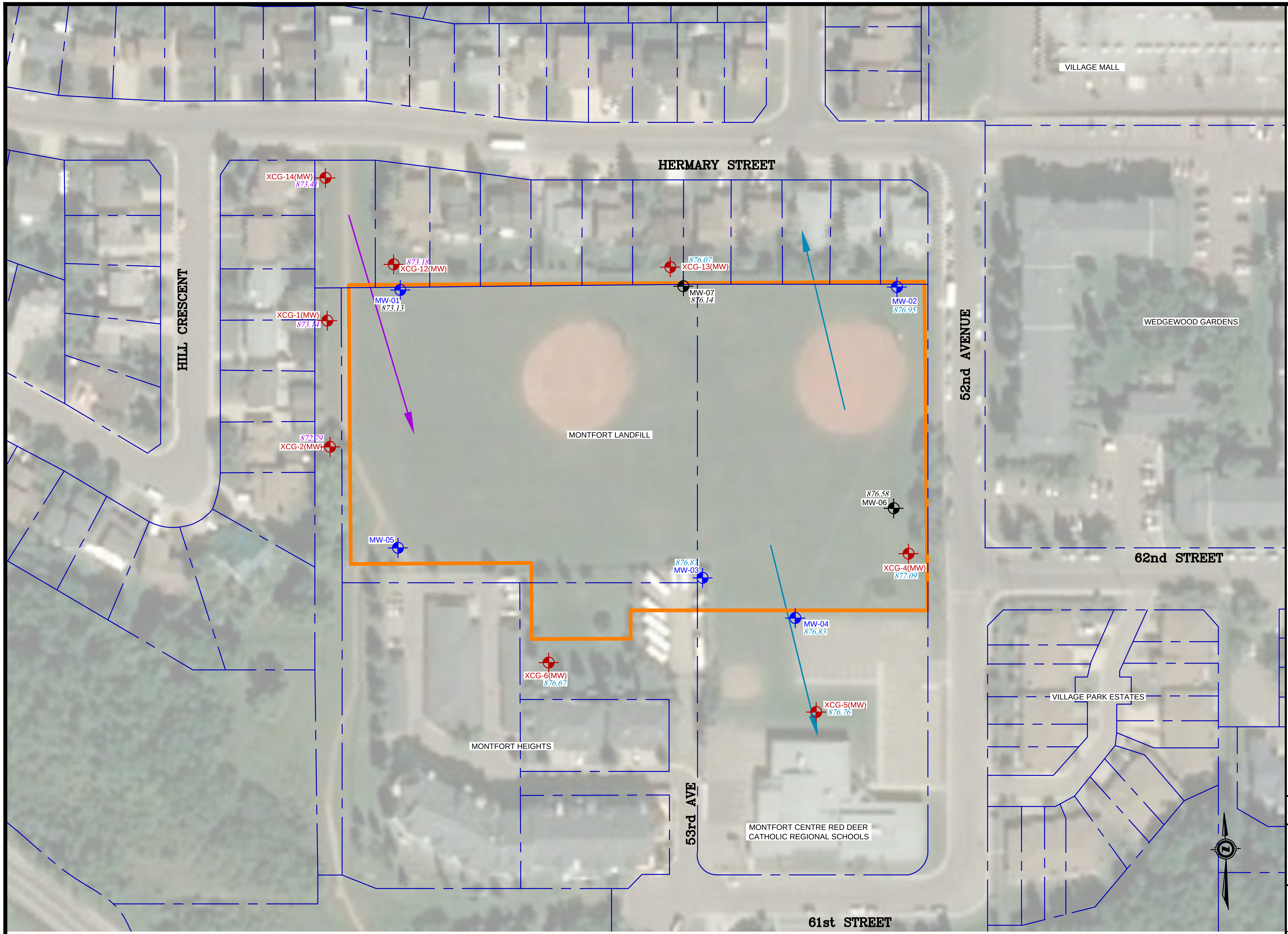
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	12

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

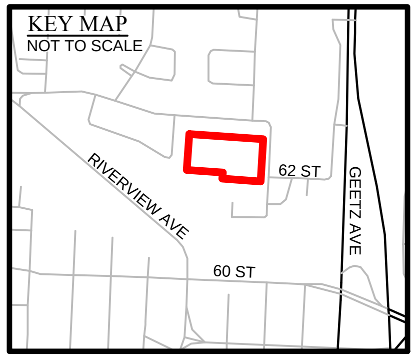
SHEET: R423520403007FIG12.pdf
FILE: R423520403007.dwg



DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG13.pdf
FILE: R423520403007.dwg

KEY MAP
NOT TO SCALE



LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⊕	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⊕	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
⊕	MONITORING WELL LOCATION (XCG, JAN. 2017)
873.18	SHALLOW GROUNDWATER ELEVATION (M.A.S.L., JUNE 2017)
→	APPROXIMATE SHALLOW GROUNDWATER FLOW DIRECTION
876.61	PERCHED GROUNDWATER ELEVATION (M.A.S.L., JUNE 2017)
→	APPROXIMATE PERCHED GROUNDWATER FLOW DIRECTION
876.05	BOREHOLE LOG UNAVAILABLE OR ELEVATION NOT CONSIDERED IN INTERPRETATION OF GROUNDWATER FLOW

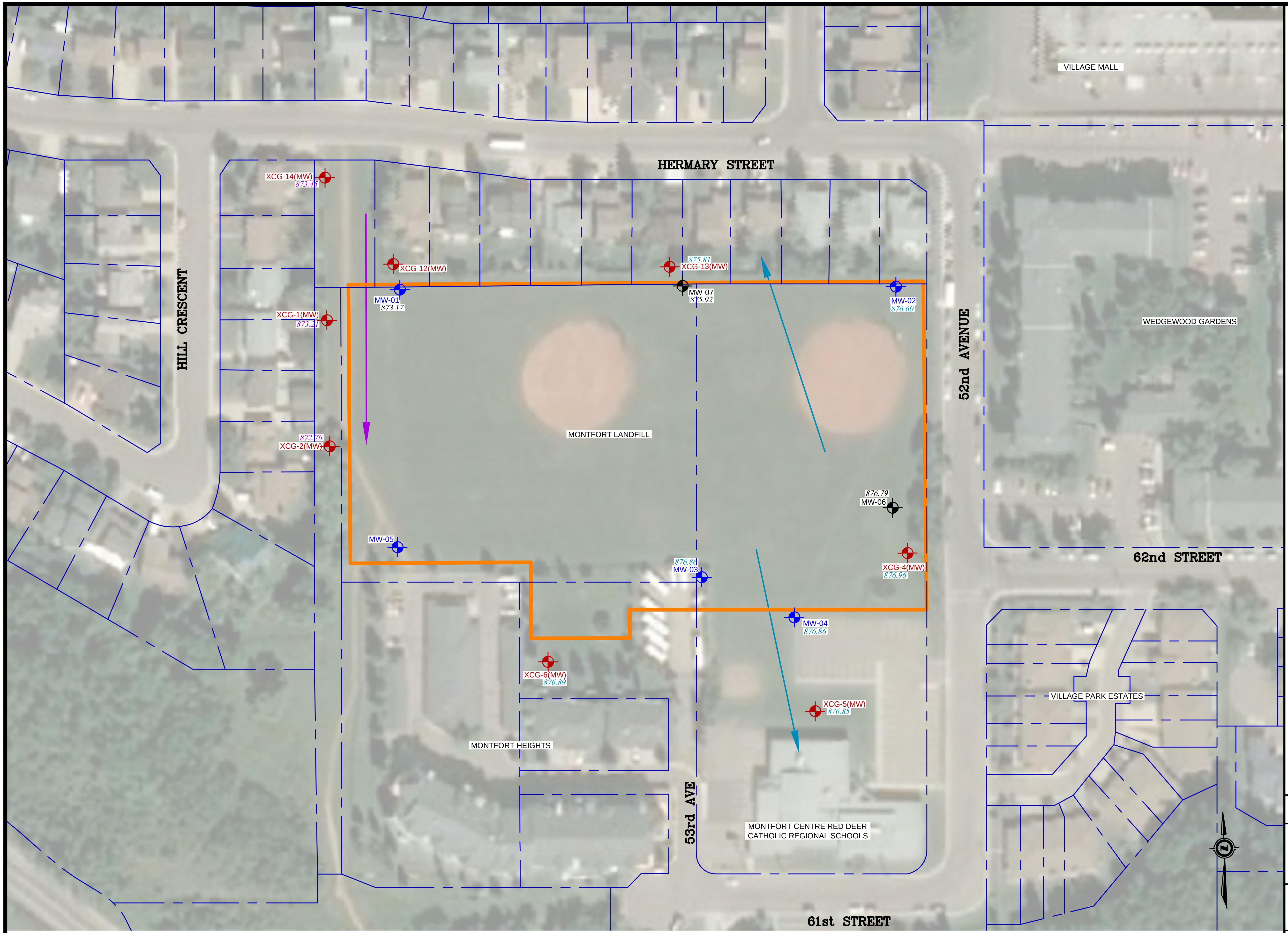
0 25 50m

GROUNDWATER ELEVATIONS
(JUNE 2017)

VAPOUR INTRUSION ASSESSMENT
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

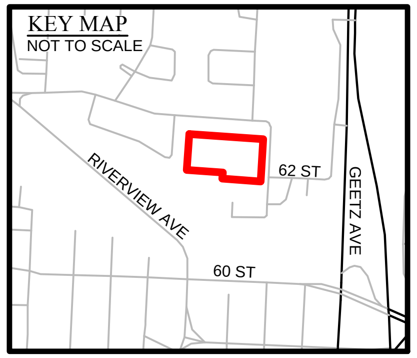
XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	13



DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG14.pdf
FILE: R423520403007.dwg



LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⌖	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⌖	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
⌖	MONITORING WELL LOCATION (XCG, JAN. 2017)
873.18	SHALLOW GROUNDWATER ELEVATION (M.A.S.L., SEPT. 2017)
→	APPROXIMATE SHALLOW GROUNDWATER FLOW DIRECTION
876.61	PERCHED GROUNDWATER ELEVATION (M.A.S.L., SEPT. 2017)
→	APPROXIMATE PERCHED GROUNDWATER FLOW DIRECTION
876.05	BOREHOLE LOG UNAVAILABLE OR ELEVATION NOT CONSIDERED IN INTERPRETATION OF GROUNDWATER FLOW

0 25 50m

GROUNDWATER ELEVATIONS
(SEPTEMBER 2017)

VAPOUR INTRUSION ASSESSMENT
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
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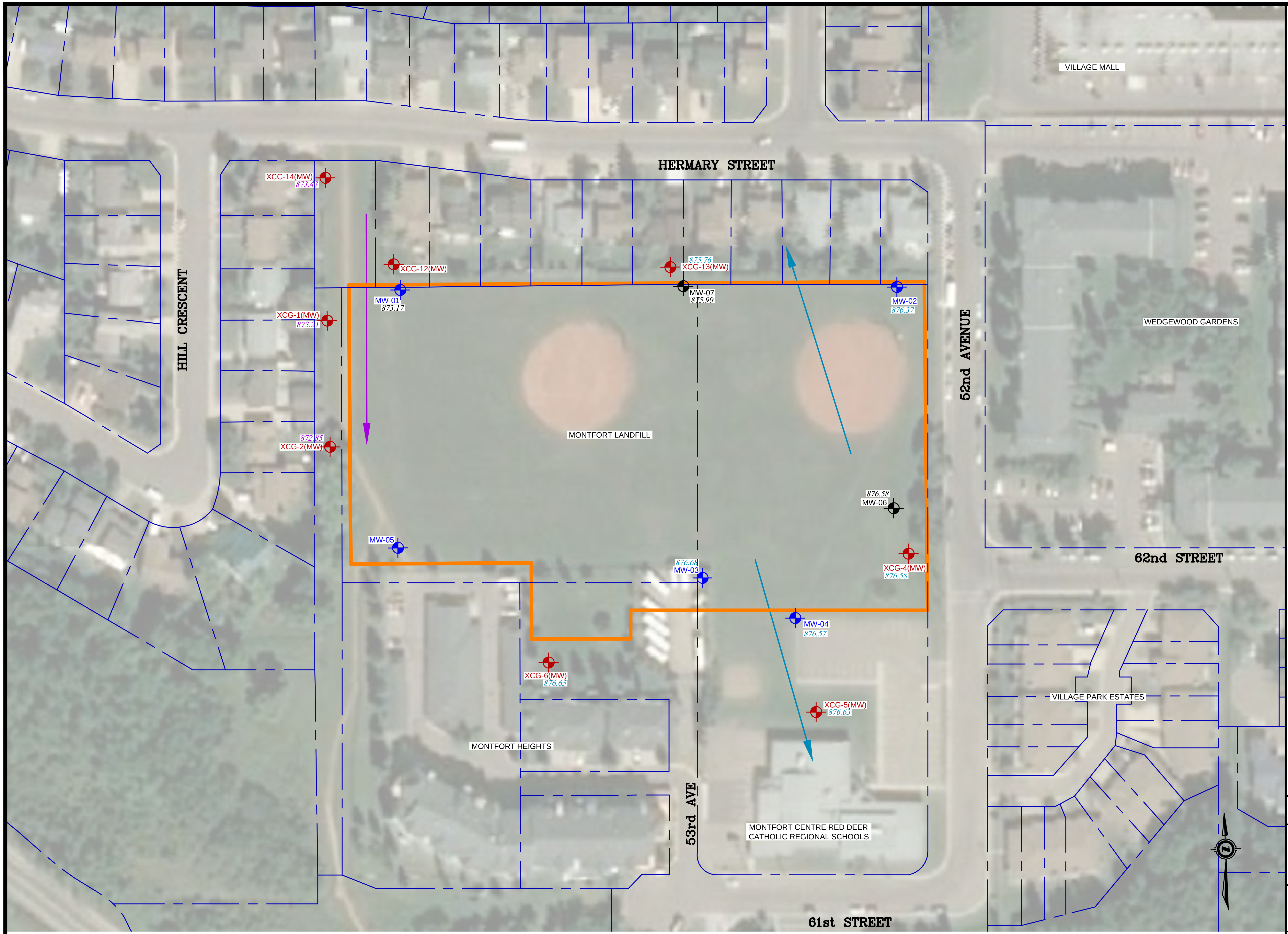
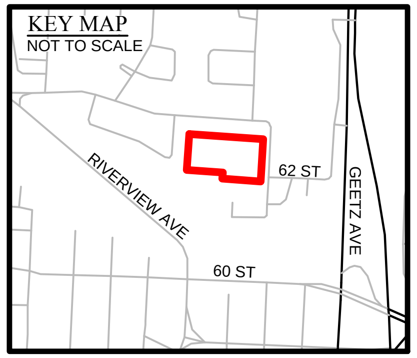
DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	14





LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
— SN — SN —	SANITARY LINE
— ST — ST —	STORM LINE
— GAS — GAS —	GAS LINE
— U/G E — U/G E —	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
⊕	GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
⊕	GROUNDWATER MONITORING WELL LOCATION (OTHERS)
⊕	MONITORING WELL LOCATION (XCG, JAN. 2017)
873.18	SHALLOW GROUNDWATER ELEVATION (M.A.S.L., DEC. 2017)
→	APPROXIMATE SHALLOW GROUNDWATER FLOW DIRECTION
876.61	PERCHED GROUNDWATER ELEVATION (M.A.S.L., DEC. 2017)
→	APPROXIMATE PERCHED GROUNDWATER FLOW DIRECTION
876.05	BOREHOLE LOG UNAVAILABLE OR ELEVATION NOT CONSIDERED IN INTERPRETATION OF GROUNDWATER FLOW

GROUNDWATER ELEVATIONS
(DECEMBER 2017)

VAPOUR INTRUSION ASSESSMENT
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
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DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	15

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
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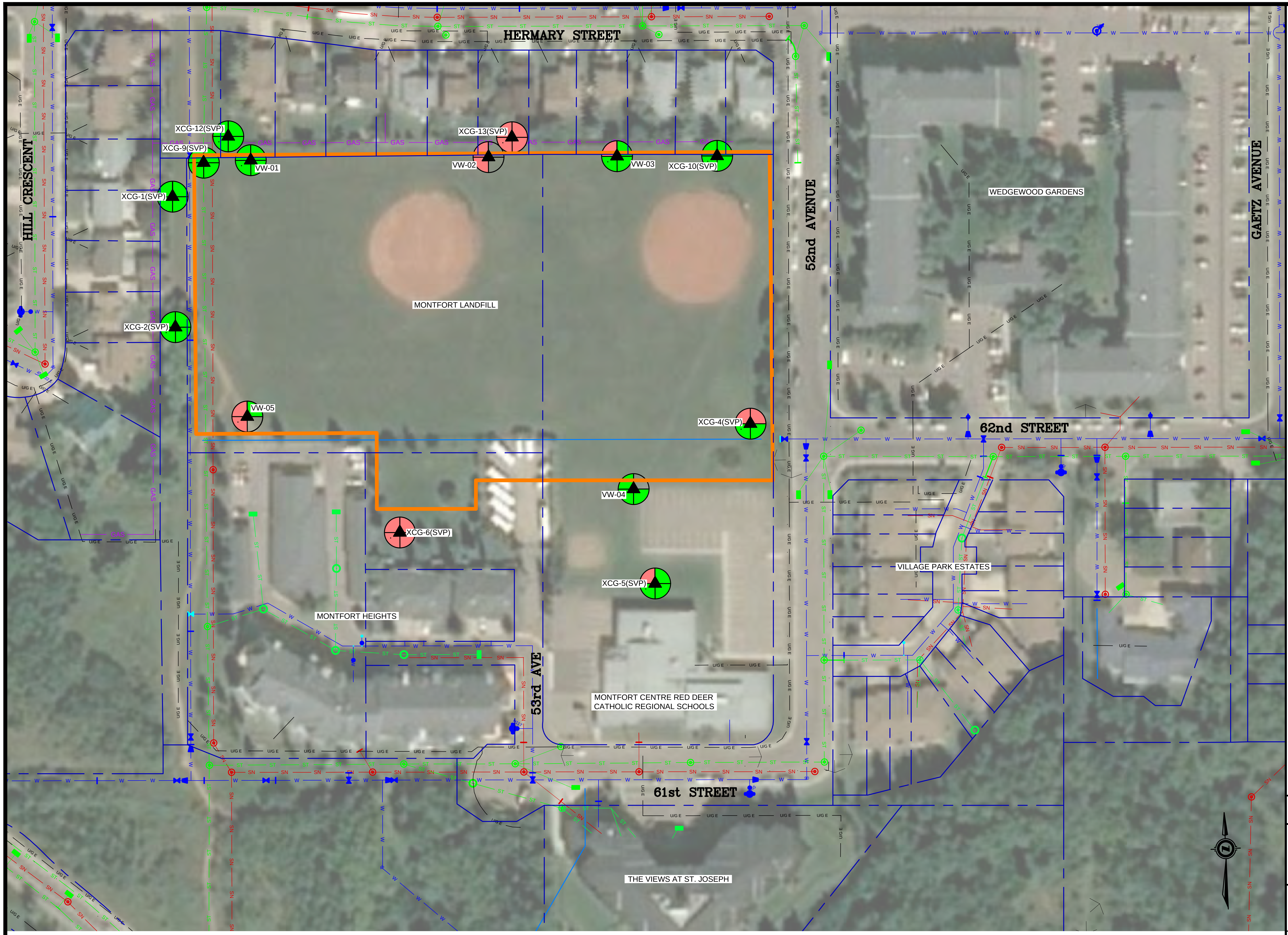
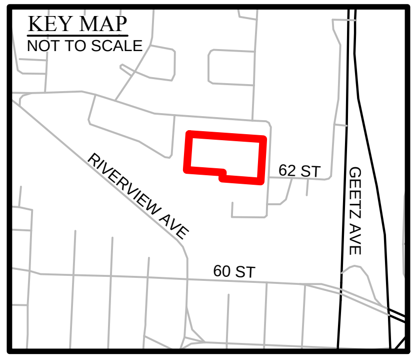
SHEET: R423520403007FIG15.pdf
FILE: R423520403007.dwg





LEGEND:

— — —	APPROXIMATE PROPERTY BOUNDARIES
—— SN —— SN ——	SANITARY LINE
—— ST —— ST ——	STORM LINE
—— GAS —— GAS ——	GAS LINE
—— U/G E —— U/G E ——	UNDERGROUND ELECTRICAL TRENCH
▭	APPROXIMATE LIMIT OF WASTE
▲	SOIL VAPOUR MONITORING WELL

SAMPLING RESULTS FOR
METHANE IN 2017 BY QUARTER

DEC. 2017
MARCH 2017
SEPT. 2017
JUNE 2017

🔴	METHANE DETECTED
🟢	METHANE NOT DETECTED

0 25 50m

QUARTERLY SOIL VAPOUR
METHANE RESULTS

VAPOUR INTRUSION ASSESSMENT AND
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	16

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
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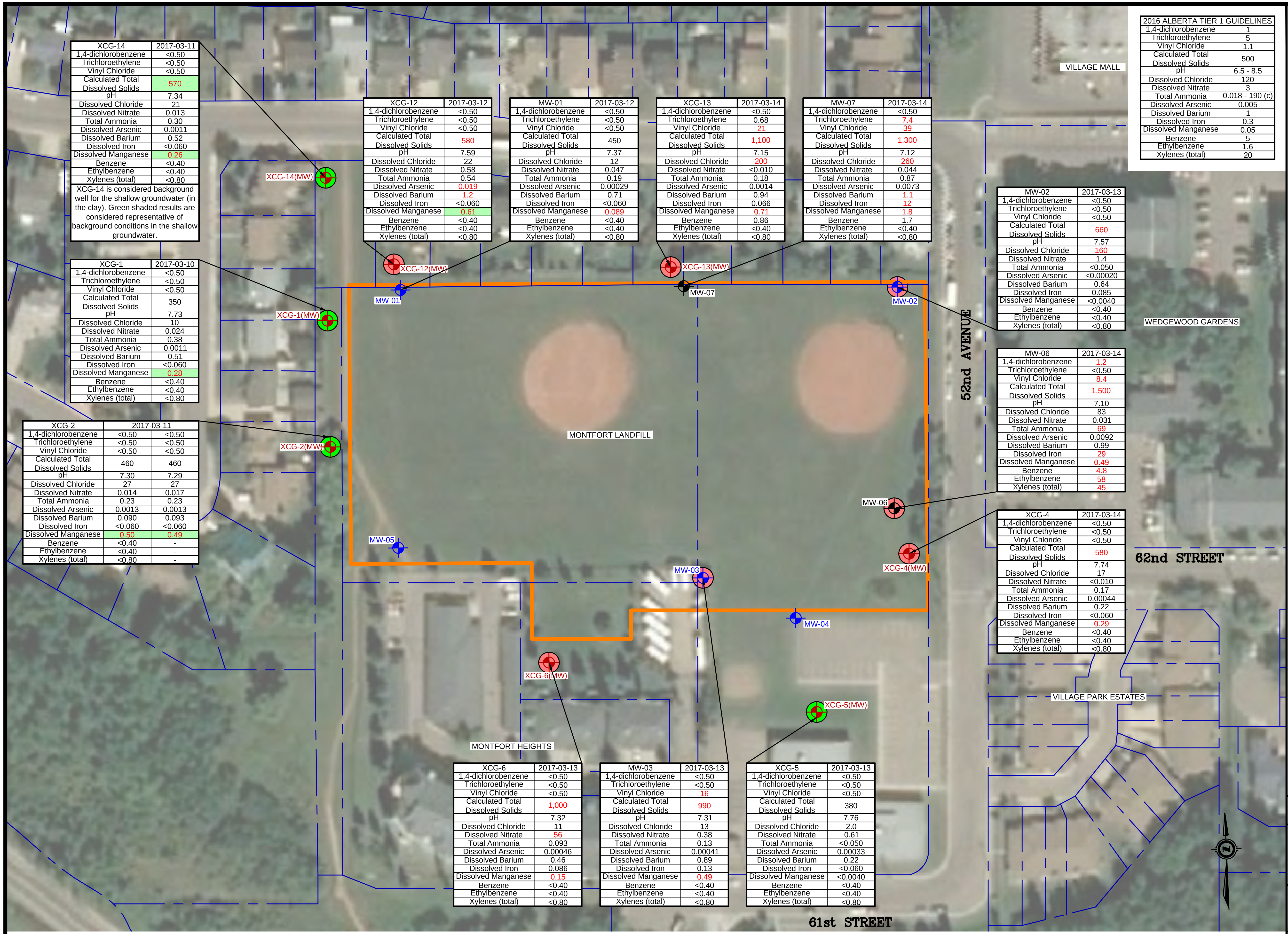
SHEET: R423520403007FIG16.pdf
FILE: R423520403007.dwg



XCG-14	2017-03-11
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	570
pH	7.34
Dissolved Chloride	21
Dissolved Nitrate	0.013
Total Ammonia	0.30
Dissolved Arsenic	0.0011
Dissolved Barium	0.52
Dissolved Iron	<0.060
Dissolved Manganese	0.26
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

XCG-14 is considered background well for the shallow groundwater (in the clay). Green shaded results are considered representative of background conditions in the shallow groundwater.

XCG-1	2017-03-10
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	350
pH	7.73
Dissolved Chloride	10
Dissolved Nitrate	0.024
Total Ammonia	0.38
Dissolved Arsenic	0.0011
Dissolved Barium	0.51
Dissolved Iron	<0.060
Dissolved Manganese	0.28
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

XCG-2	2017-03-11	
1,4-dichlorobenzene	<0.50	<0.50
Trichloroethylene	<0.50	<0.50
Vinyl Chloride	<0.50	<0.50
Calculated Total Dissolved Solids	460	460
pH	7.30	7.29
Dissolved Chloride	27	27
Dissolved Nitrate	0.014	0.017
Total Ammonia	0.23	0.23
Dissolved Arsenic	0.0013	0.0013
Dissolved Barium	0.090	0.093
Dissolved Iron	<0.060	<0.060
Dissolved Manganese	0.50	0.49
Benzene	<0.40	-
Ethylbenzene	<0.40	-
Xylenes (total)	<0.80	-

XCG-12	2017-03-12
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	580
pH	7.59
Dissolved Chloride	22
Dissolved Nitrate	0.58
Total Ammonia	0.54
Dissolved Arsenic	0.019
Dissolved Barium	1.2
Dissolved Iron	<0.060
Dissolved Manganese	0.61
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

MW-01	2017-03-12
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	450
pH	7.37
Dissolved Chloride	12
Dissolved Nitrate	0.047
Total Ammonia	0.19
Dissolved Arsenic	0.00029
Dissolved Barium	0.71
Dissolved Iron	<0.060
Dissolved Manganese	0.089
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

XCG-13	2017-03-14
1,4-dichlorobenzene	<0.50
Trichloroethylene	0.68
Vinyl Chloride	21
Calculated Total Dissolved Solids	1,100
pH	7.15
Dissolved Chloride	200
Dissolved Nitrate	<0.010
Total Ammonia	0.18
Dissolved Arsenic	0.0014
Dissolved Barium	0.94
Dissolved Iron	0.066
Dissolved Manganese	0.71
Benzene	0.86
Ethylbenzene	<0.40
Xylenes (total)	<0.80

MW-07	2017-03-14
1,4-dichlorobenzene	<0.50
Trichloroethylene	7.4
Vinyl Chloride	39
Calculated Total Dissolved Solids	1,300
pH	7.12
Dissolved Chloride	260
Dissolved Nitrate	0.044
Total Ammonia	0.87
Dissolved Arsenic	0.0073
Dissolved Barium	1.1
Dissolved Iron	12
Dissolved Manganese	1.8
Benzene	1.7
Ethylbenzene	<0.40
Xylenes (total)	<0.80

MW-02	2017-03-13
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	660
pH	7.57
Dissolved Chloride	160
Dissolved Nitrate	1.4
Total Ammonia	<0.050
Dissolved Arsenic	<0.00020
Dissolved Barium	0.64
Dissolved Iron	0.085
Dissolved Manganese	<0.0040
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

MW-06	2017-03-14
1,4-dichlorobenzene	1.2
Trichloroethylene	<0.50
Vinyl Chloride	8.4
Calculated Total Dissolved Solids	1,500
pH	7.10
Dissolved Chloride	83
Dissolved Nitrate	0.031
Total Ammonia	69
Dissolved Arsenic	0.0092
Dissolved Barium	0.99
Dissolved Iron	29
Dissolved Manganese	0.49
Benzene	4.8
Ethylbenzene	58
Xylenes (total)	45

XCG-4	2017-03-14
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	580
pH	7.74
Dissolved Chloride	17
Dissolved Nitrate	<0.010
Total Ammonia	0.17
Dissolved Arsenic	0.00044
Dissolved Barium	0.22
Dissolved Iron	<0.060
Dissolved Manganese	0.29
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

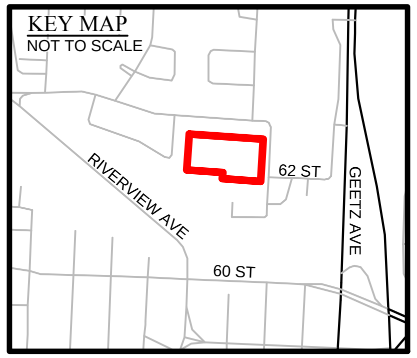
XCG-6	2017-03-13
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	1,000
pH	7.32
Dissolved Chloride	11
Dissolved Nitrate	56
Total Ammonia	0.093
Dissolved Arsenic	0.00046
Dissolved Barium	0.46
Dissolved Iron	0.086
Dissolved Manganese	0.15
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

MW-03	2017-03-13
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	16
Calculated Total Dissolved Solids	990
pH	7.31
Dissolved Chloride	13
Dissolved Nitrate	0.38
Total Ammonia	0.13
Dissolved Arsenic	0.00041
Dissolved Barium	0.89
Dissolved Iron	0.13
Dissolved Manganese	0.49
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

XCG-5	2017-03-13
1,4-dichlorobenzene	<0.50
Trichloroethylene	<0.50
Vinyl Chloride	<0.50
Calculated Total Dissolved Solids	380
pH	7.76
Dissolved Chloride	2.0
Dissolved Nitrate	0.61
Total Ammonia	<0.050
Dissolved Arsenic	0.00033
Dissolved Barium	0.22
Dissolved Iron	<0.060
Dissolved Manganese	<0.0040
Benzene	<0.40
Ethylbenzene	<0.40
Xylenes (total)	<0.80

2016 ALBERTA TIER 1 GUIDELINES	
1,4-dichlorobenzene	1
Trichloroethylene	5
Vinyl Chloride	1.1
Calculated Total Dissolved Solids	500
pH	6.5 - 8.5
Dissolved Chloride	120
Dissolved Nitrate	3
Total Ammonia	0.018 - 190 (c)
Dissolved Arsenic	0.005
Dissolved Barium	1
Dissolved Iron	0.3
Dissolved Manganese	0.05
Benzene	5
Ethylbenzene	1.6
Xylenes (total)	20

KEY MAP
NOT TO SCALE



LEGEND:

- APPROXIMATE PROPERTY BOUNDARIES
- SN — SN SANITARY LINE
- ST — ST STORM LINE
- GAS — GAS GAS LINE
- U/G E — U/G E UNDERGROUND ELECTRICAL TRENCH
- APPROXIMATE LIMIT OF WASTE
- GROUNDWATER MONITORING WELL LOCATION (TIAMAT, 2014)
- GROUNDWATER MONITORING WELL LOCATION (OTHERS)
- MONITORING WELL LOCATION (XCG, JAN. 2017)
- ● ONE OR MORE RESULTS EXCEED 2016 ALBERTA TIER 1 GUIDELINES
- ● ALL RESULTS MEET 2016 ALBERTA TIER 1 GUIDELINES

SAMPLE ID — SAMPLE DATE

MW-02	2017-03-13
1,4-dichlorobenzene	<0.50
Calculated Total Dissolved Solids	660
pH	7.57
Dissolved Chloride	160
Xylenes (total)	<0.80

SAMPLE PARAMETER — SAMPLE RESULT

RED TEXT INDICATES RESULT EXCEEDS 2016 ALBERTA TIER 1 GUIDELINES
A "-" VALUE INDICATES A PARAMETER THAT WAS NOT ANALYZED

0 25 50m

CONCENTRATION OF COCs
IN GROUNDWATER (MARCH 2017)

VAPOUR INTRUSION ASSESSMENT
ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4–2352–04–03	17

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
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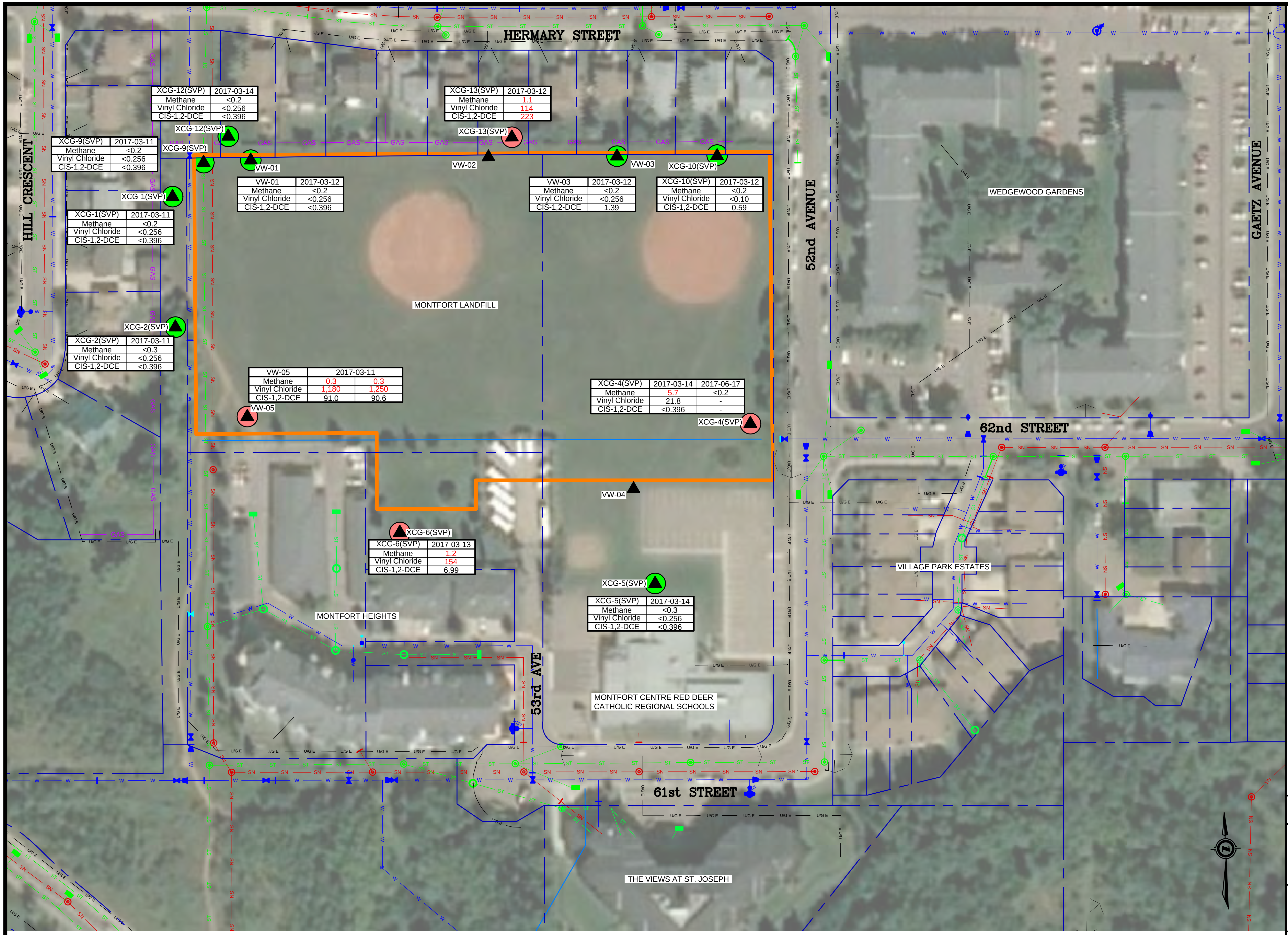
SHEET: R423520403007FIG17.pdf
FILE: R423520403007.dwg



XCG-12(SVP)	2017-03-14
Methane	<0.2
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

XCG-13(SVP)	2017-03-12
Methane	1.1
Vinyl Chloride	114
CIS-1,2-DCE	223

XCG-9(SVP)	2017-03-11
Methane	<0.2
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

VW-01	2017-03-12
Methane	<0.2
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

VW-03	2017-03-12
Methane	<0.2
Vinyl Chloride	<0.256
CIS-1,2-DCE	1.39

XCG-10(SVP)	2017-03-12
Methane	<0.2
Vinyl Chloride	<0.10
CIS-1,2-DCE	0.59

XCG-1(SVP)	2017-03-11
Methane	<0.2
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

XCG-2(SVP)	2017-03-11
Methane	<0.3
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

VW-05	2017-03-11	
Methane	0.3	0.3
Vinyl Chloride	1,180	1,250
CIS-1,2-DCE	91.0	90.6

XCG-4(SVP)	2017-03-14	2017-06-17
Methane	5.7	<0.2
Vinyl Chloride	21.8	-
CIS-1,2-DCE	<0.396	-

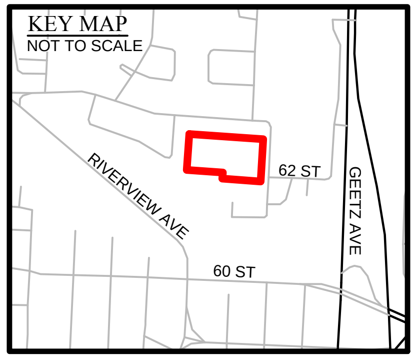
XCG-6(SVP)	2017-03-13
Methane	1.2
Vinyl Chloride	154
CIS-1,2-DCE	6.99

XCG-5(SVP)	2017-03-14
Methane	<0.3
Vinyl Chloride	<0.256
CIS-1,2-DCE	<0.396

DRAWING REFERENCE: Figure based on Phase II ESA (Tiamat Environmental Consultants Ltd., April 2014), City of Red Deer online mapping and XCG field notes.
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R423520403007FIG18.pdf
FILE: R423520403007.dwg

KEY MAP
NOT TO SCALE



LEGEND:

APPROXIMATE PROPERTY BOUNDARIES
SN — SN SANITARY LINE
ST — ST STORM LINE
GAS — GAS GAS LINE
U/G E — U/G E UNDERGROUND ELECTRICAL TRENCH
APPROXIMATE LIMIT OF WASTE
▲ SOIL VAPOUR MONITORING WELL
● ONE OR MORE RESULTS EXCEED SOIL VAPOUR SCREENING LEVEL
● ALL RESULTS MEET SOIL VAPOUR SCREENING LEVEL

SAMPLE ID
SAMPLE DATE

XCG-6(SVP)	2017-03-13
Methane	1.2
Vinyl Chloride	154
CIS-1,2-DCE	6.99

SAMPLE PARAMETER
SAMPLE RESULT

RED TEXT INDICATES RESULT EXCEEDS SOIL VAPOUR SCREENING LEVEL

0 25 50m

SOIL VAPOUR RESULTS
(MARCH 2017)

VAPOUR INTRUSION ASSESSMENT AND ENVIRONMENTAL MONITORING REPORT
FORMER MONTFORT LANDFILL SITE
CITY OF RED DEER, ALBERTA

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2018	4-2352-04-03	18

TABLES

Table 1 Groundwater, Soil Vapour, and Indoor Air Monitoring Program

	Monitoring Locations	Date	Hydraulic Monitoring	Soil Vapour Monitoring	Indoor Air Sampling	Analytical Parameters
Groundwater Wells	15	March 2017	✓	-		BTEX, hydrocarbon fractions F1, F2, VOCs, total and dissolved metals, Cl^-, sulfate (SO_4), ammonium (NH_4-N), phosphorous (P), TOC, chemical oxygen demand (COD), biochemical oxygen demand (BOD), NO_3^-/NO_2^-, total nitrogen (N), pH, electrical conductivity (EC), absorbable organic halides (AOXs), and volatile fatty acids
		June 2017	✓	-		-
		September 2017	✓	-		-
		December 2017	✓	-		-
Soil Vapour Probes	13	March 2017	✓	✓		VOCs, oxygen (O_2), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), nitrogen (N), volatile hydrocarbons and siloxanes, or volatile organic silicon compounds (VOSCs)
		June 2017	✓	✓		-
		September 2017	✓	✓		-
		December 2017	✓	✓		-
Residential Dwellings	10	March 2017			✓	

Table 2 *Observations documented during Preliminary Site Inspections*

Date of Initial Inspection	Finishes	Preferential Pathways	Observations & Actions
Residence A (Hill Crescent)			
06/12/2016	Basement has finished floors (tile, carpet) and walls. Layout encompasses a larger living room area, washroom, bedrooms, and a utility room.	Sanitary stack runs through floor outside of utility room.	No recommended actions.
		Floor drain outside of utility room.	
Residence B (Hermary Street)			
05/12/2016	Basement has finished floors (carpet) and walls except for the utility room. Layout encompasses a larger living room area, washroom, bedrooms, laundry room, and a utility room off the laundry room.	Sanitary stack runs through floor in utility room.	Paints and thinners in a cupboard in another room in basement. Recommended to not open paints in basement until after sampling. Cans of insecticides, window cleaners, etc. in laundry room. These were moved to the garage prior to the sampling event.
		Floor drain in utility room.	
Residence C (Hermary Street)			
06/12/2016	Basement has finished floors (tile, carpet) and walls except for utility room. Layout is completely open other than wall/hall dividing stairwell from rest of basement.	Sanitary stack runs through floor near furnace.	Tubes of acrylic paint present (hobby sized). Not opened for long time. Recommended to keep closed until after sampling.
	New carpeting on main level installed November 2016.	Floor drain near furnace.	
Residence D (Hermary Street)			
05/12/2016	Basement has finished floors (linoleum) and walls except for crawlspace. Layout is open other than half of basement is a crawlspace which has a door separating it from the rest of the basement.	Sanitary stack runs through floor near furnace.	No recommended actions.
		No visible floor drain- possibly present under furniture or utilities.	
Residence E (Hermary Street)			
06/12/2016	Basement has finished floors (carpet) and walls in approximately two-thirds of area. Layout encompasses a living room area, a bedroom, a storage area/crawlspace, and a utility room situated off the bedroom.	Sanitary stack runs through floor in utility room.	At least one member of the household smokes cigarettes in the house. Basement bedroom is occupied full time, therefore personal hygiene products (deodorant, etc.) present.
		Floor drain in utility room.	Ductwork in crawl space formerly directly connected to garage above. Homeowner sealed off.
		Several cracks visible in slab in storage area. Movement of air between storage area and the utility room is possible even with the doors closed to both areas.	No recommended actions.
Residence F (62nd Street)			
06/12/2016	Basement has finished floors (tile, carpet) and walls except for utility room. Layout encompasses a larger living room area, washroom, small storage room, and utility room.	Sanitary stack runs through floor in utility room.	Household cleaners in basement moved to garage before sampling event
	New flooring, carpeting on main level installed November 2016.	Floor drain in utility room.	
	Renovations within the week prior to sampling included new woodwork and the use of low VOC paint in the basement (Minwax water-based Wood Stain).	0.6m x 0.6m piece of plywood covering hole through slab in craft room in basement. Appears to be native clay below.	

Table 2 *Observations documented during Preliminary Site Inspections*

Date of Initial Inspection	Finishes	Preferential Pathways	Observations & Actions
Residence G (62nd Street)			
06/12/2016	Basement has finished floors (carpet) and walls except for utility room. Layout encompasses a larger living room area, washroom, small storage room, and utility room.	Sanitary stack runs through floor in utility room. Floor drain in utility room.	Bleach powder under sink in basement washroom. No recommended actions.
Residence H (62nd Street)			
06/12/2016	Basement unfinished - Concrete floor slab and studs visible. Basement completely open - no dividing walls.	Sanitary stack and floor drain near furnace. Minor crack in slab.	No recommended actions.
Residence I (Montfort Heights - 53 Avenue)			
09/03/2017	Basement has finished floors (carpet) and walls except for the utility area. Layout encompasses a larger living room area, washroom, laundry room, and a utility room off the laundry room.	Sanitary stack and floor drain near furnace. Minor crack in slab.	No recommended actions.
Residence J (Montfort Heights - 53rd Avenue)			
09/03/2017	Basement has finished floors (carpet) and walls except for the utility area. Layout encompasses a larger living room area, washroom, and a laundry/utility room.	Sanitary stack and floor drain near furnace. Minor cracks in slab.	Removed household cleaning products from the laundry/utility room prior to sampling.

Table 3 Summary of Groundwater Monitoring Levels

Location	Date	Ground Surface Elevation (mASL)	Top of Casing Elevation (mASL)	Top of Pipe Elevation (mASL)	Top of Casing - Top of Pipe (m)	Top of Pipe - Ground Surface (m)	Water Depth from Top of Pipe (m)	Water Depth from Top of Casing (m)	Water Table Elevation (mASL)
MW-01	10-Mar-17	880.579	880.565	880.505	0.060	--	--	7.45	873.12
	01-Jun-17						--	7.44	873.13
	24-Sep-17						--	7.40	873.17
	16-Dec-17						7.340	--	873.17
MW-02	01-Mar-17	879.006	878.976	878.866	0.110	--	--	2.37	876.61
	01-Jun-17						--	2.03	876.95
	24-Sep-17						--	2.38	876.60
	16-Dec-17						2.500	--	876.37
MW-03	10-Mar-17	879.393	879.396	879.346	0.050	--	--	2.86	876.54
	01-Jun-17						--	2.53	876.87
	24-Sep-17						--	2.54	876.86
	17-Dec-17						2.670	--	876.68
MW-04	01-Mar-17	879.589	879.499	879.479	0.020	--	--	--	--
	01-Jun-17						--	2.67	876.83
	24-Sep-17						--	2.64	876.86
	17-Dec-17						2.910	--	876.57
MW-05	01-Mar-17	--	--	--	--	--	--	--	--
	01-Jun-17						--	5.61	--
	24-Sep-17						--	5.55	--
	17-Dec-17						5.670	--	--
MW-06	01-Mar-17	879.108	879.941	879.881	0.060	--	3.30	--	876.58
	01-Jun-17						3.30	--	876.58
	24-Sep-17						3.09	--	876.79
	17-Dec-17						3.30	--	876.58
MW-07	01-Mar-17	879.575	880.626	880.530	--	0.955	4.48	--	876.05
	01-Jun-17						4.39	--	876.14
	24-Sep-17						4.61	--	875.92
	16-Dec-17						4.63	--	875.90
XCG-1 (MW)	01-Mar-17	881.206	881.186	881.146	0.040	--	--	8.01	873.18
	01-Jun-17						--	8.05	873.14
	24-Sep-17						--	7.98	873.21
	17-Dec-17						7.940	--	873.21
XCG-2 (MW)	01-Mar-17	881.102	882.329	882.219	0.110	--	9.32	--	872.90
	01-Jun-17						9.43	--	872.79
	24-Sep-17						9.46	--	872.76
	17-Dec-17						9.37	--	872.85
XCG-4 (MW)	01-Mar-17	879.220	880.342	880.282	0.060	--	3.65	--	876.63
	01-Jun-17						3.19	--	877.09
	24-Sep-17						3.32	--	876.96
	17-Dec-17						3.70	--	876.58
XCG-5 (MW)	01-Mar-17	880.271	880.289	880.189	0.100	--	--	3.76	876.53
	01-Jun-17						--	3.53	876.76
	24-Sep-17						--	3.44	876.85
	17-Dec-17						3.560	--	876.63
XCG-6 (MW)	01-Mar-17	879.971	879.987	879.897	0.090	--	--	3.45	876.54
	01-Jun-17						--	3.32	876.67
	24-Sep-17						--	3.10	876.89
	17-Dec-17						3.250	--	876.65
XCG-12 (MW)	10-Mar-17	880.827	880.847	880.757	0.090	--	--	7.63	873.22
	01-Jun-17						--	7.67	873.18
	24-Sep-17						--	Dry	--
	17-Dec-17						Dry	--	--
XCG-13 (MW)	02-Mar-17	879.672	879.702	879.612	0.090	--	--	3.73	875.97
	01-Jun-17						--	3.63	876.07
	24-Sep-17						--	3.89	875.81
	17-Dec-17						3.850	--	875.76
XCG-14 (MW)	01-Mar-17	880.719	880.704	880.674	0.030	--	--	7.31	873.39
	01-Jun-17						--	7.29	873.41
	24-Sep-17						--	7.25	873.45
	17-Dec-17						7.240	--	873.43

Notes:

-- no data

Benchmark: ASCM 283036, property line nail at 5794702.76, 12182.95 as determined by Bemco Land Surveying Ltd, December 15, 2016.

Table 4 Summary of Quarterly Soil Vapour Monitoring Results

	Date	Pressure		FIELD - w/o filter	FIELD - w/ filter	FIELD - w/o filter	FIELD - w/ filter	FIELD - w/o filter	FIELD - w/ filter	Probe Depth (mbgs)	Nearest MW	Nearby Water Level (mbgs)	Comments
		(units "WC)	(units PSI)	CH$_4$ (%)		O2 (%)		CO2 (%)					
VW-01	14-Mar-17	0	0	0	--	17.7	--	4.3	--	6.1	MW-01 (similar elevations)	7.5	
	01-Jun-17	-0.022	-0.0007942	0	0	14.8	21.9	3.1	0.2			7.5	
	24-Sep-17	0		0	0	17.1	17.6	3.9	3.4			7.4	
	16-Dec-17	0		0	0	17.2	17.9	4.7	4.1			7.4	
VW-02	13-Mar-17	no cap (damaged)		--	--	--	--	--	--	7.6	MW-07 (similar elevations)	3.5	no cap (damaged) and would not stabilize, likely blinded
	01-Jun-17			--	--	--	--	--	--			3.4	
	24-Sep-17	--		**39.8**	**38.8**	2.5	2.5	30.4	28.2			3.6	
	16-Dec-17	--		**29.2**	**31.4**	0.5	0	25	30.2			3.6	Cap had an ice plug - had to take it off
VW-03	13-Mar-17	0	0	0	--	12.4	--	6.5	--	3.0	MW-07 (similar elevations)	3.5	
	01-Jun-17	-0.001	-0.0000361	0.8	0	0.2	22.3	18.9	0.5			3.4	
	24-Sep-17	0		0	0	4.4	4.2	19.3	18.3			3.6	
	16-Dec-17	0		0	**0.1**	10.7	10.5	10.7	11.6			3.6	
VW-04	14-Mar-17	--		--	--	--	--	--	--	3.0	MW-04 (similar elevations)	--	not located
	01-Jun-17	-0.002	-0.0000722	0	0	14.1	18.3	4.2	0.3			2.8	
	24-Sep-17	0		0	0	16.5	16.2	4.9	4.6			2.7	
	17-Dec-17	0		0	0	17.8	19	3.4	3.5			3.0	
VW-05	14-Mar-17	0		0	--	19	--	2.6	--	4.4	MW-05 (similar elevations)	--	
	01-Jun-17	no cap (damaged)		--	--	--	--	--	--			--	snow plough?
	24-Sep-17	0		**3.8**	**3.6**	0	0.2	21.5	19.7			--	
	17-Dec-17	--		**1.9**	**2**	3.3	3.2	15.9	16.5			5.8	
XCG-1(SVP)	14-Mar-17	0		0	--	18.8	--	2.6	--	4.0	MW-01 (~1.3m lower than SVP)	7.5	
	01-Jun-17	-0.007	-0.0002527	--	0	--	17.5	--	0.7			7.5	
	24-Sep-17	0		0	0	17	17.4	4.3	4			7.4	
	17-Dec-17	0		0	0	17.1	17.2	3.8	3.8			7.4	
XCG-2(SVP)	14-Mar-17	0		0	--	18.7	--	1.6	--	3.0	MW-05 (~1.2m lower than SVP)	--	
	01-Jun-17	-0.018	-0.0006498	--	0	--	17.9	--	1.2			--	
	24-Sep-17	0		0	0	20.7	18.4	0.2	3			--	
	17-Dec-17	0		0	0	18.3	18.5	2.2	2.2			5.8	
XCG-4(SVP)	14-Mar-17	0		**0.7**	--	18.8	--	0.7	--	3.0	MW-06 (similar elevations)	2.5	
	01-Jun-17	0.002	0.0000722	0	0	8.9	18.5	5.7	0			2.5	
	24-Sep-17	0		0	0	15.5	16.1	4.6	3.9			2.3	
	17-Dec-17	0		0	**0.1**	16.8	17.9	3.3	3.3			2.5	
XCG-5(SVP)	14-Mar-17	0		0	--	21	--	0.3	--	2.0	MW-04 (~0.7m lower than SVP)	--	
	01-Jun-17	0.002	0.0000722	--	0	--	18.6	--	0.1			2.8	
	24-Sep-17	0		0	0	18.3	17.9	3	2.7			2.7	
	17-Dec-17	0		0	**0.1**	18.2	20.2	2.2	2			3.0	
XCG-6(SVP)	14-Mar-17	0		**1**	--	1.1	--	17.4	--	1.7	MW-05 (similar elevations)	--	
	01-Jun-17	-0.056	-0.0020216	**0.9**	0	16.6	18.7	1.5	0			--	
	24-Sep-17	0		**2.1**	**2.5**	2.9	0.4	19	20.4			--	
	17-Dec-17	0		**1**	**1**	1.4	2.5	14.5	14.6			5.8	
XCG-9(SVP)	14-Mar-17	0		0	--	20.8	--	0.5	--	1.5	MW-01 (similar elevations)	7.5	
	01-Jun-17	ND		--	0	--	18.7	--	0			7.5	
	24-Sep-17	0		0	0	19.1	19.7	2	1.7			7.4	
	17-Dec-17	0		0	0	19.1	19.7	0.8	0.8			7.4	
XCG-10(SVP)	13-Mar-17	0		0	--	14.3	--	2.4	--	1.5	MW-02 (similar elevations)	2.4	
	01-Jun-17	-0.002	-0.0000722	--	0	--	22.3	--	0.7			2.1	
	24-Sep-17	0		0	0	17.4	18.3	5.2	3.8			2.4	
	16-Dec-17	0		0	0	18.7	18.6	2.6	2..8			2.6	
XCG-12(SVP)	14-Mar-17	0		0	--	20.5	--	0.1	--	2.0	MW-01 (similar elevations)	7.5	
	01-Jun-17	0		--	0	--	21.4	--	0.2			7.5	
	24-Sep-17	0		0	0	18.6	18.8	3.4	3.4			7.4	
	17-Dec-17	0		0	0	18.5	18.8	2.6	2.7			7.4	
XCG-13(SVP)	13-Mar-17	0		**0.7**	--	16.7	--	3.3	--	2.0	MW-07 (similar elevations)	3.5	
	01-Jun-17	-0.058	-0.0020938	**5.6***	0	0	22.4	18.8	0			3.38	
	24-Sep-17	0		**0.4**	**1.9***	11.9	4.5	11.19	16			3.6	
	16-Dec-17	0		0	**0.2**	16.3	16.4	6.3	6.4			3.62	

Notes:

March - Dwyer manometer inches WC

--	No Data

* discrepancy between with and without filter. Deemed to be interference from other PHCs present in the vapour and GW. Known problem based on correspondence with manufacturer.

Bold	Methane detected

XCG-14 (MW) - lid sheared off as of Sept monitoring

Table 5 Summary of Field Parameters in Groundwater

Location	Date	Temperature (°C)	pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Redox (mV)
2016 Alberta Tier 1 Guidelines[1] **(COARSE)**		--	6.5-8.5	--	--	--
March Sampling Event						
MW-01	12-Mar-17	7.45	6.56	828	9.05	184.2
MW-02	13-Mar-17	4.16	7.32	1247	2.95	-31.0
MW-03	13-Mar-17	4.31	6.90	1766	0.86	-23.6
MW-06	14-Mar-17	5.05	**6.06**	2847	4.54	16.3
MW-07	14-Mar-17	6.33	**6.11**	2370	0.99	-15.6
XCG-1 (MW)	11-Mar-17	6.80	7.17	676	6.82	72.2
XCG-2 (MW)	11-Mar-17	6.04	7.25	822	5.10	118.6
XCG-4 (MW)	13-Mar-17	1.59	8.38	1110	3.21	-137.2
XCG-5 (MW)	13-Mar-17	4.59	**10.29**	747	8.36	-186.6
XCG-6 (MW)	13-Mar-17	4.36	**6.20**	1842	3.76	210.7
XCG-12 (MW)	14-Mar-17	3.25	**6.47**	1017	4.54	16.3
XCG-13 (MW)	14-Mar-17	3.82	**6.19**	2025	1.13	11.3
XCG-14 (MW)	11-Mar-17	6.16	7.26	1022	4.53	58.8

Notes:

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

--	No Value
Bold	Exceeds the Alberta Tier 1 Guidelines

Table 6 Summary of Analytical Results for VOCs in Groundwater

Sample ID		2016 Alberta Tier 1 Guidelines[1] (COARSE)	MW-01	MW-02	MW-03	MW-06	MW-07	XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG 5 (MW)	XCG 6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)	Field Blank
Laboratory ID	**RDL**	**Groundwater**	QR8541	QS0279	QS0278	QS2251	QS2250	QR7384	QR8538	QR8539	QS2248	QS0277	QS0276	QR8542	QS2249	QR8540	QR8543
Units	**µg/L**	**µg/L**	**12-Mar-17**	**13-Mar-17**	**13-Mar-17**	**14-Mar-17**	**14-Mar-17**	**10-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**13-Mar-17**	**12-Mar-17**	**14-Mar-17**	**11-Mar-17**	**12-Mar-17**
Total Trihalomethanes	1	100	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
Bromodichloromethane	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bromoform	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bromomethane	2.0	--	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon tetrachloride	0.50	0.57	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chlorobenzene	0.50	1.3	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chlorodibromomethane	1.00	190	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	1.00	--	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	0.50	1.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloromethane	2.00	--	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2-dibromoethane	0.20	--	<0.20	<0.20	<0.20	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
1,2-dichlorobenzene	0.50	0.7	<0.50	<0.50	<0.50	0.52	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,3-dichlorobenzene	0.5	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,4-dichlorobenzene	0.50	1	<0.50	<0.50	<0.50	**1.2**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-dichloroethane	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2-dichloroethane	0.50	5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-dichloroethene	0.50	14	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,2-dichloroethene	0.50	--	<0.50	<0.50	20	18	120	<0.50	<0.50	<0.50	<0.50	<0.50	1.2	<0.50	130	<0.50	<0.50
trans-1,2-dichloroethene	0.50	--	<0.50	<0.50	<0.50	<0.50	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.9	<0.50	<0.50
Dichloromethane	2.00	50	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2-dichloropropane	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,3-dichloropropene	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
trans-1,3-dichloropropene	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl methacrylate	0.5	470	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl-tert-butylether (MTBE)	0.5	15	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Styrene	1	72	<0.50	<0.50	<0.50	0.75	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,1,2-tetrachloroethane	1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-tetrachloroethane	2.00	--	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Tetrachloroethene	0.50	10	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2,3-trichlorobenzene	1.00	8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-trichlorobenzene	1.00	15	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3,5-trichlorobenzene	0.50	14	<0.50	<0.50	<0.50	0.73	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,1-trichloroethane	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,2-trichloroethane	0.50	--	<0.50	<0.50	<0.50	0.56	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Trichloroethene	0.50	5	<0.50	<0.50	<0.50	<0.50	**7.4**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.68	<0.50	<0.50
Trichlorofluoromethane	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2,4-trimethylbenzene	0.50	--	<0.50	<0.50	<0.50	14	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,3,5-trimethylbenzene	0.50	--	<0.50	<0.50	<0.50	3.8	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vinyl chloride	0.50	1.1	<0.50	<0.50	**16**	**8.4**	**39**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**21**	<0.50	<0.50

Notes:

RDL	Laboratory Reportable Detection Limit
1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).	
--	no value
<	Less than the RDL
Bold	Exceeds the Alberta Tier 1 Guidelines

Table 7 Summary of Analytical Results for Routine Parameters and Nutrients in Groundwater

Sample ID			**2016 Alberta Tier 1 Guidelines[1] (COARSE)**	**MW-01**	**MW-02**	**MW-03**	**MW-06**	**MW-07**	**XCG-1 (MW)**	**XCG-2 (MW)**		**XCG-4 (MW)**	**XCG-5 (MW)**	**XCG-6 (MW)**	**XCG-12 (MW)**	**XCG-13 (MW)**	**XCG-14 (MW)**	**Field Blank**
Laboratory ID		**RDL**	**Groundwater**	QR8541	QS0279	QS0278	QS2251	QS2250	QR7384	QR8538	QR8539	QS2248	QS0277	QS0276	QR8542	QS2249	QR8540	QR8543
	Units			**12-Mar-17**	**13-Mar-17**	**13-Mar-17**	**14-Mar-17**	**14-Mar-17**	**10-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**13-Mar-17**	**12-Mar-17**	**14-Mar-17**	**11-Mar-17**	**12-Mar-17**
Calculated Parameters																		
Anion Sum	meq/L	N/A	--	9.3	13	20	32	25	7.1	8.8	8.8	12	8.1	18	12	24	12	0.0000
Cation Sum	meq/L	N/A	--	8.9	13	20	30	26	7.1	8.8	8.9	12	8.0	18	12	23	12	0.0030
Hardness (CaCO3)	mg/L	0.50	--	420	520	920	970	1100	340	320	320	480	390	870	550	1000	560	<0.50
Ion Balance (% Difference)	N/A	0.010	--	2.0	1.3	0.29	3.5	0.66	0.43	0.13	0.50	0.87	0.31	0.89	1.5	2.3	0.77	NC
Dissolved Nitrate (NO3)	mg/L	0.044	--	0.21	6.2	1.7	0.14	0.20	0.10	0.063	0.077	<0.044	2.7	250	0.17	<0.044	0.056	<0.044
Nitrate plus Nitrite (N)	mg/L	0.010	--	0.047	1.4	0.38	0.031	0.044	0.024	0.014	0.017	<0.010	0.61	56	0.037	<0.010	0.013	<0.010
Dissolved Nitrite (NO2)	mg/L	0.033	--	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	0.20	<0.033	<0.033	<0.033	<0.033
Calculated Total Dissolved Solids	mg/L	10	500	450	**660**	**990**	**1500**	**1300**	350	460	460	**580**	380	**1000**	**580**	**1100**	**570**	<10
Miscellaneous Inorganics																		
Conductivity	uS/cm	1.0	--	830	1200	1800	2800	2400	660	820	830	1000	700	1700	1000	2100	1000	1.1
pH	pH	N/A	6.5-8.5	7.37	7.57	7.31	7.10	7.12	7.73	7.30	7.29	7.74	7.76	7.32	7.59	7.15	7.34	**5.57**
Anions																		
Alkalinity (PP as CaCO3)	mg/L	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Alkalinity (Total as CaCO3)	mg/L	0.50	--	410	360	960	1500	890	310	340	340	550	390	600	530	920	490	<0.50
Bicarbonate (HCO3)	mg/L	0.50	--	500	430	1200	1800	1100	380	420	420	670	470	730	640	1100	590	<0.50
Carbonate (CO3)	mg/L	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Hydroxide (OH)	mg/L	0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Sulphate (SO4)	mg/L	1.0	500 or 128 to 429 (a)	37	53	36	<1.0	7.2	29	57	58	9.3	10	82	42	6.8	56	<1.0
Dissolved Chloride (Cl)	mg/L	1.0	120	12	**160**	13	83	**260**	10	27	27	17	2.0	11	22	**200**	21	<1.0
Nutrients																		
Dissolved Nitrite (N)	mg/L	0.010-0.033	1.0 or 0.06 to 0.6 (b)	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.060	<0.033	<0.010	<0.010	<0.010
Dissolved Nitrate (N)	mg/L	0.010	3	0.047	1.4	0.38	0.031	0.044	0.024	0.014	0.017	<0.010	0.61	**56**	0.58	<0.010	0.013	<0.010
Total Ammonia (N)	mg/L	0.050	0.018 to 190 (c)	0.19	<0.050	0.13	**69**	0.87	0.38	0.23	0.23	0.17	<0.050	0.093	0.54	0.18	0.30	<0.050
Total Nitrogen (N)	mg/L	0.055	--	1.3	1.8	1.0	96	1.9	2.5	0.45	0.55	0.64	0.82	57	3.6	0.93	1.4	<0.055
Total Phosphorus (P)	mg/L	0.015-0.0030	--	0.70	0.0061	0.0097	1.1	0.030	2.5	0.19	0.10	0.11	0.0085	0.0046	1.2	0.020	2.6	<0.0030
Total Kjeldahl Nitrogen	mg/L	0.050-0.25	--	1.2	0.34	0.63	96	1.9	2.5	0.44	0.53	0.64	0.21	1.0	3.4	0.93	1.4	<0.050
Demand Parameters																		
Biochemical Oxygen Demand	mg/L	2-10	--	<2.0	<2.0	6.9	22	7.8	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	8.3	3.1	<2.0	<2.0
Total Chemical Oxygen Demand	mg/L	5	--	<5.0	15	65	330	64	71	37	36	41	<5.0	20	110	41	85	<5.0
Misc. Inorganics																		
Total Organic Carbon (C)	mg/L	0.5-5.0	--	4.3	8.8	8.1	72.0	19	<2.5	3.3	4.2	4.3	3.7	12.0	16	15	<5.0	<0.50
Organic Acids																		
Formic Acid	mg/L	<0.5	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Acetic Acid	mg/L	<0.5	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Propionic Acid	mg/L	<0.5	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Butyric Acid	mg/L	<10	--	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Misc. Organics																		
Adsorbable Organic Halogen	mg/L	0.01	--	0.02	0.07	<0.01	0.14	0.06	0.02	0.03	0.02	0.03	0.01	0.03	0.02	0.6	0.02	0.02

Notes:

RDL	Laboratory Reportable Detection Limit

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

--	no value
<	Less than the RDL

(a) Varies with hardness. See table 1.7 of the Environmental Quality Guidelines for Alberta Surface Waters (2014) if hardness is less than 250 mg/L.

(b) Varies with chloride. See table 1.4 of the Environmental Quality Guidelines for Alberta Surface Waters (2014) if chloride is less than 10 mg/L.

(c) Temperature and pH dependent. See table 1.2 of the Environmental Quality Guidelines for Alberta Surface Waters (2014).

Bold	Exceeds the Alberta Tier 1 Guidelines

Table 8 Summary of Analytical Results for Dissolved Metals in Groundwater

Sample ID			2016 Alberta Tier 1 Guidelines$^{1\ (COARSE)}$	MW-01	MW-02	MW-03	MW-06	MW-07	XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG-5 (MW)	XCG-6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)	Field Blank
Laboratory ID		**RDL**	**Groundwater**	**QR8541**	**QS0279**	**QS0278**	**QS2251**	**QS2250**	**QR7384**	**QR8538**	**QR8539**	**QS2248**	**QS0277**	**QS0276**	**QR8542**	**QS2249**	**QR8540**	**QR8543**
	Units			**12-Mar-17**	**13-Mar-17**	**13-Mar-17**	**14-Mar-17**	**14-Mar-17**	**10-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**13-Mar-17**	**12-Mar-17**	**14-Mar-17**	**11-Mar-17**	**12-Mar-17**
Dissolved Cadmium (Cd)	ug/L	0.02	5 or 0.11 to 7.7 (a)	0.29	0.044	0.044	<0.020	0.022	0.053	0.15	0.13	0.29	0.042	0.060	0.023	0.088	0.064	<0.020
Dissolved Aluminum (Al)	mg/L	0.003	0.1 or 0.023 to 0.074 (b)	0.0039	<0.0030	<0.0030	0.0057	<0.0030	0.0056	0.0031	0.0038	0.0044	<0.0030	<0.0030	0.0054	0.0042	0.0031	<0.0030
Dissolved Antimony (Sb)	mg/L	0.0006	0.006	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	0.00065	<0.00060	<0.00060	0.00075	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
Dissolved Arsenic (As)	mg/L	0.0002	0.005	0.00029	<0.00020	0.00041	0.0092	0.0073	0.0011	0.0013	0.0013	0.00044	0.00033	0.00046	**0.019**	0.0014	0.0011	<0.00020
Dissolved Barium (Ba)	mg/L	0.01	1	0.71	0.64	0.89	0.99	**1.1**	0.51	0.090	0.093	0.22	0.22	0.46	**1.2**	0.94	0.52	<0.010
Dissolved Beryllium (Be)	mg/L	0.001	--	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Boron (B)	mg/L	0.02	1.5	0.042	0.025	0.17	0.23	0.066	0.038	0.090	0.090	0.038	0.024	0.049	0.054	0.050	0.046	<0.020
Dissolved Calcium (Ca)	mg/L	0.3	--	110	130	220	230	230	77	84	83	130	86	250	130	190	120	<0.30
Dissolved Chromium (Cr)	mg/L	0.001	--	<0.0010	<0.0010	<0.0010	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Cobalt (Co)	mg/L	0.0003	--	<0.00030	0.0011	0.0016	0.014	0.012	0.00097	0.0024	0.0023	0.00099	<0.00030	0.00050	0.00080	0.0068	0.00043	<0.00030
Dissolved Copper (Cu)	mg/L	0.0002	0.007	0.00085	0.0010	0.0013	<0.00020	<0.00020	0.0032	0.0011	0.0010	0.0019	0.00071	0.0022	0.00047	0.00089	0.00071	<0.00020
Dissolved Iron (Fe)	mg/L	0.06	0.3	<0.060	0.065	0.13	**29**	**12**	<0.060	<0.060	<0.060	<0.060	<0.060	0.086	<0.060	0.066	<0.060	<0.060
Dissolved Lead (Pb)	mg/L	0.0002	0.001 to 0.007 (a)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Lithium (Li)	mg/L	0.02	--	0.027	0.022	0.064	<0.020	0.038	0.020	0.037	0.038	<0.020	<0.020	<0.020	0.031	0.051	0.047	<0.020
Dissolved Magnesium (Mg)	mg/L	0.2	--	37	51	88	97	130	35	28	27	38	42	62	56	140	61	<0.20
Dissolved Manganese (Mn)	mg/L	0.004	0.05	**0.089**	<0.0040	**0.49**	**0.49**	**1.8**	**0.28**	**0.50**	**0.49**	**0.29**	<0.0040	**0.15**	**0.61**	**0.71**	**0.26**	<0.0040
Dissolved Molybdenum (Mo)	mg/L	0.0002	--	0.0027	0.00040	0.00069	0.00074	0.0024	0.0040	0.0043	0.0046	0.00081	0.00088	0.00044	0.0034	0.00055	0.0020	<0.00020
Dissolved Nickel (Ni)	mg/L	0.0005	0.037 to 1.52 (a)	0.00092	0.0029	0.0072	0.012	0.016	0.0032	0.0073	0.0069	0.0081	0.0012	0.0049	0.0021	0.015	0.0013	<0.00050
Dissolved Phosphorus (P)	mg/L	0.1	--	0.11	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Potassium (K)	mg/L	0.3	--	3.9	2.5	6.3	33	3.7	3.3	3.7	3.7	25	2.0	6.5	7.7	3.2	2.5	<0.30
Dissolved Selenium (Se)	mg/L	0.0002	0.001	0.00023	<0.00020	<0.00020	0.00050	0.00026	0.00030	0.00061	0.00058	<0.00020	0.00021	0.00034	<0.00020	0.00027	<0.00020	<0.00020
Dissolved Silicon (Si)	mg/L	0.1	--	6.1	7.7	7.8	15	11	6.2	6.5	6.6	7.6	11	8.1	7.6	9.4	6.8	<0.10
Dissolved Silver (Ag)	mg/L	0.0001	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Sodium (Na)	mg/L	0.5	200	9.8	48	39	88	73	6.8	51	54	29	4.8	17	11	54	10	<0.50
Dissolved Strontium (Sr)	mg/L	0.02	--	0.71	0.41	1.3	1.2	1.7	0.55	0.81	0.82	0.38	0.28	0.65	0.72	1.9	1.1	<0.020
Dissolved Sulphur (S)	mg/L	0.2	--	10	15	9.0	2.3	3.4	8.3	16	17	3.1	2.8	21	12	2.7	15	<0.20
Dissolved Thallium (Tl)	mg/L	0.0002	--	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Tin (Sn)	mg/L	0.001	--	<0.0010	<0.0010	<0.0010	0.0018	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010
Dissolved Titanium (Ti)	mg/L	0.001	--	<0.0010	<0.0010	<0.0010	0.0022	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Uranium (U)	mg/L	0.0001	0.015	0.0098	0.0026	0.0095	0.00060	0.010	0.0037	0.013	0.014	0.0028	0.0016	0.0025	0.0013	0.011	0.015	<0.00010
Dissolved Vanadium (V)	mg/L	0.001	--	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Zinc (Zn)	mg/L	0.003	0.03	0.0036	<0.0030	<0.0030	0.013	<0.0030	0.0032	<0.0030	<0.0030	0.0073	<0.0030	<0.0030	<0.0030	0.0034	<0.0030	<0.0030

Notes:

RDL	Laboratory Reportable Detection Limit
--	no value
<	Less than the RDL
Bold ▨	Exceeds the Alberta Tier 1 Guidelines

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

(a) Varies with hardness. See table 1.3 of the Environmental Quality Guidelines for Alberta Surface Waters (2014).

(b) Varies with pH, see table 1.1 of the Environmental Quality Guidelines for Alberta Surface Waters (2014).

Table 9 Summary of Analytical Results for Total Metals in Groundwater

Sample ID			2016 Alberta Tier 1 Guidelines[1] (COARSE)	MW-01	MW-02	MW-03	MW-06	MW-07	XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG-5 (MW)	XCG-6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)	Field Blank
Laboratory ID		**RDL**	**Groundwater**	**QR8541**	**QS0279**	**QS0278**	**QS2251**	**QS2250**	**QR7384**	**QR8538**	**QR8539**	**QS2248**	**QS0277**	**QS0276**	**QR8542**	**QS2249**	**QR8540**	**QR8543**
	Units			**12-Mar-17**	**13-Mar-17**	**13-Mar-17**	**14-Mar-17**	**14-Mar-17**	**10-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**13-Mar-17**	**12-Mar-17**	**14-Mar-17**	**11-Mar-17**	**12-Mar-17**
Total Cadmium (Cd)	ug/L	0.020	--	1.9	0.34	0.089	0.77	0.25	4.2	1.1	0.76	12	0.12	0.19	1.8	0.17	1.7	<0.020
Total Aluminum (Al)	mg/L	0.0030	--	6.6	0.18	0.53	11	0.39	27	2.8	2.5	3.3	0.087	0.067	12	0.18	16	<0.0030
Total Antimony (Sb)	mg/L	0.00060	--	0.00063	<0.00060	<0.00060	0.00096	<0.00060	0.00090	0.00093	0.00075	<0.00060	0.00082	<0.00060	0.00077	<0.00060	0.00085	<0.00060
Total Arsenic (As)	mg/L	0.00020	--	0.0086	0.00036	0.00094	0.023	0.015	0.056	0.0043	0.0037	0.0030	0.00057	0.00047	0.062	0.0018	0.021	<0.00020
Total Barium (Ba)	mg/L	0.010	--	0.85	0.68 (1)	0.91	1.5	1.2	1.5	0.14	0.13	0.27	0.23	0.47	1.4	0.91	1.2	<0.010
Total Beryllium (Be)	mg/L	0.0010	--	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0016	<0.0010
Total Boron (B)	mg/L	0.020	--	0.042	0.030	0.20	0.25	0.064	0.047	0.11	0.098	0.039	0.029	0.057	0.055	0.050	0.065	<0.020
Total Calcium (Ca)	mg/L	0.30	--	130	130	240	280	240	250	93	83	140	88	260	170	190	240	<0.30
Total Chromium (Cr)	mg/L	0.0010	--	0.011	<0.0010	0.0018	0.019	<0.0010	0.048	0.0036	0.0026	0.0060	<0.0010	<0.0010	0.021	<0.0010	0.029	<0.0010
Total Cobalt (Co)	mg/L	0.00030	--	0.0081	0.0015	0.0019	0.024	0.014	0.035	0.0047	0.0044	0.0035	<0.00030	0.00060	0.015	0.0070	0.022	<0.00030
Total Copper (Cu)	mg/L	0.00020	--	0.019	0.0018	0.0025	0.032	0.0017	0.091	0.0063	0.0057	0.0095	0.0012	0.0023	0.034	0.0012	0.056	<0.00020
Total Iron (Fe)	mg/L	0.060	--	14	0.46 (1)	1.2	69	19	75	4.6	3.7	5.6	0.30	0.26	28	0.52	41	<0.060
Total Lead (Pb)	mg/L	0.00020	--	0.0084	0.00023	0.00082	0.021	0.00084	0.036	0.0045	0.0038	0.010	<0.00020	<0.00020	0.016	0.00024	0.024	<0.00020
Total Lithium (Li)	mg/L	0.020	--	0.032	0.025	0.072	0.026	0.036	0.061	0.041	0.037	<0.020	<0.020	<0.020	0.038	0.047	0.068	<0.020
Total Magnesium (Mg)	mg/L	0.20	--	46	54	97	120	130	83	31	27	41	43	66	60	140	92	<0.20
Total Manganese (Mn)	mg/L	0.0040	--	0.87	0.0061	0.55	0.79	1.8	1.6	0.60	0.54	0.37	0.0054	0.19	0.97	0.71	1.0	<0.0040
Total Molybdenum (Mo)	mg/L	0.00020	--	0.0036	0.00049	0.00087	0.0018	0.0025	0.0058	0.0049	0.0046	0.0014	0.00088	0.00053	0.0041	0.00061	0.0031	<0.00020
Total Nickel (Ni)	mg/L	0.00050	--	0.022	0.0046	0.0088	0.039	0.018	0.089	0.014	0.013	0.019	0.0015	0.0054	0.044	0.015	0.059	<0.00050
Total Phosphorus (P)	mg/L	0.10	--	0.48	<0.10 (1)	<0.10	1.1	<0.10	2.1	0.19	0.15	0.10	<0.10	<0.10	0.75	<0.10	1.2	<0.10
Total Potassium (K)	mg/L	0.30	--	5.1	2.7 (1)	7.3	38	3.7	8.0	4.5	4.0	26	2.1	7.1	8.3	3.3	6.0	<0.30
Total Selenium (Se)	mg/L	0.00020	--	0.00060	<0.00020	0.00021	0.00076	0.00021	0.0024	0.00089	0.00081	0.00029	0.00023	0.00037	0.00064	0.00025	0.0029	<0.00020
Total Silicon (Si)	mg/L	0.10	--	20	8.8 (1)	11	36	12	50	16	14	17	12	9.2	30	10	43	<0.10
Total Silver (Ag)	mg/L	0.00010	--	0.00013	<0.00010	<0.00010	0.00023	<0.00010	0.00064	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00033	<0.00010	0.00029	<0.00010
Total Sodium (Na)	mg/L	0.50	--	8.0	51	42	95	76	7.3	56	51	35	4.6	19	9.7	56	10	<0.50
Total Strontium (Sr)	mg/L	0.020	--	0.66	0.44 (1)	1.3	1.3	1.6	0.80	0.86	0.77	0.38	0.28	0.65	0.67	1.7	1.2	<0.020
Total Sulphur (S)	mg/L	0.20	--	9.3	17	11	3.0	3.8	9.1	17	16	4.5	3.0	27	11	2.8	17	<0.20
Total Thallium (Tl)	mg/L	0.00020	--	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00072	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00031	<0.00020	0.00040	<0.00020
Total Tin (Sn)	mg/L	0.0010	--	0.0017	<0.0010	<0.0010	0.0065	<0.0010	0.0084	0.0045	0.0037	0.0020	0.0010	<0.0010	0.0095	<0.0010	0.0019	<0.0010
Total Titanium (Ti)	mg/L	0.0010	--	0.11	0.0069	0.016	0.19	0.014	0.26	0.037	0.032	0.13	0.0022	0.0046	0.17	0.0050	0.21	<0.0010
Total Uranium (U)	mg/L	0.00010	--	0.010	0.0031	0.0091	0.0016	0.0099	0.0066	0.015	0.014	0.0035	0.0016	0.0025	0.0023	0.011	0.015	<0.00010
Total Vanadium (V)	mg/L	0.0010	--	0.019	<0.0010	0.0022	0.031	0.0017	0.075	0.0058	0.0053	0.010	<0.0010	<0.0010	0.036	<0.0010	0.050	<0.0010
Total Zinc (Zn)	mg/L	0.0030	--	0.090	0.011	0.0074	0.099	0.0071	0.27	0.032	0.030	0.044	0.0053	<0.0030	0.15	0.0053	0.19	<0.0030

Notes:

RDL	Laboratory Reportable Detection Limit

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

--	no value
<	Less than the RDL
Bold ▨	Exceeds the Alberta Tier 1 Guidelines

Table 10 Summary of Analytical Results for PHCs in Groundwater

Sample ID			2016 Alberta Tier 1 Guidelines$^{1\ (COARSE)}$	MW-01	MW-02	MW-03	MW-06	MW-07	XCG-1 (MW)	XCG-2 (MW)	XCG-4 (MW)	XCG 5 (MW)	XCG 6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)	Field Blank
Laboratory ID		**RDL**	**Groundwater**	**QR8541**	**QS0279**	**QS0278**	**QS2251**	**QS2250**	**QR7384**	**QR8538**	**QS2248**	**QS0277**	**QS0276**	**QR8542**	**QS2249**	**QR8540**	**QR8543**
	Units			**12-Mar-17**	**13-Mar-17**	**13-Mar-17**	**14-Mar-17**	**14-Mar-17**	**10-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**13-Mar-17**	**12-Mar-17**	**14-Mar-17**	**11-Mar-17**	**12-Mar-17**
Benzene	µg/L	0.40	5	<0.40	<0.40	<0.40	**4.8**	1.7	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.86	<0.40	<0.40
Toluene	µg/L	0.40	21	<0.40	<0.40	<0.40	3.5	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Ethylbenzene	µg/L	0.40	1.6	<0.40	<0.40	<0.40	**58**	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
m & p-Xylene	µg/L	0.80	--	<0.80	<0.80	<0.80	30	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
o-Xylene	µg/L	0.40	--	<0.40	<0.40	<0.40	15	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Xylenes (Total)	µg/L	0.80	20	<0.80	<0.80	<0.80	**45**	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
F1 (C6-C10) - BTEX	µg/L	100	810	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F1 (C6-C10)	µg/L	100	810	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F2 (C10-C16 Hydrocarbons)	mg/L	0.10	1100	<0.10	<0.10	<0.10	0.52	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Notes:

RDL	Laboratory Reportable Detection Limit

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

--	no value
<	Less than the RDL
Bold	Exceeds the Alberta Tier 1 Guidelines

Table 11 Summary of Analytical Results for Fixed Gases and Petroleum Hydrocarbons in Soil Vapour

				Soil Vapour Probes														
Sample ID	**Units**	**Reportable Detection Limit**	**Deminimus Screening - Soil Vapour Screening Criteria**	**VW-01**	**VW-03**	**VW-05**		**XCG-1(SVP)**	**XCG-2(SVP)**	**XCG-4(SVP)**		**XCG-5(SVP)**	**XCG-6(SVP)**	**XCG-9(SVP)**	**XCG-10(SVP)**	**XCG-12(SVP)**	**XCG-13(SVP)**	**Trip Blank**
Laboratory				**Maxxam**	**Maxxam**	**Maxxam**		**Maxxam**	**Maxxam**	**Maxxam**		**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**
Canister number				**332**	**1280**	**1800**	**3017**	**1470**	**243**	**1281**	**212**	**1380**	**238**	**333**	**354**	**262**	**354**	**215**
Laboratory ID				**EBG095**	**EBG097**	**EBG090**	**EBG091**	**EBG092**	**EBG089**	**EBG086**	**EMV462**	**EBG085**	**EBG088**	**EBG096**	**EBG094**	**EBG087**	**EBG093**	**EBG098**
Date Sampled				**12-Mar-17**	**12-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**01-Jun-17**	**14-Mar-17**	**13-Mar-17**	**11-Mar-17**	**12-Mar-17**	**14-Mar-17**	**12-Mar-17**	**N/A**
Summa Canister Pressure on Receipt (psig)	(psig)	NV		(-2.9)	(-3.1)	(-1.9)	(-2.0)	(-1.7)	(-3.6)	(-3.4)	(-2.5)	(-3.4)	(-3.0)	(-2.7)	(-1.1)	(-3.0)	(-1.7)	(-14.3)
Oxygen	(% v/v)	0.2-0.3	NV	23.0	12.5	8.6	9.6	20.4	20.3	2.0	5.5	20.3	1.9	21.3	15.8	18.7	4.3	--
Nitrogen	(% v/v)	0.2-0.3	NV	77.0	80.7	79.0	78.9	78.1	78.4	82.8	--	77.4	81.5	78.2	81.7	79.0	84.8	--
Carbon Monoxide	(% v/v)	0.2-0.3	NV	<0.2	<0.2	<0.2	<0.2	<0.2	<0.3	<0.2	--	<0.3	<0.2	<0.2	<0.2	<0.2	<0.2	--
Methane	(% v/v)	0.2-0.3	0.1 to 0.5 % v/v	<0.2	<0.2	**0.3**	**0.3**	<0.2	<0.3	**5.7**	< 0.2	<0.3	**1.2**	<0.2	<0.2	<0.2	**1.1**	--
Methane	ppm	3.4-5.4	1000 ppm to 5000 ppm	<4.3	<3.8	NR	NR	<3.9	5.9	NR	--	<5.2	NR	<4.2	<3.4	32	NR	--
Carbon Dioxide	(% v/v)	0.2-0.3	NV	<0.2	6.8	12.1	11.3	1.5	1.3	9.5	9.6	2.3	15.4	0.6	2.5	2.3	9.8	--
Ethane	ppm	0.17-0.27	1,000	<0.21	<0.19	2.3	2.1	<0.2	<0.27	0.24	--	<0.26	<0.22	<0.21	<0.17	<0.23	<0.19	--
Ethylene	ppm	0.17-0.27	200	<0.21	<0.19	6.8	6.3	<0.2	<0.27	6.2	--	<0.26	0.57	<0.21	<0.17	<0.23	0.25	--
Propane	ppm	0.17-0.27	1,000	<0.21	<0.19	<0.21	<0.2	<0.2	<0.27	<0.23	--	<0.26	<0.22	<0.21	<0.17	<0.23	<0.19	--
Propene	ppm	0.17-0.27	35	<0.21	<0.19	<0.21	<0.2	<0.2	<0.27	<0.23	--	<0.26	<0.22	<0.21	<0.17	<0.23	<0.19	--
F1-BTEX, C6-C10 (as Toluene)	µg/m3	5.0	59,532	7.9	31.8	486	530	36.1	<5.0	39.7	--	18.4	668	6.0	43.0	8.8	5830	<5.0
F2, C10-C16 (as Decane)	µg/m3	5.0	27,778	12.7	<5.0	62.8	68.9	<5.0	<5.0	<5.0	--	6.2	<5.0	<5.0	<5.0	<5.0	972	<5.0

Notes:

Bold Shaded	Concentration exceeds calculated soil vapour screening criteria
-	Criteria not derived (concentration below detection limits)
NR	Lab did not report ppm units (based on elevated %v/v detection)
--	No Data
<	Below Laboratory MDL

Table 12 Summary of Analytical Results for VOCs in Soil Vapour

				Soil Vapour Probes														
Sample ID	**Units**	**Reportable Detection Limit**	**Deminimus Screening -Soil Vapour Screening Criteria**	**VW-01**	**VW-03**	**VW-05**		**XCG-1(SVP)**	**XCG-2(SVP)**	**XCG-4(SVP)**		**XCG-5(SVP)**	**XCG-6(SVP)**	**XCG-9(SVP)**	**XCG-10(SVP)**	**XCG-12(SVP)**	**XCG-13(SVP)**	**Trip Blank**
Laboratory				**Maxxam**	**Maxxam**	**Maxxam**		**Maxxam**	**Maxxam**	**Maxxam**		**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**
Canister number				**332**	**1280**	**1800**	**3017**	**1470**	**243**	**1281**	**212**	**1380**	**238**	**333**	**354**	**262**	**354**	**215**
Laboratory ID				**EBG095**	**EBG097**	**EBG090**	**EBG091**	**EBG092**	**EBG089**	**EBG086**	**EMV462**	**EBG085**	**EBG088**	**EBG096**	EBG094	**EBG087**	**EBG093**	**EBG098**
Date Sampled				**12-Mar-17**	**12-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**01-Jun-17**	**14-Mar-17**	**13-Mar-17**	**11-Mar-17**	**12-Mar-17**	**14-Mar-17**	**12-Mar-17**	**N/A**
Dichlorodifluoromethane (FREON 12)	$\mu g/m^3$	0.989 - 9.89	17,800	2.50	571	867	855	8.46	2.68	41.3	--	280	88.9	2.46	3.67	89.5	2950	<0.989
1,2-Dichlorotetrafluoroethane	$\mu g/m^3$	1.19 - 4.75	7,000,000	<1.19	1790	516	512	<1.19	<1.19	44.4	--	<1.19	341	<1.19	4.91	<1.19	565	<1.19
Chloromethane	$\mu g/m^3$	0.62	1,800	4.39	<0.620	<0.620	<0.620	<0.620	<0.620	<0.620	--	<0.620	<0.620	<0.620	<0.30	<0.620	<0.620	<0.620
Vinyl Chloride	$\mu g/m^3$	0.256 - 1.28	114.00	<0.256	<0.256	**1180**	**1250**	<0.256	<0.256	21.8	--	<0.256	**154**	<0.256	<0.10	<0.256	**114**	<0.256
Chloroethane	$\mu g/m^3$	0.792	200,000.0	<0.792	<0.792	23.2	23.1	<0.792	<0.792	<0.792	--	<0.792	0.978	<0.792	<0.30	<0.792	4.36	<0.792
1,3-Butadiene	$\mu g/m^3$	1.11	-	<1.11	<1.11	<1.11	<1.11	<1.11	<1.11	<1.11	--	<1.11	<1.11	<1.11	<0.50	<1.11	<1.11	<1.11
Trichlorofluoromethane (FREON 11)	$\mu g/m^3$	0.12	20,000	1.21	<1.12	5.92	5.85	<1.12	<1.12	<1.12	--	1.31	<1.12	<1.12	<0.20	<1.12	<1.12	<1.12
Ethanol (ethyl alcohol)	$\mu g/m^3$	1.88	1,900,000	21.1	<1.88	81.9	81.7	<1.88	<1.88	180	--	2.74	<1.88	<1.88	<1.0	<1.88	<1.88	<1.88
Trichlorotrifluoroethane	$\mu g/m^3$	1.15	-	<1.15	<1.15	<1.15	<1.15	<1.15	<1.15	<1.15	--	<1.15	<1.15	<1.15	<0.15	<1.15	<1.15	<1.15
2-propanol	$\mu g/m^3$	2.46	491,000	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	--	<2.46	<2.46	<2.46	<1.0	<2.46	<2.46	<2.46
2-Propanone	$\mu g/m^3$	1.90 - 47.5	618,000	11.1	<1.90	4.33	4.45	<1.90	<1.90	<21.1	--	3.29	5.48	<1.90	<0.80	<1.90	<47.5	<1.90
Methyl Ethyl Ketone (2-Butanone)	$\mu g/m^3$	2.95 - 6.19	100,000	<2.95	<2.95	<2.95	<2.95	<2.95	<2.95	<2.95	--	<2.95	<6.19	<2.95	<1.0	<2.95	<3.24	<2.95
Methyl Isobutyl Ketone	$\mu g/m^3$	4.1	-	<4.10	<4.10	<4.10	<4.10	<4.10	<4.10	<4.10	--	<4.10	<4.10	<4.10	<1.0	<4.10	<4.10	<4.10
Methyl Butyl Ketone (2-Hexanone)	$\mu g/m^3$	4.1	-	<4.10	<4.10	<4.10	<4.10	<4.10	<4.10	<4.10	--	<4.10	<4.10	<4.10	<1.0	<4.10	<4.10	<4.10
Methyl t-butyl ether (MTBE)	$\mu g/m^3$	0.721	-	<0.721	<0.721	<0.721	<0.721	<0.721	<0.721	<0.721	--	<0.721	<0.721	<0.721	<0.20	<0.721	<0.721	<0.721
Ethyl Acetate	$\mu g/m^3$	3.6	-	<3.60	<3.60	<3.60	<3.60	<3.60	<3.60	<3.60	--	<3.60	<3.60	<3.60	<1.0	<3.60	<3.60	<3.60
1,1-Dichloroethylene	$\mu g/m^3$	0.396	4,000	<0.396	<0.396	<0.396	<0.396	<0.396	<0.396	<0.396	--	<0.396	<0.396	<0.396	<0.10	<0.396	5.72	<0.396
cis-1,2-Dichloroethylene	$\mu g/m^3$	0.396	179	<0.396	1.39	91.0	90.6	<0.396	<0.396	<0.396	--	<0.396	6.99	<0.396	0.59	<0.396	**223**	<0.396
trans-1,2-Dichloroethylene	$\mu g/m^3$	0.396	179	<0.396	<0.396	5.07	5.05	<0.396	<0.396	<0.396	--	<0.396	1.60	<0.396	<0.10	<0.396	5.49	<0.396
Methylene Chloride(Dichloromethane)	$\mu g/m^3$	2.78	-	<2.78	<2.78	<2.78	<2.78	<2.78	<2.78	<2.78	--	<2.78	<2.78	<2.78	<0.80	<2.78	<2.78	<2.78
Chloroform	$\mu g/m^3$	0.488	560	1.40	21.2	<0.488	<0.488	0.734	3.24	0.523	--	<0.488	<0.488	10.5	3.03	0.793	1.32	<0.488
Carbon Tetrachloride	$\mu g/m^3$	0.629	-	<0.629	<0.629	<0.629	<0.629	<0.629	<0.629	<0.629	--	<0.629	<0.629	<0.629	<0.10	<0.629	<0.629	<0.629
1,1-Dichloroethane	$\mu g/m^3$	0.405 - 1.21	3,300	<0.405	0.522	<1.21	<1.21	<0.405	<0.405	<0.405	--	<0.405	<0.405	<0.405	<0.10	<0.405	1.74	<0.405
1,2-Dichloroethane	$\mu g/m^3$	0.405	-	<0.405	<0.405	<0.405	<0.405	<0.405	<0.405	<0.405	--	<0.405	<0.405	<0.405	<0.10	<0.405	<0.405	<0.405
Ethylene Dibromide	$\mu g/m^3$	0.768	-	<0.768	<0.768	<0.768	<0.768	<0.768	<0.768	<0.768	--	<0.768	<0.768	<0.768	<0.10	<0.768	<0.768	<0.768
1,1,1-Trichloroethane	$\mu g/m^3$	0.546	20,000	<0.546	<0.546	0.930	0.937	<0.546	<0.546	<0.546	--	<0.546	<0.546	<0.546	<0.10	<0.546	<0.546	<0.546
1,1,2-Trichloroethane	$\mu g/m^3$	0.546	-	<0.546	<0.546	<0.546	<0.546	<0.546	<0.546	<0.546	--	<0.546	<0.546	<0.546	<0.10	<0.546	<0.546	<0.546
1,1,2,2-Tetrachloroethane	$\mu g/m^3$	0.687	-	<0.687	<0.687	<0.687	<0.687	<0.687	<0.687	<0.687	--	<0.687	<0.687	<0.687	<0.10	<0.687	<0.687	<0.687
cis-1,3-Dichloropropene	$\mu g/m^3$	0.454	-	<0.454	<0.454	<0.454	<0.454	<0.454	<0.454	<0.454	--	<0.454	<0.454	<0.454	<0.10	<0.454	<0.454	<0.454
trans-1,3-Dichloropropene	$\mu g/m^3$	0.454	-	<0.454	<0.454	<0.454	<0.454	<0.454	<0.454	<0.454	--	<0.454	<0.454	<0.454	<0.10	<0.454	<0.454	<0.454
1,2-Dichloropropane	$\mu g/m^3$	0.462	-	<0.462	<0.462	<0.462	<0.462	<0.462	<0.462	<0.462	--	<0.462	<0.462	<0.462	<0.10	<0.462	<0.462	<0.462
Bromomethane	$\mu g/m^3$	0.388	-	<0.388	<0.388	<0.388	<0.388	<0.388	<0.388	<0.388	--	<0.388	<0.388	<0.388	<0.10	<0.388	<0.388	<0.388
Bromoform	$\mu g/m^3$	2.07	-	<2.07	<2.07	<2.07	<2.07	<2.07	<2.07	<2.07	--	<2.07	<2.07	<2.07	<0.20	<2.07	<2.07	<2.07
Bromodichloromethane	$\mu g/m^3$	1.34	-	<1.34	<1.34	<1.34	<1.34	<1.34	<1.34	<1.34	--	<1.34	<1.34	<1.34	<0.20	<1.34	<1.34	<1.34
Dibromochloromethane	$\mu g/m^3$	1.7	-	<1.70	<1.70	<1.70	<1.70	<1.70	<1.70	<1.70	--	<1.70	<1.70	<1.70	<0.20	<1.70	<1.70	<1.70
Trichloroethylene	$\mu g/m^3$	0.537	800	<0.537	1.02	1.24	1.59	<0.537	<0.537	<0.537	--	<0.537	0.566	<0.537	1.01	<0.537	11.7	<0.537
Tetrachloroethylene	$\mu g/m^3$	0.678	800	<0.678	3.55	4.49	4.43	1.84	2.08	8.87	--	<0.678	0.991	0.792	1.86	<0.678	1.40	<0.678
Benzene	$\mu g/m^3$	0.319	303	0.529	0.366	1.35	1.31	<0.319	<0.319	<0.319	--	<0.319	0.950	<0.319	<0.10	<0.319	0.923	<0.319
Toluene	$\mu g/m^3$	0.376	190,000	1.62	0.529	6.61	2.46	1.07	0.879	1.10	--	1.43	1.85	0.943	0.20	1.08	2.18	<0.376
Ethylbenzene	$\mu g/m^3$	0.434	50,000	<0.434	<0.434	<0.434	<0.434	<0.434	<0.434	<0.434	--	<0.434	<0.434	<0.434	<0.10	<0.434	<0.434	<0.434
p+m-Xylene	$\mu g/m^3$	0.868 - 1.30	9,000	<0.868	<0.868	1.11	1.08	<0.868	<0.868	<0.868	--	<0.868	<0.868	<0.868	<0.20	<0.868	<1.30	<0.868
o-Xylene	$\mu g/m^3$	0.434	9,000	<0.434	<0.434	<0.434	<0.434	<0.434	<0.434	<0.434	--	<0.434	<0.434	<0.434	<0.10	<0.434	0.608	<0.434
Styrene	$\mu g/m^3$	0.426	4,600	<0.426	<0.426	<0.426	<0.426	<0.426	<0.426	2.41	--	<0.426	<0.426	<0.426	<0.10	<0.426	<0.426	<0.426
4-ethyltoluene	$\mu g/m^3$	2.46	-	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	--	<2.46	<2.46	<2.46	<0.50	<2.46	<2.46	<2.46
1,3,5-Trimethylbenzene	$\mu g/m^3$	2.46	400	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	--	<2.46	<2.46	<2.46	<0.50	<2.46	<2.46	<2.46
1,2,4-Trimethylbenzene	$\mu g/m^3$	2.46	400	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	<2.46	--	<2.46	<2.46	<2.46	<0.50	<2.46	<2.46	<2.46
Chlorobenzene	$\mu g/m^3$	0.46	-	<0.460	<0.460	<0.460	<0.460	<0.460	<0.460	<0.460	--	<0.460	<0.460	<0.460	<0.10	<0.460	<0.460	<0.460
Benzyl chloride	$\mu g/m^3$	2.59	-	<2.59	<2.59	<2.59	<2.59	<2.59	<2.59	<2.59	--	<2.59	<2.59	<2.59	<0.50	<2.59	<2.59	<2.59
1,3-Dichlorobenzene	$\mu g/m^3$	2.4	-	<2.40	<2.40	<2.40	<2.40	<2.40	<2.40	<2.40	--	<2.40	<2.40	<2.40	<0.40	<2.40	<2.40	<2.40
1,4-Dichlorobenzene	$\mu g/m^3$	0.601	1,900	<0.601	<0.601	<0.601	<0.601	<0.601	<0.601	<0.601	--	<0.601	<0.601	<0.601	<0.10	<0.601	<0.601	<0.601
1,2-Dichlorobenzene	$\mu g/m^3$	0.601	-	<0.601	<0.601	<0.601	<0.601	<0.601	<0.601	<0.601	--	<0.601	<0.601	<0.601	<0.10	<0.601	<0.601	<0.601
1,2,4-Trichlorobenzene	$\mu g/m^3$	3.71	-	<3.71	<3.71	<3.71	<3.71	<3.71	<3.71	<3.71	--	<3.71	<3.71	<3.71	<0.50	<3.71	<3.71	<3.71
Hexachlorobutadiene	$\mu g/m^3$	5.33	-	<5.33	<5.33	<5.33	<5.33	<5.33	<5.33	<5.33	--	<5.33	<5.33	<5.33	<0.50	<5.33	<5.33	<5.33
Hexane	$\mu g/m^3$	1.06	14,000	<1.06	<1.06	3.33	3.17	2.93	<1.06	1.71	--	<1.06	7.14	<1.06	<0.30	<1.06	6.03	<1.06
Heptane	$\mu g/m^3$	1.23	8,000	<1.23	<1.23	1.89	1.34	1.48	1.50	1.33	--	<1.23	1.92	<1.23	<0.30	<1.23	<1.23	<1.23
Cyclohexane	$\mu g/m^3$	0.688	120,000	<0.688	<0.688	31.5	30.9	<0.688	<0.688	<0.688	--	<0.688	27.4	<0.688	<0.20	<0.688	92.6	<0.688
Tetrahydrofuran	$\mu g/m^3$	1.18	40,000	<1.18	<1.18	<1.18	<1.18	<1.18	<1.18	<1.18	--	<1.18	<1.18	<1.18	<0.40	<1.18	<1.18	<1.18
1,4-Dioxane	$\mu g/m^3$	3.6	-	<3.60	<3.60	<3.60	<3.60	<3.60	<3.60	<3.60	--	<3.60	<3.60	<3.60	<1.0	<3.60	<3.60	<3.60
Naphthalene	$\mu g/m^3$	2.62	-	<2.62	<2.62	<2.62	<2.62	<2.62	<2.62	<2.62	--	<2.62	<2.62	<2.62	<0.50	<2.62	<2.62	<2.62
Total Xylenes	$\mu g/m^3$	1.3 - 1.74	9,000	<1.30	<1.30	<1.30	<1.30	<1.30	<1.30	<1.30	--	<1.30	<1.30	<1.30	<0.30	<1.30	<1.74	<1.30
1,1,1,2-Tetrachloroethane	$\mu g/m^3$	0.687	-	<0.687	<0.687	<0.687	<0.687	<0.687	<0.687	<0.687	--	<0.687	<0.687	<0.687	<0.10	<0.687	<0.687	<0.687
Vinyl Bromide	$\mu g/m^3$	0.875	-	<0.875	<0.875	<0.875	<0.875	<0.875	<0.875	<0.875	--	<0.875	<0.875	<0.875	<0.20	<0.875	<0.875	<0.875
Propene	$\mu g/m^3$	0.861- 31.0	60,000	<3.10	<1.72	73.2	72.7	<2.93	<0.861	89.2	--	<0.861	38.9	<3.10	<1.0	<1.55	<31.0	<0.861
2,2,4-Trimethylpentane	$\mu g/m^3$	0.934	64,173	<0.934	<0.934	3.03	2.95	<0.934	<0.934	<0.934	--	<0.934	4.56	<0.934	<0.20	<0.934	8.17	<0.934
Carbon Disulfide	$\mu g/m^3$	1.56	2,000	<1.56	<1.56	<1.56	<1.56	6.11	3.69	<1.56	--	3.48	<1.56	7.53	4.11	25.7	<1.56	<1.56
Vinyl Acetate	$\mu g/m^3$	0.704 - 4.23	-	<0.704	<0.704	<2.82	<2.46	<0.704	<0.704	<0.704	--	<0.704	<2.11	<0.704	<0.20	<0.704	<4.23	<0.704

Notes:

BOLD Shaded	**Concentration exceeds calculated soil vapour screening criteria**
-	Criteria not derived (concentration below detection limits)
--	No Data
<	Below Laboratory MDL

Table 13 Summary of Analytical Results for Siloxanes in Soil Vapour

Sample ID	Units	Reportable Detection Limit	Deminimus Screening -Soil Vapour Screening Criteria	Soil Vapour Probes									
				VW-01	**VW-03**	**VW-05**		**XCG-1(SVP)**	**XCG-2(SVP)**	**XCG-4(SVP)**	**XCG-6(SVP)**	**XCG-10(SVP)**	**XCG-13(SVP)**
Laboratory				**ALS**	**ALS**	**ALS**		**ALS**	**ALS**	**ALS**	**ALS**	**ALS**	**ALS**
Tube ID				**G0150695SVI**	**G0150687SVI**	**G0150642SVI**	**G0150640SVI**	**G0150699SVI**	**G0150637SVI**	**G0150637SVI**	**G0150069SVI**	**G0150698SVI**	**G0150688SVI**
Laboratory ID				**L1901643-2**	**L1901643-1**	**L1901643-3**	**L1901643-4**	**L1901643-5**	**L1901643-8**	**L1901643-8**	**L1901643-7**	**L1901643-9**	**L1901643-6**
Date Sampled				**12-Mar-17**	**12-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**13-Mar-17**	**12-Mar-17**	**12-Mar-17**
hexamethyl cyclotrisolxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
octamethyl cyclotetrasiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
decamethyl cyclopentasiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
dodecamethyl cyclohexasiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
hexamethyldisiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
octamethyltrisiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
decamethyltetrasiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170
dodecamethylpentasiloxane	µg/m^3	170	-	<170	<170	<170	<170	<170	<170	<170	<170	<170	<170

Notes:

-	**Criteria not derived (concentration below detection limits)**
<	Below Laboratory RDL

Table 14 Summary of Deminimus Screening Results for Indoor Air Parameters
Derive Acceptable Soil Vapour Concentrations (Soil Vapour Screening Levels)

$$Csv = \frac{Cair}{alpha}$$

where
Csv = Allowable Concentration of Soil Vapour
Cair = Concentration in indoor air (or trench air)
alpha = vapour attenuation factor Alpha Coarse Graine Alpha Fine Grained = 2. Demininus Alpha = 0.01 Deminimus Alpha = 0.01

Assumptions in selection of vapour attenuation factors
1. Assume 0.3 metre depth from vapour sample to building foundation
2. Assume residential building with basement (this is considered protective of slab on grade)
3. Alpha values calculated in accordance with CCME, 2014 "A Protocol for the Derivation of Soil Vapour Guidelines for Protection of Human Exposures Via Inhalation"
concern. The physical-chemical properties for benzene have been applied to all

Chemical	**Assume Coarse Grained Residential Basement Setting**	**Assume Fine Grained Residential Basement Setting**	**Deminimus Screening**				
	(Coarse Grained) Soil Vapour Screening ($\mu g/m^3$)	**(Fine Grained) Soil Vapour Screening ($\mu g/m^3$)**	***Soil Vapour Screening ($\mu g/m^3$)***	***Soil Vapour Screening ($\mu g/m^3$)***	**Worst case concentration in soil vapour probes (including probes within the limit of waste)**	**Location**	**Include in Indoor Air Testing? (Y/N)**
trans-1,2-dichloroethylene	9.13E+02	8.22E+03	**1.79E+02**	**179**	5.49	XCG-13(SVP)	N
1,2-dibromoethane	9.18E+02	8.27E+03	**1.80E+02**	**180**	0.768	RDL in all	N
1,2-dichlorobenzene	1.96E+05	1.77E+06	**3.85E+04**	**38482**	0.601	RDL in all	N
styrene	2.35E+04	2.11E+05	**4.60E+03**	**4600**	2.41	XCG-4(SVP)	N
1,3,5-trichlorobenzene	3.67E+02	3.31E+03	**7.20E+01**	**72**	*not measured in SV. See note below.		N
1,1,2-trichloroethane	1.83E+03	1.64E+04	**3.58E+02**	**358**	0.546	RDL in all	N
Ethane	8.13E+05	8.13E+05	**8.13E+05**	**813000**	318	XCG-4(SVP)	N
Ethylene	1.74E+05	1.74E+05	**1.74E+05**	**174000**	8400	VW-05	N
Methane	methane concentration ppmv 1,000 to <5000 and soil gas pressure 0.69 to <3.5 kPa	methane concentration ppmv 1,000 to <5000 and soil gas pressure 0.69 to <3.5 kPa	**1.5E+6 to <7.6E+6 ug/m3**	**1,500,000 to <7,600,000 ug/m3**	37,393,865.03 (5.7%)	XCG-4(SVP)	**Y**
Propane	1.80E+06	1.80E+06	**1.80E+06**	**1800000**	524	Non-detect in all, XCG-2 (SVP) was potential highest	N
Dichlorodifluoromethane (Freon 12)	9.08E+04	8.17E+05	**1.78E+04**	**17800**	2950	XCG-13(SVP)	N
1,2-dichlorotetrafluorethane (R114)	7.00E+06	7.00E+06	**7.00E+06**	**7000000**	1790	VW-03	N
Chloromethane	9.18E+03	8.27E+04	**1.80E+08**	**1800**	4.39	VW-01	N
Vinyl Chloride	5.80E+02	5.22E+03	**1.14E+02**	**114**	1250	VW-05 (duplicate)	**Y**
Chloroethane	1.02E+06	9.18E+06	**2.00E+05**	**200000**	23.2	VW-05	N
Trichlorofluormethane (Freon 11)	1.02E+05	9.18E+05	**2.00E+04**	**20000**	5.92	VW-05	N
Ethanol (Ethyl Alcohol)	1.90E+06	1.90E+06	**1.90E+06**	**618000**	180	XCG-4(SVP)	N
2-Propanol (isopropyl alcohol)	4.91E+05	4.91E+05	**4.91E+05**	**491000**	2.46	RDL in all	N
2-Propanone (acetone)	3.15E+06	2.84E+07	**6.18E+05**	**618000**	47.5	XCG-13(SVP)- elevated RDL bc of matrix interference	N
Methyl Ethyl Ketone (2-Butanone)	5.10E+05	4.59E+06	**1.00E+05**	**100000**	6.19	XCG-6(SVP)- elevated RDL bc of matrix interference	N
1,4-dichlorobenzene	9.69E+03	8.73E+04	**1.90E+03**	**1900**	0.601	RDL in all	N
1,1,-dichlorethylene	2.04E+04	1.84E+05	**4.00E+03**	**4000**	5.72	XCG-13(SVP)	N
cis-1,2-dichloroethylene	9.13E+02	8.22E+03	**1.79E+02**	**179**	223	XCG-13(SVP)	**Y**
methylene chloride (dichloromethane)	2.22E+05	2.00E+06	**4.35E+04**	**43478**	2.78	RDL in all	N
chloroform	2.86E+03	2.57E+04	**5.60E+02**	**560**	21.2	VW-03	N
1,1,1-trichloroethane	1.02E+05	9.18E+05	**2.00E+04**	**20000**	0.937	VW-05 (duplicate)	N
trichloroethylene (updated)	4.08E+03	3.67E+04	**8.00E+02**	**800**	11.7	XCG-13 (SVP)	N
tetrachloroethylene	4.08E+03	3.67E+04	**8.00E+02**	**800**	12.6	XCG-10(SVP)	N
benzene	1.55E+03	1.39E+04	**3.03E+02**	**303**	1.35	VW-05	N
toluene	9.69E+05	8.73E+06	**1.90E+05**	**190000**	6.61	VW-05	N
PHC F1	3.04E+05	2.73E+06	**5.95E+04**	**59532**	5830	XCG-13(SVP)	N
PHC F2	1.42E+05	1.28E+06	**2.78E+04**	**27778**	972	XCG-13(SVP)	N
ethylbenzene	2.55E+05	2.30E+06	**5.00E+04**	**50000**	0.434	RDL in all	N
total xylenes	4.59E+04	4.13E+05	**9.00E+03**	**9000**	1.74	XCG-13(SVP)- elevated RDL bc of matrix interference	N
1,3,5-trimethylbenzene	2.04E+03	1.84E+04	**4.00E+02**	**400**	2.46	RDL in all	N
1,2,4-trimethylbenzene	2.04E+03	1.84E+04	**4.00E+02**	**400**	2.46	RDL in all	N
hexane	7.14E+04	6.43E+05	**1.40E+04**	**14000**	7.14	XCG-6(SVP)	N
heptane	4.08E+04	3.67E+05	**8.00E+03**	**8000**	1.92	XCG-6(SVP)	N
cyclohexane	6.12E+05	5.51E+06	**1.20E+05**	**120000**	92.6	XCG-13(SVP)	N
tetrahydrofuran	2.04E+05	1.84E+06	**4.00E+04**	**40000**	1.18	RDL in all	N
propene	3.06E+05	2.76E+06	**6.00E+04**	**60000**	89.2	XCG-4(SVP)	N
2,2,4-trimethylpentane	6.42E+04	6.42E+04	**6.42E+04**	**64173**	8.17	XCG-13(SVP)	N
carbon disulfide	1.02E+04	9.18E+04	**2.00E+03**	**2000**	25.7	XCG-12(SVP)	N

Notes

1. Methane screening will be completed in accordance with Table 6, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services)

*1,3,5-trichlorobenzene was detected in MW-06 but not measured in soil vapour because of the following:
(note that MW-06 is assumed to be within the limit of waste, and therefore 1,3,5-trichlorobenzene was not under consideration for indoor air testing)
Henry's Law Constant (HCL) 1.9x 10-3 atm m^3/mol
Convert to HLC (unitless) 0.077661031
Concentration of 1,3,5-trichlorobenzene detected in Groundwater 0.73 µg/L

Using Henry's Law to convert to soil vapour concentration = Csv = Cgw (µg/L) X HCL(unitless) x 1000 L/m^3

Concentration in Soil Vapour = Csv = 0.73 µg/L * 0.077661 * 1000 L/m^3 = 56.69 µg/m^3

This concentration is less than the soil vapour screening value of 72 µg/m^3. Therefore, even with very conservative assumptions, groundwater at concentrations detected would not cause a soil vapour concentration to exceed the demininums screening concentrations.

Table 15 Summary of Analytical Results for VOCs in Indoor Air

Sample ID	UNITS	Reportable Detection Limit	Health Based Indoor Air Criteria	Indoor Air Samples											Ambient
				Residence A / 2758	Residence B / T21636	Residence C / 14258		Residence D / 18232	Residence E / 129	Residence F / 14918	Residence G / 14531	Residence H / 18260	Residence I / 14530	Residence J / 2813	OAQ/2595
Laboratory				**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**
Laboratory ID				**EBG197**	**EBG194**	**EBG196**	**EBG205**	**EBG201**	**EBG200**	**EBG199**	**EBG198**	**EBG195**	**EBG202**	**EBG203**	**EBG204**
Date Sampled				**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**	**14/03/2017**
Summa Canister Pressure on Receipt	**psig**	NV	NV	(-3.9)	(-5.0)	(-4.5)	(-4.5)	(-4.6)	(-4.5)	(-4.0)	(-4.0)	(-3.6)	(-4.5)	(-4.3)	(-2.2)
Vinyl Chloride	**µg/m^3**	0.0511	1.136	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051	<0.051
cis-1,2-Dichloroethylene	**µg/m^3**	0.200	1.790	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Methane	**% v/v**	0.1-0.2	0.25-0.5	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Notes:

Note 1	Health Based Indoor Air Criteria is derived from Risk Assessment modelling, which takes a number of conservative assumptions into consideration. The Criteria are not regulated, rather are indicators of possible sources
Bold and underline	Parameter concentration exceeds Health Based Indoor Air Criteria for Residential Use
NA	Not Analyzed
<	Below Laboratory RDL

APPENDIX A

STRATIGRAPHIC LOGS

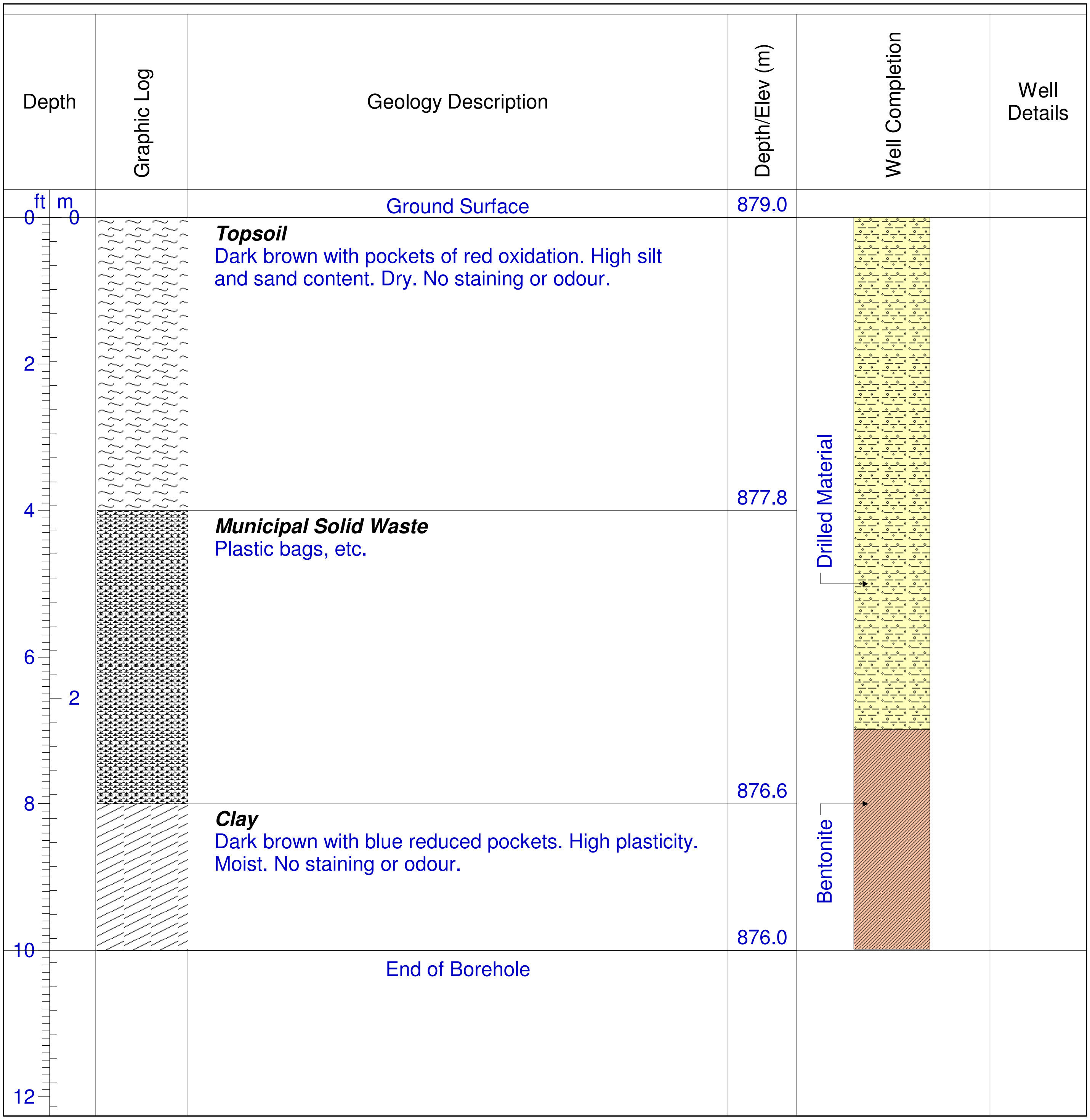
Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: BH1

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL



Geology Description	Depth/Elev (m)
Ground Surface	879.0
Topsoil Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	877.8
Municipal Solid Waste Plastic bags, etc.	876.6
Clay Dark brown with blue reduced pockets. High plasticity. Moist. No staining or odour.	876.0
End of Borehole	

Groundwater Elevation: N/A
T.O.C. Elevation: N/A
Ground Surface Elevation: 879.024

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

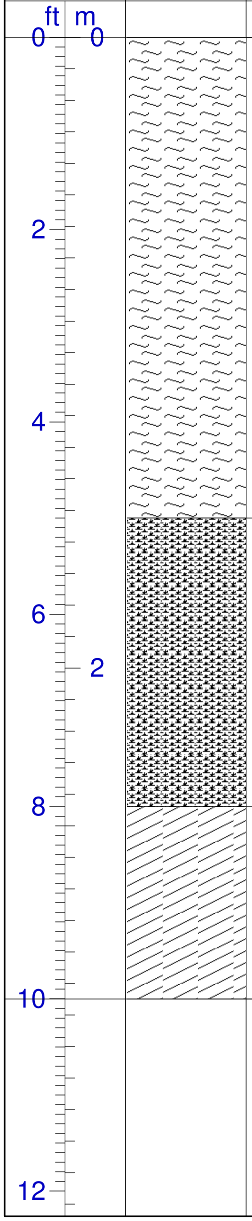
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

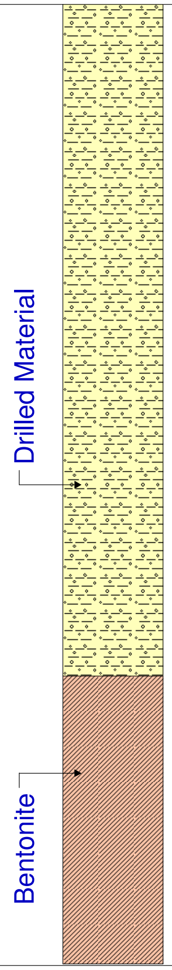
Privileged and Confidential
LOG OF WELL: BH2

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL

Depth (ft)	Depth (m)	Geology Description	Depth/Elev (m)	Well Completion	Well Details
0	0	Ground Surface	879.0		
0	0	***Topsoil*** Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	877.5	Drilled Material	
5		***Municipal Solid Waste*** Plastic bags, etc.	876.5		
8		***Clay*** Dark brown with blue reduced pockets. High plasticity. Moist. No staining or odour.	875.9	Bentonite	
10		End of Borehole			





Groundwater Elevation: N/A
T.O.C. Elevation: N/A
Ground Surface Elevation: 878.982

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

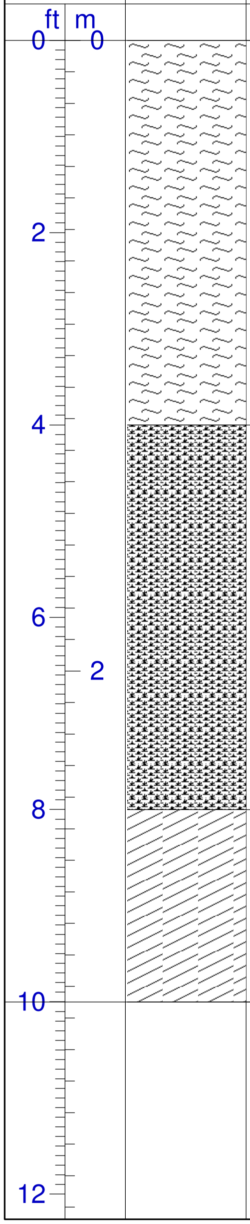
Project #: 4-2352-04-03

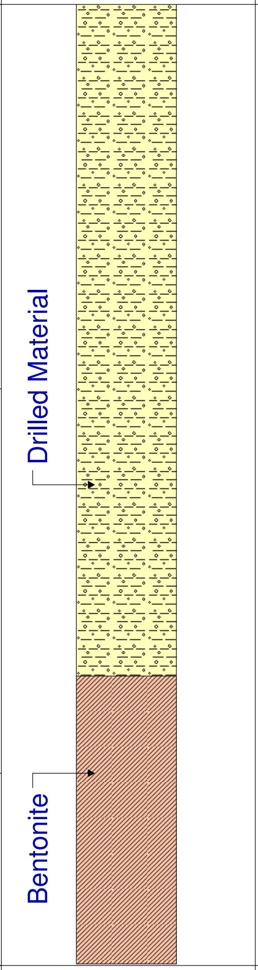
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: BH3

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL





Geology Description	Depth/Elev (m)	Well Details
Ground Surface	879.0	
Topsoil Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	877.7	
Municipal Solid Waste Plastic bags, etc.	876.5	
Clay Dark brown with blue reduced pockets. High plasticity. Moist. No staining or odour.	875.9	
End of Borehole		

Groundwater Elevation: N/A
T.O.C. Elevation: N/A
Ground Surface Elevation: 878.953

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

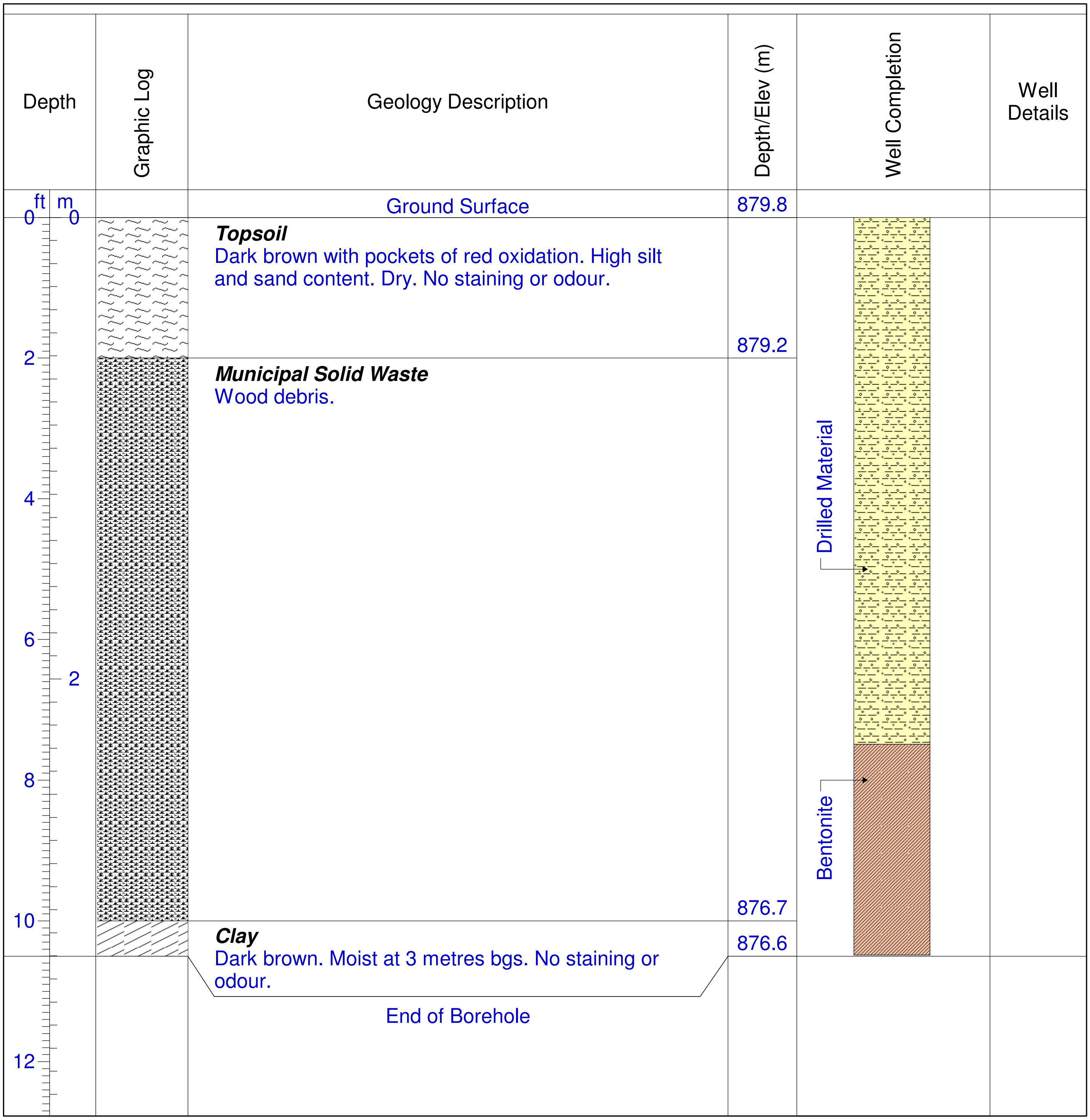
Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: BH4

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 7, 2016
Completed: December 7, 2016
Checked By: EM
Logged By: MCL



Depth (m)	Geology Description	Depth/Elev (m)
	Ground Surface	879.8
0	***Topsoil*** Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	879.2
	Municipal Solid Waste Wood debris.	876.7
	Clay Dark brown. Moist at 3 metres bgs. No staining or odour.	876.6
	End of Borehole	

Groundwater Elevation: N/A
T.O.C. Elevation: N/A
Ground Surface Elevation: 879.794

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

XCG
Environmental Engineers & Scientists

Project #: 4-2352-04-03

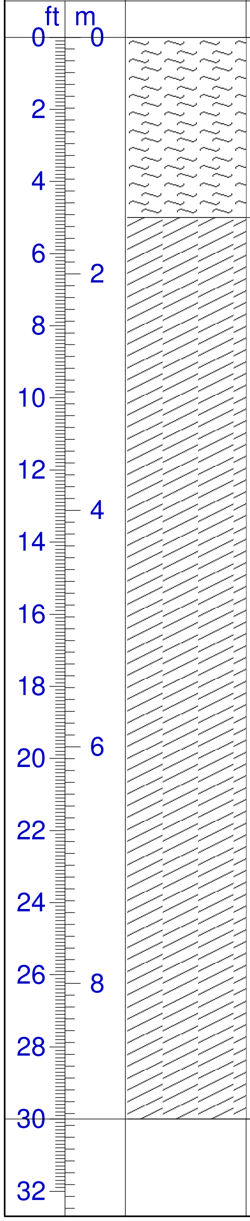
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential

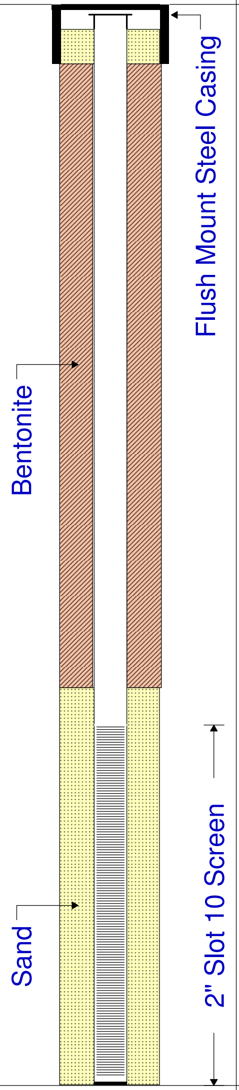
LOG OF WELL: XCG-1(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL



Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
		Ground Surface	881.2		
		Topsoil Dark brown with some silt and sand. Dry. No staining or odour.	879.7		
		Clay Dark brown. High plasticity. No staining or odour. Wet at 7.5 metres bgs.	872.1		
		End of Borehole			



Groundwater Elevation: N/A
T.O.C. Elevation: 881.206
Ground Surface Elevation: 881.206

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Sheet: 1 of 1

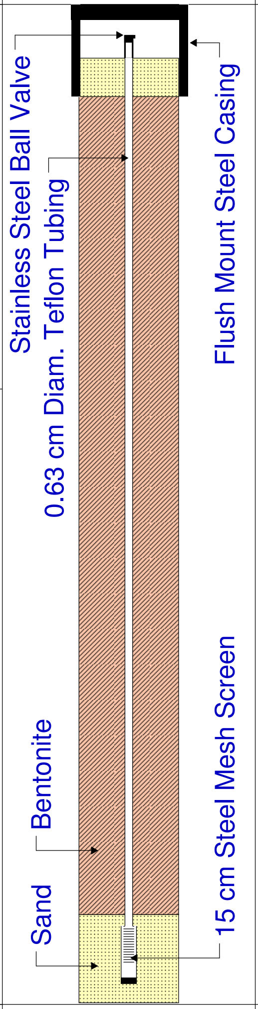
Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-1(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	881.3		
0 0 2 4		***Topsoil*** Dark brown with some silt and sand. Dry. No staining or odour.	879.8		
6 2 8 10 12		***Clay*** Dark brown. High plasticity. No staining or odour.	877.4		
4 14		End of Borehole			

Groundwater Elevation: N/A
T.O.C. Elevation: 881.326
Ground Surface Elevation: 881.326

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Sheet: 1 of 1

XCG Environmental Engineers & Scientists

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

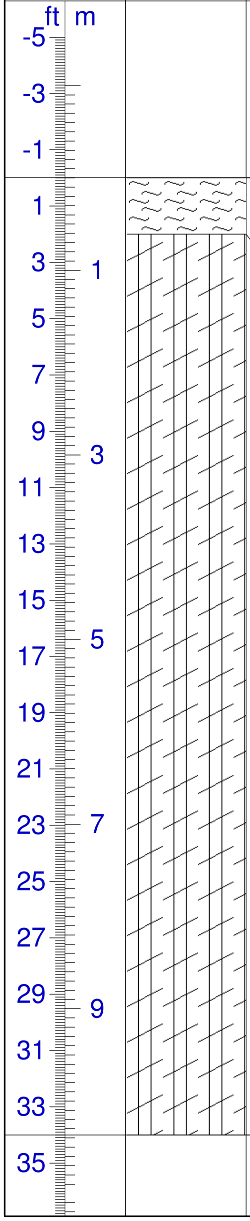
Privileged and Confidential

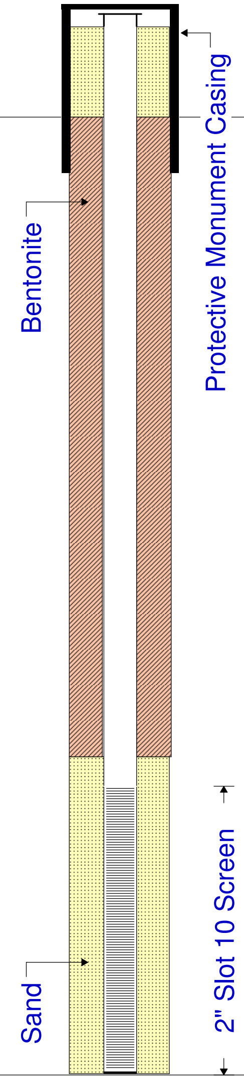
LOG OF WELL: XCG-2(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016

Checked By: EM
Logged By: MCL





Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
		Ground Surface	881.1		
		Topsoil Dark brown with some sand and silt. Dry. No staining or odour.	880.5		
		Clayey Silt Medium brown with some fine sand. No staining or odour.			
		Moist at 7.5 metres bgs.			
		Wet at 9.0 metres bgs. Increasing clay content at 9.0 metres bgs.	870.7		
		End of Borehole			

Groundwater Elevation: N/A
T.O.C. Elevation: 882.328
Ground Surface Elevation: 881.101

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

XCG Environmental Engineers & Scientists

Project #: 4-2352-04-03

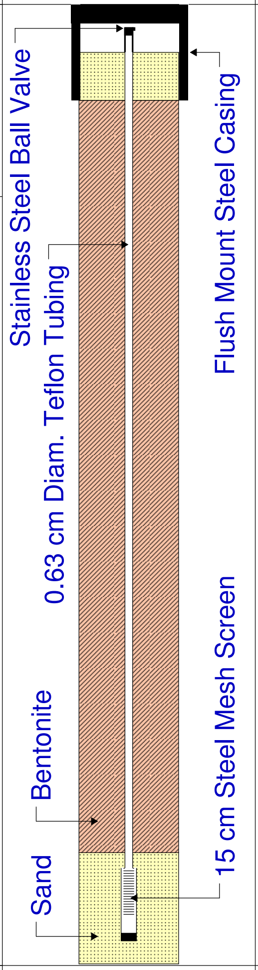
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-2(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	881.2		
0 0		***Topsoil*** Dark brown with some sand and silt. Dry. No staining or odour.	880.6		
2 4 6 2 8		***Clayey Silt*** Medium brown with some fine sand. No staining or odour.	878.1		
10 12		End of Borehole			



Groundwater Elevation: N/A
T.O.C. Elevation: 881.163
Ground Surface Elevation: 881.163

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

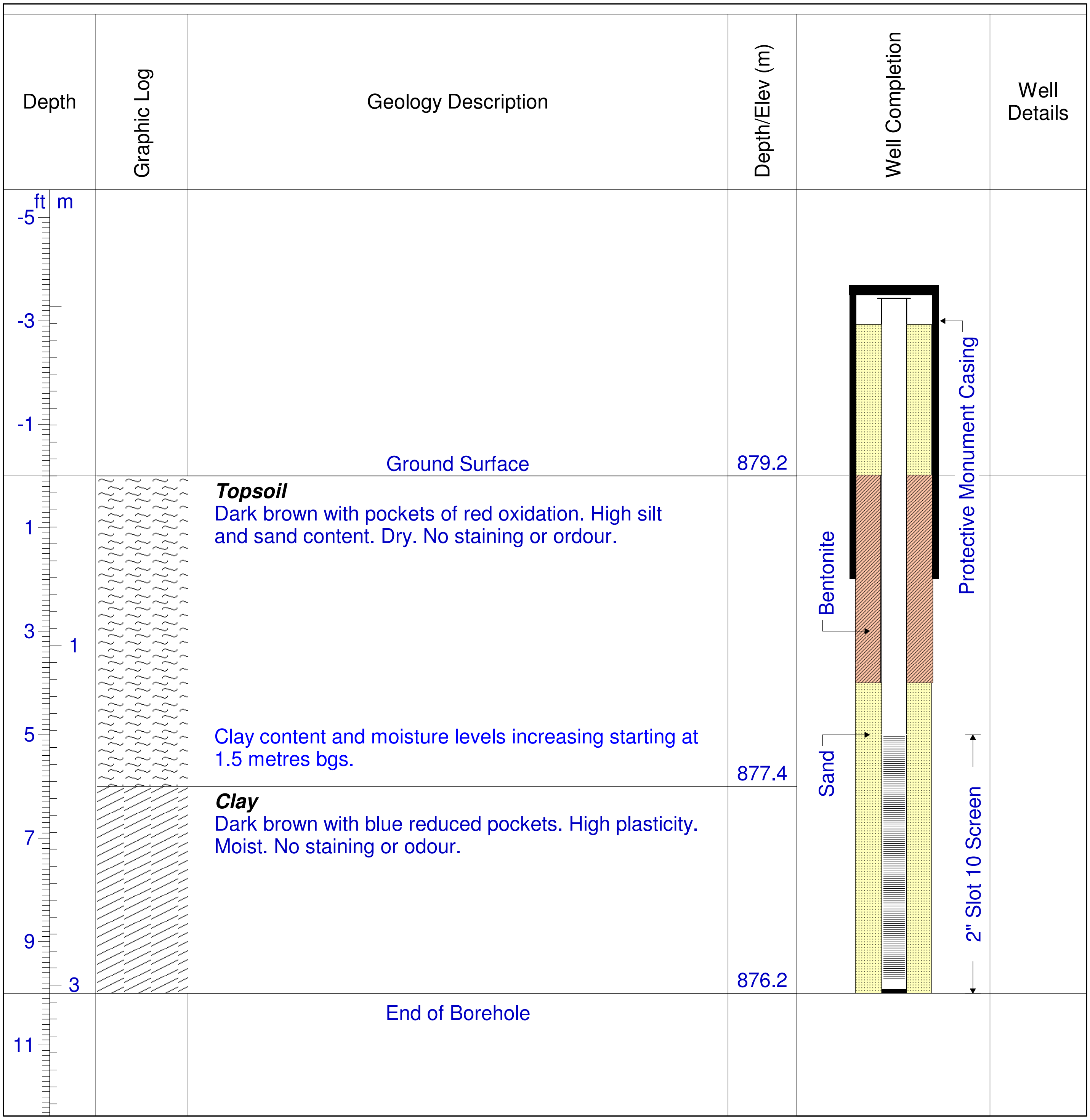
XCG Environmental Engineers & Scientists

Project #: 4-2352-04-03
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-4(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL



Geology Description	Depth/Elev (m)
Ground Surface	879.2
Topsoil Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or ordour. Clay content and moisture levels increasing starting at 1.5 metres bgs.	877.4
Clay Dark brown with blue reduced pockets. High plasticity. Moist. No staining or odour.	876.2
End of Borehole	

Groundwater Elevation: N/A
T.O.C. Elevation: 880.342
Ground Surface Elevation: 879.22

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

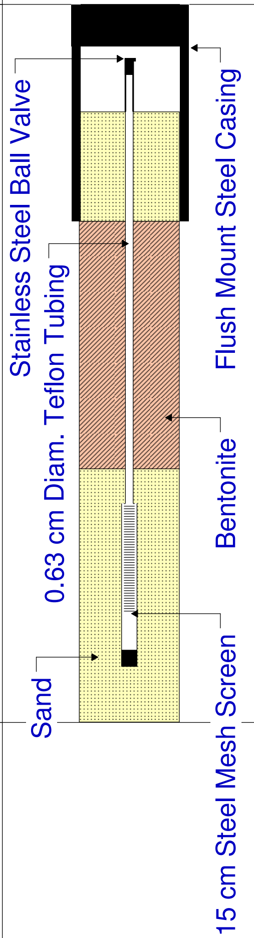
Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-4(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft 0 / m 0		Ground Surface	879.2		
2		***Topsoil*** Dark brown with pockets of red oxidation. High sand and silt content. Dry. No staining or odour.	878.2		
4		End of Borehole			

Groundwater Elevation: N/A
T.O.C. Elevation: 879.194
Ground Surface Elevation: 879.194

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

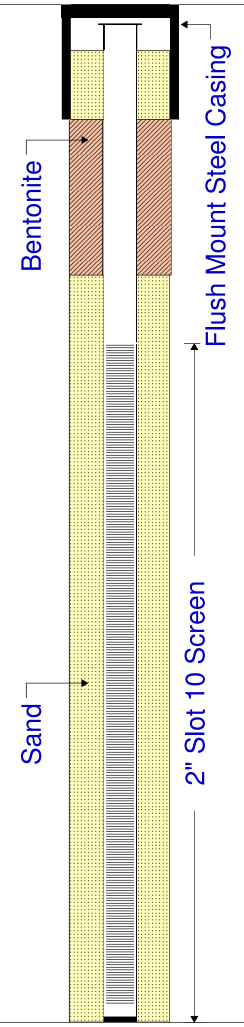
Privileged and Confidential

LOG OF WELL: XCG-5(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 7, 2016
Completed: December 7, 2016
Checked By: EM
Logged By: MCL

Depth (ft / m)	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
0 / 0		Ground Surface	880.3		
0–2.5 ft		***Topsoil*** Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	879.5		
2.5–10 ft		***Sand*** Medium brown. Very fine with some silt. Moist at 2.8 metres bgs. No staining or odour.	877.2		
10–15 ft		***Clayey Silt*** Dark brown. Wet at 3.2 metres bgs. No staining or odour.	875.7		
		End of Borehole			



Groundwater Elevation: N/A
T.O.C. Elevation: 880.27
Ground Surface Elevation: 880.27

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

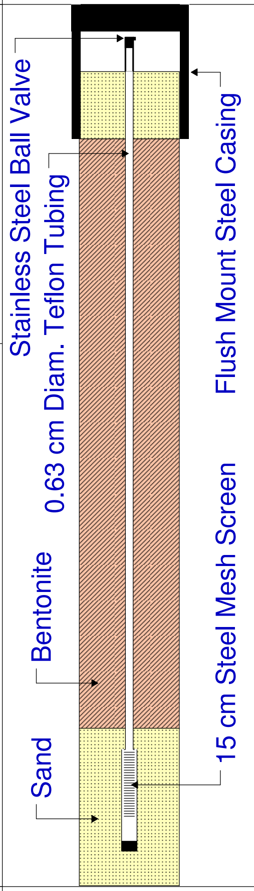
Privileged and Confidential

LOG OF WELL: XCG-5(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 7, 2016
Completed: December 7, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	880.4		
0 0 2		***Topsoil*** Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	879.6		
4 6		***Sand*** Medium brown. Very fine with some silt. Moist at 2.8 metres bgs. No staining or odour.	878.4		
2 8		End of Borehole			



Groundwater Elevation: N/A
T.O.C. Elevation: 880.356
Ground Surface Elevation: 880.356

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

XCG Environmental Engineers & Scientists

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

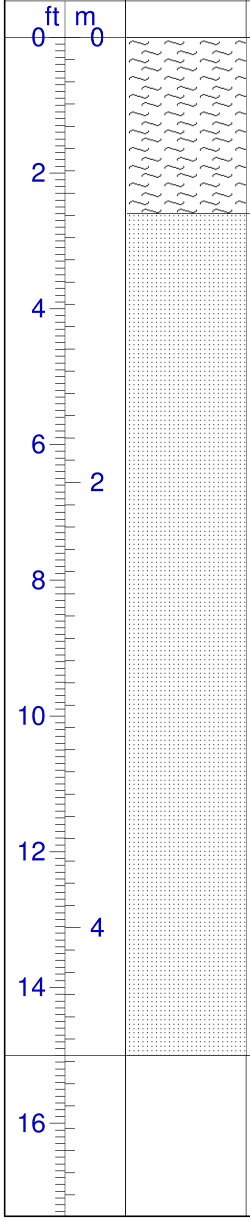
Privileged and Confidential

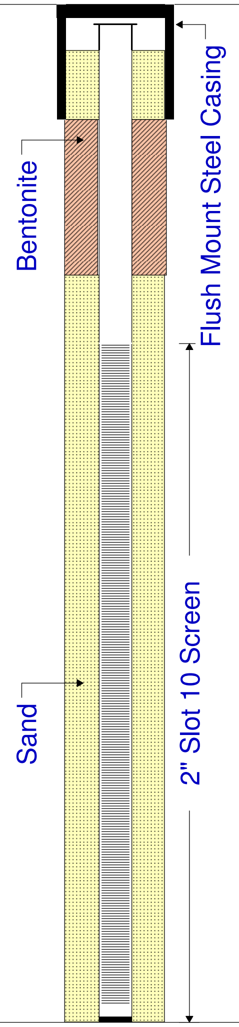
LOG OF WELL: XCG-6(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 7, 2016
Completed: December 7, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
		Ground Surface	880.0		
		Topsoil Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	879.2		
		Sand Medium brown. Fine with some silt. Some redox (red/blue) striations. No staining or odour. Moist at 2.3 metres bgs. Wet at 3.0 metres bgs.	875.4		
		End of Borehole			





Groundwater Elevation: N/A
T.O.C. Elevation: 879.971
Ground Surface Elevation: 879.971

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Sheet: 1 of 1

Environmental Engineers & Scientists

Project #: 4-2352-04-03

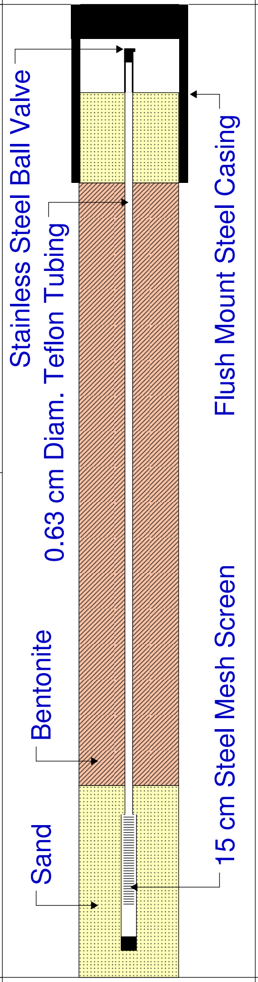
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential

LOG OF WELL: XCG-6(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 7, 2016
Completed: December 7, 2016
Checked By: EM
Logged By: MCL

Depth (ft / m)	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
0 / 0		Ground Surface	879.9		
0–2		***Topsoil*** Dark brown with pockets of red oxidation. High silt and sand content. Dry. No staining or odour.	879.1		
2–4		***Sand*** Medium brown. Fine with some silt. Some redox (red/blue) striations. No staining or odour.	878.3		
6		End of Borehole			

Groundwater Elevation: N/A
T.O.C. Elevation: 879.903
Ground Surface Elevation: 879.903

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential

LOG OF WELL: XCG-9(SVP)

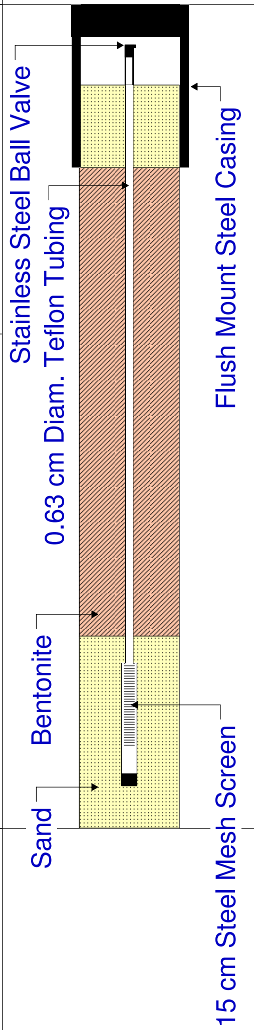
Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016
Checked By: EM
Logged By: MCL

Depth (ft)	Depth (m)	Geology Description	Depth/Elev (m)
		Ground Surface	880.7
0	0	***Topsoil*** Dark brown with silt and sand content. Dry. No staining or odour.	
2		***Clay*** Dark brown. High plasticity. Mixed with some topsoil. No staining or odour. Clay was disturbed and had been packed back around utilities.	880.1
4			
		End of Borehole	879.2
6			
	2		

Well Completion

Well Details



Groundwater Elevation: N/A
T.O.C. Elevation: 880.703
Ground Surface Elevation: 880.703

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

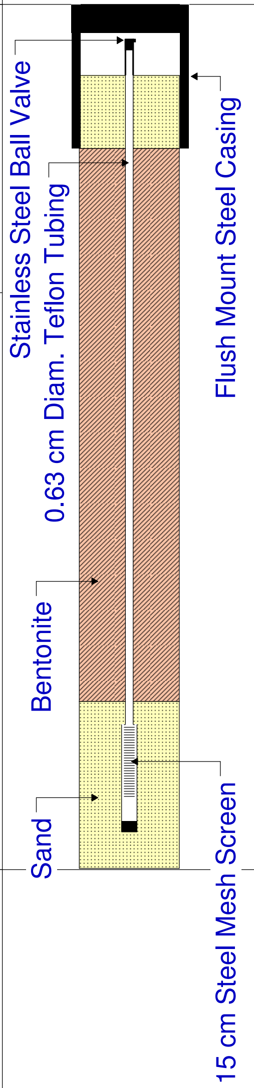
Privileged and Confidential

LOG OF WELL: XCG-10(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	879.1		
0 0	▨	***Topsoil*** Dark brown with silt and sand content. Dry. No staining or odour.	878.5		
2	▨	***Clay*** Dark brown. High plasticity. No staining or odour. Increasing moisture starting at 1.5 metres bgs.	877.3		
4					
6		End of Borehole			
2					
8					



Groundwater Elevation: N/A
T.O.C. Elevation: 879.122
Ground Surface Elevation: 879.122

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Sheet: 1 of 1

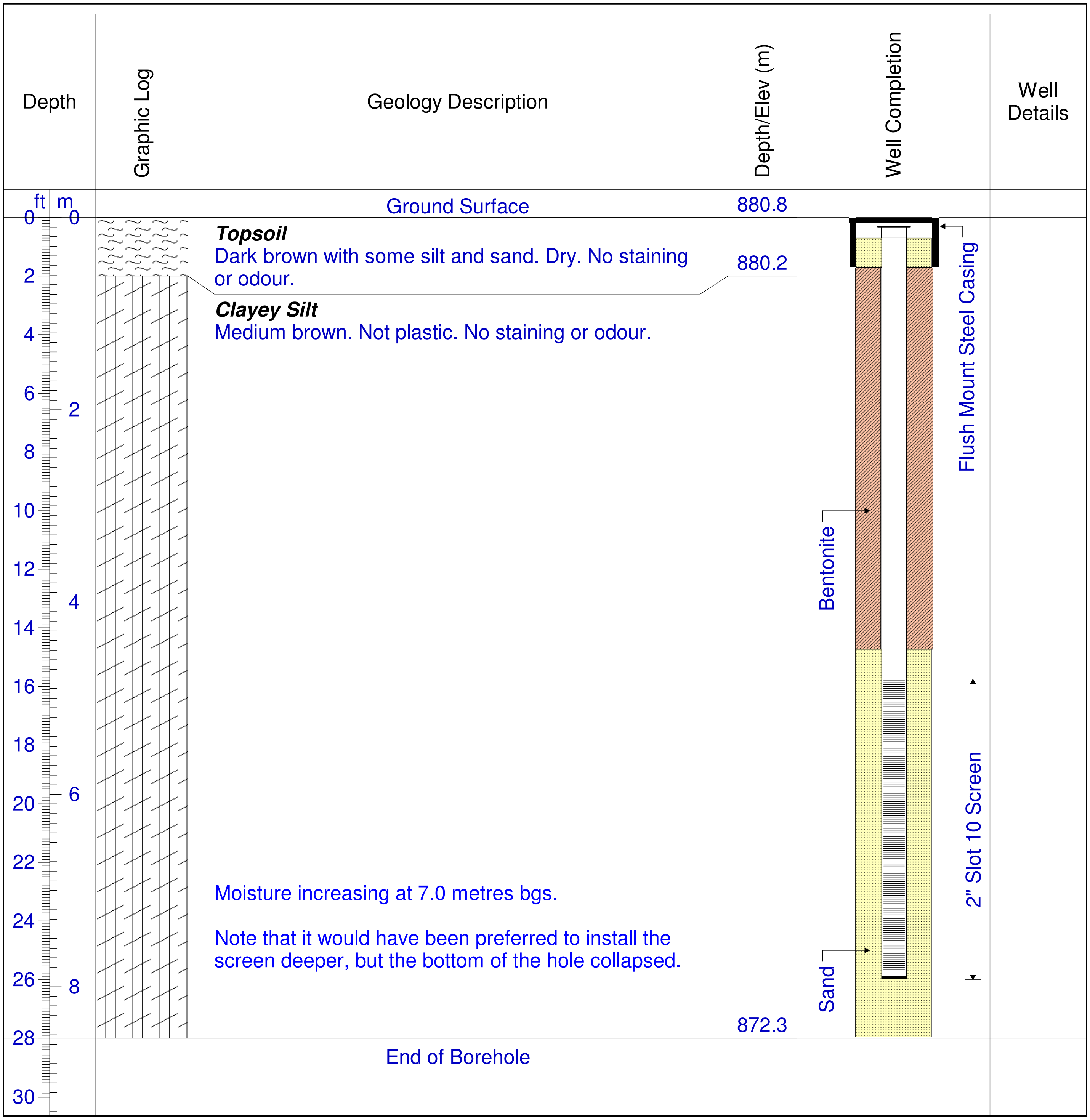
Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-12(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016
Checked By: EM
Logged By: MCL



Ground Surface

Topsoil
Dark brown with some silt and sand. Dry. No staining or odour.

Clayey Silt
Medium brown. Not plastic. No staining or odour.

Moisture increasing at 7.0 metres bgs.

Note that it would have been preferred to install the screen deeper, but the bottom of the hole collapsed.

End of Borehole

Groundwater Elevation: N/A
T.O.C. Elevation: 880.799
Ground Surface Elevation: 880.799

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

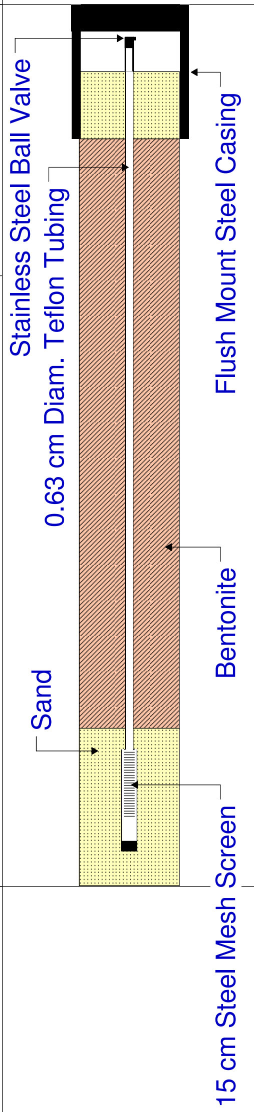
Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential
LOG OF WELL: XCG-12(SVP)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	880.8		
0 0		***Topsoil*** Dark brown with some silt and sand. Dry. No staining or odour.	880.2		
2		***Clayey Silt*** Medium brown. Not plastic. No staining or odour.			
4					
6			878.8		
2		End of Borehole			
8					



Groundwater Elevation: N/A
T.O.C. Elevation: 880.799
Ground Surface Elevation: 880.799

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Privileged and Confidential

LOG OF WELL: XCG-13(MW)

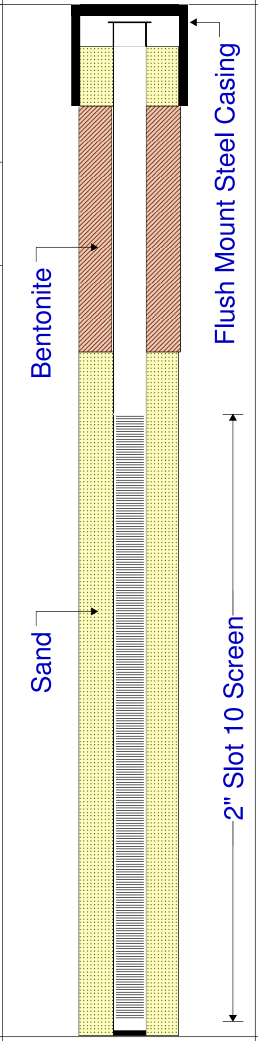
XCG Environmental Engineers & Scientists

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016
Checked By: EM
Logged By: MCL

Depth (ft / m)	Geology Description	Depth/Elev (m)
0 ft / 0 m	Ground Surface	879.7
0–2.6 ft	***Topsoil*** Some clay. Dry. No staining or odour. Different from topsoil across the site. Homeowner brought additional topsoil in.	878.9
2.6–4.3 ft	***Topsoil*** Dark brown with some silt and sand. Dry. No staining or odour.	878.4
4.3–17 ft	***Clay*** Dark brown / black. No staining or odour. Wet at 3.7 metres bgs.	874.5
	End of Borehole	



Groundwater Elevation: N/A
T.O.C. Elevation: 879.672
Ground Surface Elevation: 879.672

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

Privileged and Confidential

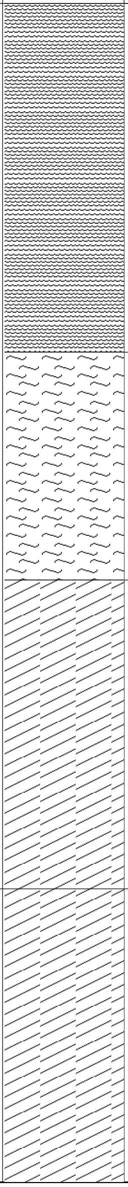
LOG OF WELL: XCG-13(SVP)

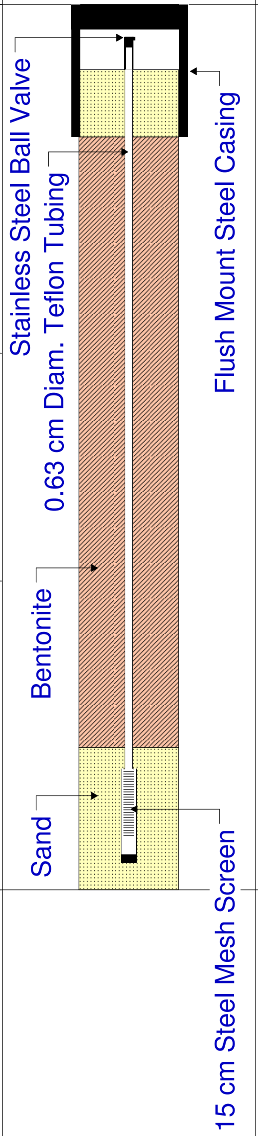
Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 6, 2016
Completed: December 6, 2016

Checked By: EM
Logged By: MCL

Depth (ft / m)	Geology Description	Depth/Elev (m)
0 / 0	Ground Surface	879.7
0–2.6 ft	***Topsoil*** Some clay. Dry. No staining or odour. Different from topsoil across the site. Homeowner brought topsoil in.	878.9
2.6–4.3 ft	***Topsoil*** Dark brown with some silt and sand. Dry. No staining or odour.	878.4
4.3 ft – 2 m	***Clay*** Dark brown / black. No staining or odour. Wet at 3.7 metres bgs.	877.7
2 m	End of Borehole	





Groundwater Elevation: N/A
T.O.C. Elevation: 879.679
Ground Surface Elevation: 879.679

Screening Tool: N/A

Monitoring Well Log
For Environmental Purposes Only

Sheet: 1 of 1

Project #: 4-2352-04-03

Project: Montfort
Client: City of Red Deer
Location: Red Deer, AB

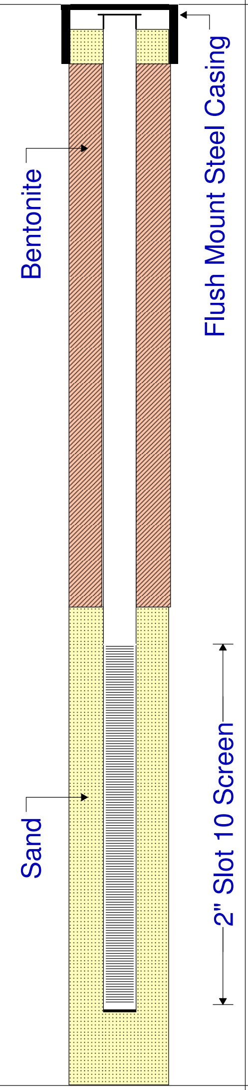
Privileged and Confidential

LOG OF WELL: XCG-14(MW)

Driller: JED Anchors & Environmental
Drill Method: Solid Stem
Sample Method: N/A

Borehole Diameter: 0.15 m
Start Date: December 5, 2016
Completed: December 5, 2016
Checked By: EM
Logged By: MCL

Depth	Graphic Log	Geology Description	Depth/Elev (m)	Well Completion	Well Details
ft m		Ground Surface	880.7		
0 0 2 4		***Topsoil*** Dark brown with some silt and sand. Dry. No staining or odour.	879.5		
6 2 8 10 12 4 14 16 18 20 6 22 24 26 8 28		***Clay*** Dark brown. Decreasing sand starting at 1.4 metres bgs. Increasing moisture starting at 1.5 metres bgs. No staining or odour. Wet at 5.5 metres bgs. Unstable at 8.5 metres bgs. Note that hole collapsed at 8.5 to 9 metres bgs.	871.6		
30 32		End of Borehole			



Groundwater Elevation: N/A
T.O.C. Elevation: 880.719
Ground Surface Elevation: 880.719

Monitoring Well Log
For Environmental Purposes Only

Screening Tool: N/A

Sheet: 1 of 1

APPENDIX B

TOPOGRAPHIC MAP

CLIENT: THE CITY OF RED DEER

PROJECT: PHASE I HISTORIC WASTE DISPOSAL SITES
MONTFORT PTN NE 20-38-27 W4M

TITLE: SITE PLAN SHOWING SURROUNDING LAND USE

Tiamat Environmental Consultants Ltd.

SCALE: 1 : 5000	DATE: JUNE 6/13	PROJECT NO.: 12-435	FIGURE NO.: FIGURE 1
DRAWN BY: LCH	CHECKED BY: LTM	CAD FILE NO.: site plan v1.02.dwg	

APPENDIX C

SITE SPECIFIC SOIL VAPOUR CRITERIA

Table C1 Toxicity Reference Values

(List of chemicals is based on parameters with detectable levels in groundwater and soil vapour from Tiamat Environmental Consultants Ltd., Environmental Risk Management Plan (ERMP) and Phase II ESA- Montfort Landfill Site, City of Red Deer)

Chemical	Carcinogen		Toxicity Reference Value (TRV)				Source Allocation Factor
			Tolerable Concentration (TC) (mg/m^3)	Reference	Inhalation Unit Risk (UR) (mg/m^3)$^{-1}$	Reference	
trans-1,2-dichloroethylene	N/E		0.009	IRIS 2010 adopted from Oral TRV 0.002 mg/kg/d	-		0.2
1,2-dibromoethane	Likely Carcinogen		0.009	IRIS 2004	0.0006	IRIS 2004	0.2
1,2-dichlorobenzene	N/E		1.92411	Alberta Env [HC (2004) estimated from Oral]	-		0.2
styrene	N/E		0.092	Alberta Env [HC (2004)]	-		0.5
1,3,5-trichlorobenzene	N/E		0.0036	Alberta Env [HC (2004)]	-		0.2
1,1,2-trichloroethane	Possible Carcinogen		0.018	USEPA 1995 adopted from Oral TRV of 0.004 mg/kg/day	0.000016	USEPA 1995	0.2
Ethane	N/E		813	Occupational Exposure Limit (1000 ppm)	-		
Ethylene	Non-Carcinogen		174	Occupational Exposure Limit (200 ppm)	-		
Methane	Non-Carcinogen		-		-		
Propane	Non-Carcinogen		1800	Occupational Exposure Limit (1000 ppm)	-		1
Dichlorodifluoromethane (Freon 12)	Non-Carcinogen		0.89	IRIS 1987 adopted from Oral TRV 0.2 mg/kg/d	-		0.2
1,2-dichlorotetrafluorethane (R114)	N/E		7000	Alberta ENV - Occupational Exposure Limit	-		1
Chloromethane	Non-Carcinogen		0.09	IRIS 2001	-		0.2
Vinyl Chloride	Carcinogen		0.1	Alberta Env [USEPA (2006)]	0.0088	Alberta Env [USEPA (2006)]	0.2
Chloroethane	N/E		10	IRIS 1991	-		0.2
Trichlorofluormethane (Freon 11)	Non-Carcinogen		1	(Subchronic) [PPRTV Provisional Peer Review]	-		0.2
Ethanol (Ethyl Alcohol)	Carcinogen		1900	ACGIH exposure Limit (1000 ppm)	-		1
2-Propanol (isopropyl alcohol)	N/E		491	ACGIH exposure Limit (400 ppm)	-		1
2-Propanone (acetone)	N/E		3.09E+01	ATSDR	-		0.2
Methyl Ethyl Ketone (2-Butanone)	N/E	Developmental Effects	5	IRIS 2003	-		0.2
1,4-dichlorobenzene	Possible Carcinogen		0.095	Alberta Env [Health Canada 2004]			0.2
1,1,-dichloroethane	Possible Carcinogen		1.65E-01	MOECC (modified from HEAST 1984)	-		0.2
1,1,-dichlorethylene	Possible Carcinogen		0.2	Alberta Env [USEPA (2006)]	-		0.2
cis-1,2-dichloroethylene	N/E		0.009	IRIS 2010 adopted from Oral TRV 0.002 mg/kg/d	-		0.2
methylene chloride (dichloromethane)	Possible Carcinogen		3	Alberta Env [ORNL (2006)]	0.000023	Alberta Env [HC (2004b)]	0.2
chloroform	Possible Carcinogen		0.028	(modified from HC 2006 oral TDI)	-		0.2
1,1,1-trichloroethane	N/E		1	MOECC (Cal EPA chREL 2000)	-		0.2
trichloroethylene (updated)	Carcinogen	Developmental Effects	0.04	Alberta Env [CCME 2006]	0.00061	Alberta Env [CCME 2006]	0.2
tetrachloroethylene	Carcinogen		0.04	USEPA IRIS 2012	0.00026	USEPA IRIS 2012	0.2
benzene	Carcinogen		0.03	MOECC (IRIS 2003)	0.0033	Alberta Env [HC (2004b)]	0.2
toluene	Non-Carcinogen		3.8	Alberta Env [HC (2004b)]	-		0.5
PHC F1							
Aliphatic C6-C8	Non-Carcinogen		18.4	CCME 2008	-		0.5
Aliphatic C8-C10	Non-Carcinogen		1	CCME 2008	-		0.5
Aromatic C8-C10	Non-Carcinogen		0.2	CCME 2008	-		0.5
PHC F2							
Aliphatic C10-C12	Non-Carcinogen		1	CCME 2008	-		0.5
Aliphatic C12-C16	Non-Carcinogen		1	CCME 2008	-		0.5
Aromatic C10-C12	Non-Carcinogen		0.2	CCME 2008	-		0.5
Aromatic C12-C16	Non-Carcinogen		0.2	CCME 2008	-		0.5
ethylbenzene	Possible Carcinogen	Developmental Effects	1	Alberta Env [USEPA (2006)]	-		0.5
total xylenes	Non-carcinogen		0.18	Alberta Env [HC (2004b)]	-		0.5
1,3,5-trimethylbenzene	Non-carcinogen		0.02	IRIS 2012b DRAFT	-		0.2
1,2,4-trimethylbenzene	Non-carcinogen		0.02	IRIS 2012b DRAFT	-		0.2
hexane	Non-carcinogen		0.7	CCME 2011	-		0.2
heptane	N/E		0.4	PPRTV [PPRTV Provisional Peer Review]	-		0.2
cyclohexane	N/E		6	IRIS 2003	-		0.2
tetrahydrofuran	Possible Carcinogen		2	IRIS 2012	-		0.2
propene	N/E		3	CalEPA	-		0.2
2,2,4-trimethylpentane	N/E		64.2	ACGIH exposure Limit (300 ppm)	-		1
carbon disulfide	Non-carcinogen		0.1	Health Canada	-		0.2
trimethylsilyl fluoride	N/E						
trimethylsilanol	N/E						
hexamethyl cyclotrisolxane - D3	N/E						
octamethyl cyclotetrasiloxane -D4	N/E						
decamethyl cyclopentasiloxane - D5	N/E						
dodecamethyl cyclohexasiloxane - D6	N/E						

Notes

N/E Not Evaluated

Table C2 Indoor Air Quality Criteria

Non Cancer

$$\text{Indoor Air Concentration} = \frac{TC \text{ X } SAF \text{ X } C}{\text{Non Cancer Pro-rating Factor}}$$

Cancer

$$\text{Indoor Air Concentration} = \frac{CRL \text{ x } C}{\text{Cancer Pro-rating Factor x } IUR}$$

where:

Indoor Air Concentration	$\mu g/m^3$	Allowable Indoor Air Concentration
TC	mg/m^3	Tolerable Concentration
IUR	$(mg/m^3)^{-1}$	Inhalation Unit Risk
SAF		Source Allocation Factor
CRL		Cancer Risk Level (assume 1 x 10^{-5})
C		1,000 µg/mg conversion factor
Pro-rating Factor		Assume no pro-rating for screening level criteria = 1

Developmental Effects

Parameters with inhalation chronic non-cancer toxicity reference values based on reproductive or developmental effects are not pro-rated for exposure.
Default exposure is set as 1.

Chemical	Tolerable Concentration (TC) (mg/m^3)	Inhalation Unit Risk (UR) $(mg/m^3)^{-1}$	Notes	Indoor Air Criteria (ug/m3)		
				threshold	non-threshold	Lowest Risk Level
trans-1,2-dichloroethylene	0.009	-		1.79E+00		1.79E+00
1,2-dibromoethane	0.009	0.0006		1.80E+00	1.67E+01	1.80E+00
1,2-dichlorobenzene	1.924	-		3.85E+02		3.85E+02
styrene	0.092	-		4.60E+01		4.60E+01
1,3,5-trichlorobenzene	0.004	-		7.20E-01		7.20E-01
1,1,2-trichloroethane	0.018	0.000016		3.58E+00	6.25E+02	3.58E+00
Ethane	813	-				1000 ppm (8.13E+5 ug/m3)
Ethylene	174	-				200 ppm (1.74 E+05 ug/m3)
Methane	-	-				2500 to 5000 ppmv (5 to <10 % LEL)
Propane	1800	-		1.80E+06		1000 ppm (1.8 E+6 ug/m3)
Dichlorodifluoromethane (Freon 12)	0.89	-		1.78E+02		1.78E+02
1,2-dichlorotetrafluorethane (R114)	7000	-		7.00E+06		1000 ppm (7.0E+6 ug/m3)
Chloromethane	0.09	-		1.80E+01		1.80E+01
Vinyl Chloride	0.1	0.0088		2.00E+01	1.14E+00	1.14E+00
Chloroethane	10	-		2.00E+03		2.00E+03
Trichlorofluormethane (Freon 11)	1	-		2.00E+02		2.00E+02
Ethanol (Ethyl Alcohol)	1900	-		1.90E+06		1.90E+06
2-Propanol (isopropyl alcohol)	491	-		4.91E+05		4.91E+05
2-Propanone (acetone)	30.9	-		6.18E+03		6.18E+03
Methyl Ethyl Ketone (2-Butanone)	5	-	Developmental Effects	1.00E+03		1.00E+03
1,4-dichlorobenzene	0.095			1.90E+01		1.90E+01
1,1,-dichloroethane	0.165	-		3.30E+01		3.30E+01
1,1,-dichlorethylene	0.2	-		4.00E+01		4.00E+01
cis-1,2-dichloroethylene	0.008949367	-		1.79E+00		1.79E+00
methylene chloride (dichloromethane)	3	0.000023		6.00E+02	4.35E+02	4.35E+02
chloroform	0.028	-		5.60E+00		5.60E+00
1,1,1-trichloroethane	1	-		2.00E+02		2.00E+02
trichloroethylene (updated)	0.04	0.00061		8.00E+00	1.64E+01	8.00E+00
tetrachloroethylene	0.04	0.00026	Developmental Effects	8.00E+00	3.85E+01	8.00E+00
benzene	0.03	0.0033		6.00E+00	3.03E+00	3.03E+00
toluene	3.8	-		1.90E+03		1.90E+03
PHC F1			CCME Soil Subfractions (Tier 1 Table C-10) used to derive F1 criteria			5.95E+02
Aliphatic C6-C8	18.4	-		9.20E+03		9.20E+03
Aliphatic C8-C10	1	-		5.00E+02		5.00E+02
Aromatic C8-C10	0.2	-		1.00E+02		1.00E+02
PHC F2			CCME Soil Subfractions (Tier 1 Table C-10) used to derive F1 criteria			2.78E+02
Aliphatic C10-C12	1	-		5.00E+02		5.00E+02
Aliphatic C12-C16	1	-		5.00E+02		5.00E+02
Aromatic C10-C12	0.2	-		1.00E+02		1.00E+02
Aromatic C12-C16	0.2	-		1.00E+02		1.00E+02
ethylbenzene	1	-		5.00E+02		5.00E+02
total xylenes	0.18	-		9.00E+01		9.00E+01
1,3,5-trimethylbenzene	0.02	-		4.00E+00		4.00E+00
1,2,4-trimethylbenzene	0.02	-		4.00E+00		4.00E+00
hexane	0.7	-		1.40E+02		1.40E+02
heptane	0.4	-		8.00E+01		8.00E+01
cyclohexane	6	-		1.20E+03		1.20E+03
tetrahydrofuran	2	-		4.00E+02		4.00E+02
propene	3	-		6.00E+02		6.00E+02
2,2,4-trimethylpentane	64.2	-		6.42E+04		6.42E+04
carbon disulfide	0.1	-		2.00E+01		2.00E+01
trimethylsilyl fluoride						
trimethylsilanol						
hexamethyl cyclotrisolxane - D3						
octamethyl cyclotetrasiloxane -D4						
decamethyl cyclopentasiloxane - D5						
dodecamethyl cyclohexasiloxane - D6						

1. Methane screening will be completed in accordance with Table 7, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services)

2. Ethane, Ethylene, Ethanol, 2-Propanol, Propane, 1,2-dichlorotetrafluorethane (R114), and 2,2,4-trimethylpentane criteria adopted from Occupational Exposure Limits (PEL), assume no dilution/attenuation

Table C3 Derive Acceptable Soil Vapour Concentrations (Soil Vapour Screening Levels)

Deminimus Soil Vapour Criteria were calculated as follows:

$$Csv_{Deminimus} = \frac{Cair}{alpha}$$

where
$Csv_{Deminimus}$ = Deminimus Concentration of Soil Vapour
Cair = Health Based Indoor Air Criteria (based on toxicity reference values)
Deminimus Alpha = 0.01 (default, as per Alberta Environment)

Chemical	**Deminimus Screening**	**Deminimus Screening**
	Soil Vapour Screening (µg/m^3)	***Soil Vapour Screening (µg/m^3)***
trans-1,2-dichloroethylene	**1.79E+02**	**179**
1,2-dibromoethane	**1.80E+02**	**180**
1,2-dichlorobenzene	**3.85E+04**	**38482**
styrene	**4.60E+03**	**4600**
1,3,5-trichlorobenzene	**7.20E+01**	**72**
1,1,2-trichloroethane	**3.58E+02**	**358**
Ethane	**1000 ppm**	**1000 ppm**
Ethylene	**200 ppm**	**200 ppm**
Methane	**1000 to 5000 ppmv**	**1000 to 5000 ppmv**
Propane	**1.80E+06**	**1800000**
Dichlorodifluoromethane (Freon 12)	**1.78E+04**	**17800**
1,2-dichlorotetrafluorethane (R114)	**7.00E+06**	**7000000**
Chloromethane	**1.80E+08**	**1800**
Vinyl Chloride	**1.14E+02**	**114**
Chloroethane	**2.00E+05**	**200000**
Trichlorofluormethane (Freon 11)	**2.00E+04**	**20000**
Ethanol (Ethyl Alcohol)	**1.90E+06**	**1900000**
2-Propanol (isopropyl alcohol)	**4.91E+05**	**491000**
2-Propanone (acetone)	**6.18E+05**	**618000**
Methyl Ethyl Ketone (2-Butanone)	**1.00E+05**	**100000**
1,4-dichlorobenzene	**1.90E+03**	**1900**
1,1,-dichloroethane	**3.30E+03**	**3300**
1,1,-dichlorethylene	**4.00E+03**	**4000**
cis-1,2-dichloroethylene	**1.79E+02**	**179**
methylene chloride (dichloromethane)	**4.35E+04**	**43478**
chloroform	**5.60E+02**	**560**
1,1,1-trichloroethane	**2.00E+04**	**20000**
trichloroethylene (updated)	**8.00E+02**	**800**
tetrachloroethylene	**8.00E+02**	**800**
benzene	**3.03E+02**	**303**
toluene	**1.90E+05**	**190000**
PHC F1	**5.95E+04**	**59532**
Aliphatic C6-C8	**9.20E+05**	**920000**
Aliphatic C8-C10	**5.00E+04**	**50000**
Aromatic C8-C10	**1.00E+04**	**10000**
PHC F2	**2.78E+04**	**27778**
Aliphatic C10-C12	**5.00E+04**	**50000**
Aliphatic C12-C16	**5.00E+04**	**50000**
Aromatic C10-C12	**1.00E+04**	**10000**
Aromatic C12-C16	**1.00E+04**	**10000**
ethylbenzene	**5.00E+04**	**50000**
total xylenes	**9.00E+03**	**9000**
1,3,5-trimethylbenzene	**4.00E+02**	**400**
1,2,4-trimethylbenzene	**4.00E+02**	**400**
hexane	**1.40E+04**	**14000**
heptane	**8.00E+03**	**8000**
cyclohexane	**1.20E+05**	**120000**
tetrahydrofuran	**4.00E+04**	**40000**
propene	**6.00E+04**	**60000**
2,2,4-trimethylpentane	**6.42E+04**	**64173**
carbon disulfide	**2.00E+03**	**2000**

Notes

1. Methane screening will be completed in accordance with Table 6, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services)

2. Ethane, Ethylene, Ethanol, 2-Propanol, Propane, 1,2-dichlorotetrafluorethane (R114), and 2,2,4-trimethylpentane criteria adopted from Occupational Exposure Limits (PEL), assume no dilution/attenuation

Table C4 Groundwater to Indoor Air Risk Evaluation

Calculate Indoor Air Exposure from Groundwater Concentration

$$Cair = \frac{\text{Cgw x H' x ET x C}}{\frac{1}{alpha}}$$

where

Cair = Concentration in indoor air (calculated exposure value) mg/m3
Cgw = Measured Maximum Concentration of Groundwater mg/L
alpha = vapour attenuation factor (deminimus = 0.01)
alpha = 0.01 for all receptor groups to account for perched shallow groundwater

ET = Exposure Term (pro-rating value)
C = conversion term 10^3 convert m^3 to L

Pro-rating Factors for Receptor Groups (Cancer and non-Cancer)

Consistent with AEP, Tier 1 Guidance

De Minimis	Pro-rating factor = **1**	24 hours/day, 365 days/year
Residential	Pro-rating factor = **1**	24 hours/day, 365 days/year
Institutional (schools)	Pro-rating factor = **1**	24 hours/day, 365 days/year
Commercial (including food establishments)	Pro-rating factor = **0.2747**	10 hours/day, 5 days week, 48 weeks/year
Construction/utility workers	Pro-rating factor = **0.2747**	10 hours/day, 5 days week, 48 weeks/year

Risk Calculation

Non-Cancer Hazard Quotient

Hazard Quotient (HQ) = Indoor Air Conc./Tolerable Concentration

Acceptable HQ is less than 0.2

Cancer Risk

Cancer Risk = Inhalation Unit Risk x Indoor Air Conc.

Acceptable Cancer Risk is less than 1 x 10-5

						De Minimis			Residential			Institutional			Commercial (including food)			Construction/Utility Worker		
Chemical	**Tolerable Concentration (TC) (mg/m^3)**	**Inhalation Unit Risk (UR) $(mg/m^3)^{-1}$**	**Henry's Law Constant (dimensionless)**	**Maximum Measured Groundwater Concentration (ug/m3) (ug/L)**	**Maximum Measured Groundwater Concentration (ug/m3) (mg/L)**	**Calculated De Minimis Exposure (Indoor Air) (mg/m3)**	**Hazard Quotient**	**Cancer Risk**	**Calculated Daily Exposure (Indoor Air) (mg/m^3)**	**Hazard Quotient**	**Cancer Risk**	**Calculated Daily Exposure (Indoor Air) (mg/m^3)**	**Hazard Quotient**	**Cancer Risk**	**Calculated Daily Exposure (Indoor Air) (mg/m^3)**	**Hazard Quotient**	**Cancer Risk**	**Calculated Daily Exposure (Trench Air)[1] (mg/m^3)**	**Hazard Quotient**	**Cancer Risk**
Vinyl Chloride	0.1	0.0088	1.11	39	0.039	4.33E-01	**4.33E+00**	**3.81E-03**	4.33E-01	**4.33E+00**	**3.81E-03**	4.33E-01	**4.33E+00**	**3.81E-03**	1.19E-01	**1.19E+00**	**1.05E-03**	3.22E-05	3.22E-04	2.83E-07
1,4-dichlorobenzene	0.095		9.66E-02	1.2	0.0012	1.16E-03	1.22E-02		1.16E-03	1.22E-02		1.16E-03	1.22E-02		3.18E-04	3.35E-03		5.56E-10	5.86E-09	
trichloroethylene (updated)	0.04	0.00061	0.422	7.4	0.0074	3.12E-02	**7.81E-01**	**1.90E-05**	3.12E-02	**7.81E-01**	**1.90E-05**	3.12E-02	**7.81E-01**	**1.90E-05**	8.58E-03	**2.14E-01**	5.23E-06	3.65E-07	9.11E-06	2.22E-10
benzene	0.03	0.0033	0.225	4.8	0.0048	1.08E-02	**3.60E-01**	**3.56E-05**	1.08E-02	**3.60E-01**	**3.56E-05**	1.08E-02	**3.60E-01**	**3.56E-05**	2.97E-03	9.89E-02	9.79E-06	3.82E-08	1.27E-06	1.26E-10
ethylbenzene	1	-	0.358	58	0.058	2.08E-01	**2.08E-01**		2.08E-01	**2.08E-01**		2.08E-01	**2.08E-01**		5.70E-02	5.70E-02		1.40E-05	1.40E-05	
total xylenes	0.18	-	0.252	45	0.045	1.13E-01	**6.30E-01**		1.13E-01	**6.30E-01**		1.13E-01	**6.30E-01**		3.12E-02	**1.73E-01**		1.59E-07	8.82E-07	

Notes:

1. Table C8 shows the derivation of the calculated daily exposure of trench air for the utility worker.

Bold and Shaded Criteria exceeds HQ value of 0.2 or Cancer Risk Value of 1 x 10-5

Methane screening was completed in accordance with Table 7, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services) and was therefore not included in the Risk Evaluation.

Table C5 Soil Vapour Risk Evaluation

Pro-rating Factors for Receptor Groups (Cancer and non-Cancer)
Consistent with AEP, Tier 1 Guidance

De Minimis = No Pro-rating	=	1	24 hours/day, 365 days/year
Residential	Pro-rating factor =	**1**	24 hours/day, 365 days/year
Institutional (schools)	Pro-rating factor =	**1**	24 hours/day, 365 days/year
Commercial (including food establ	Pro-rating factor =	**0.2747**	10 hours/day, 5 days week, 48 weeks/year
Construction/utility workers	Pro-rating =	**0.2747**	10 hours/day, 5 days week, 48 weeks/year

Calculate Indoor Air Exposure from Soil Vapour Concentration

$Cair$ = Csv x alpha x ET

where
Cair = Concentration in indoor air (calculated exposure value)
Csv = Measured Concentration of Soil Vapour
alpha = vapour attenuation factor (deminimus = 0.01)
alpha = 0.01 for all receptor groups to account for perched shallow groundwater and no source depletion.
ET = Exposure Term (pro-rating value)
Source, Alberta Tier 1 Soil and Groundwater Remediation Guidelines, February 2016.

Calculate Trench Air Exposure from Soil Vapour Concentration

$Ctrench\ air$ = Csv x AF x ET

where
Cair trench = Concentration in trench air (calculated exposure value)
Csv = Measured Concentration of Soil Vapour
AF = Attenuation Factor = 0.09 (conservative attenuation factor assuming narrow trench with shallow vapour source)
ET = Exposure Term (pro-rating value)
Source, CSAP Technical Review #18, Soil Vapour Attenuation Factors for Trench Workers, prepare by Meridian Environmental Inc., dated December 2012.

Risk Calculation

Non-Cancer Hazard Quotient

Hazard Quotient (HQ) = Indoor Air Conc./Tolerable Concentration
Acceptable HQ is less than 0.2

Cancer Risk

Cancer Risk = Inhalation Unit Risk x Indoor Air Conc.
Acceptable Cancer Risk is less than 1 x 10-5

					De Minimis			Residential			Institutional			Commercial (including food)			Construction/Utility Worker		
Chemical	Tolerable Concentration (TC)	Inhalation Unit Risk (UR)	Measured Soil Vapour Concentration (ug/m3)	Measured Soil Vapour Concentration (ug/m3)	Calculated De Minimis Exposure (Indoor Air)	Hazard Quotient	Cancer Risk	Calculated Daily Exposure (Indoor Air)	Hazard Quotient	Cancer Risk	Calculated Daily Exposure (Indoor Air)	Hazard Quotient	Cancer Risk	Calculated Daily Exposure (Indoor Air)	Hazard Quotient	Cancer Risk	Calculated Daily Exposure (Trench Air)	Hazard Quotient	Cancer Risk
	(mg/m^3)	(mg/m^3)$^{-1}$	(ug/m^3)	(mg/m^3)				(mg/m^3)			(mg/m^3)			(mg/m^3)			(mg/m^3)		
trans-1,2-dichloroethylene	0.009	-	5.49	0.00549	5.49E-05	6.13E-03		5.49E-05	6.13E-03		5.49E-05	6.13E-03		1.51E-05	1.69E-03		1.36E-04	1.52E-02	
1,2-dibromoethane	0.009	0.0006	0.768	0.000768	7.68E-06	8.53E-04	4.61E-09	7.68E-06	8.53E-04	4.61E-09	7.68E-06	8.53E-04	4.61E-09	2.11E-06	2.34E-04	1.27E-09	1.90E-05	2.11E-03	1.14E-08
1,2-dichlorobenzene	1.92411	-	0.601	0.000601	6.01E-06	3.12E-06		6.01E-06	3.12E-06		6.01E-06	3.12E-06		1.65E-06	8.58E-07		1.49E-05	7.72E-06	
styrene	0.092	-	2.41	0.00241	2.41E-05	2.62E-04		2.41E-05	2.62E-04		2.41E-05	2.62E-04		6.62E-06	7.20E-05		5.96E-05	6.48E-04	
1,3,5-trichlorobenzene	0.0036	-																	
1,1,2-trichloroethane	0.018	0.000016	0.546	0.000546	5.46E-06	3.05E-04	8.74E-11	5.46E-06	3.05E-04	8.74E-11	5.46E-06	3.05E-04	8.74E-11	1.50E-06	8.38E-05	2.40E-11	1.35E-05	7.54E-04	2.16E-10
Ethane	813	-																	
Ethylene	174	-																	
Methane	-	-																	
Propane	1800	-																	
Dichlorodifluoromethane (Freon 12)	0.89	-	2950	2.95	2.95E-02	3.31E-02		2.95E-02	3.31E-02		2.95E-02	3.31E-02		8.10E-03	9.11E-03		7.29E-02	8.19E-02	
1,2-dichlorotetrafluorethane (R114)	7000	-	1790	1.79	1.79E-02	2.56E-06		1.79E-02	2.56E-06		1.79E-02	2.56E-06		4.92E-03	7.02E-07		4.43E-02	6.32E-06	
Chloromethane	0.09	-	4.39	0.00439	4.39E-05	4.88E-04		4.39E-05	4.88E-04		4.39E-05	4.88E-04		1.21E-05	1.34E-04		1.09E-04	1.21E-03	
Vinyl Chloride	0.1	0.0088	1250	1.25	1.25E-02	1.25E-01	**1.10E-04**	1.25E-02	1.25E-01	**1.10E-04**	1.25E-02	1.25E-01	**1.10E-04**	3.43E-03	3.43E-02	**3.02E-05**	3.09E-02	**3.09E-01**	**2.72E-04**
Chloroethane	10	-	23.2	0.0232	2.32E-04	2.32E-05		2.32E-04	2.32E-05		2.32E-04	2.32E-05		6.37E-05	6.37E-06		5.74E-04	5.74E-05	
Trichlorofluormethane (Freon 11)	1	-	5.92	0.00592	5.92E-05	5.92E-05		5.92E-05	5.92E-05		5.92E-05	5.92E-05		1.63E-05	1.63E-05		1.46E-04	1.46E-04	
Ethanol (Ethyl Alcohol)	1900	-	180	0.18	1.80E-03	9.47E-07		1.80E-03	9.47E-07		1.80E-03	9.47E-07		4.94E-04	2.60E-07		4.45E-03	2.34E-06	
2-Propanol (isopropyl alcohol)	491	-	2.46	0.00246	2.46E-05	5.01E-08		2.46E-05	5.01E-08		2.46E-05	5.01E-08		6.76E-06	1.38E-08		6.08E-05	1.24E-07	
2-Propanone (acetone)	3.09E+01	-	47.5	0.0475	4.75E-04	1.54E-05		4.75E-04	1.54E-05		4.75E-04	1.54E-05		1.30E-04	4.22E-06		1.17E-03	3.80E-05	
Methyl Ethyl Ketone (2-Butanone)	5	-	6.19	0.00619	6.19E-05	1.24E-05		6.19E-05	1.24E-05		6.19E-05	1.24E-05		1.70E-05	3.40E-06		1.53E-04	3.06E-05	
1,4-dichlorobenzene	0.095		0.601	0.000601	6.01E-06	6.33E-05		6.01E-06	6.33E-05		6.01E-06	6.33E-05		1.65E-06	1.74E-05		1.49E-05	1.56E-04	
1,1,-dichlorethylene	0.2	-	5.72	0.00572	5.72E-05	2.86E-04		5.72E-05	2.86E-04		5.72E-05	2.86E-04		1.57E-05	7.86E-05		1.41E-04	7.07E-04	
cis-1,2-dichloroethylene	0.009	-	223	0.223	2.23E-03	**2.49E-01**		2.23E-03	**2.49E-01**		2.23E-03	**2.49E-01**		6.13E-04	6.84E-02		5.51E-03	**6.16E-01**	
methylene chloride (dichloromethane)	3	0.000023	2.78	0.00278	2.78E-05	9.27E-06	6.39E-10	2.78E-05	9.27E-06	6.39E-10	2.78E-05	9.27E-06	6.39E-10	7.64E-06	2.55E-06	1.76E-10	6.87E-05	2.29E-05	1.58E-09
chloroform	0.028	-	21.2	0.0212	2.12E-04	7.57E-03		2.12E-04	7.57E-03		2.12E-04	7.57E-03		5.82E-05	2.08E-03		5.24E-04	1.87E-02	
1,1,1-trichloroethane	1	-	0.937	0.000937	9.37E-06	9.37E-06		9.37E-06	9.37E-06		9.37E-06	9.37E-06		2.57E-06	2.57E-06		2.32E-05	2.32E-05	
trichloroethylene (updated)	0.04	0.00061	11.7	0.0117	1.17E-04	2.93E-03	7.14E-08	1.17E-04	2.93E-03	7.14E-08	1.17E-04	2.93E-03	7.14E-08	3.21E-05	8.03E-04	1.96E-08	2.89E-04	7.23E-03	1.76E-07
tetrachloroethylene	0.04	0.00026	12.6	0.0126	1.26E-04	3.15E-03	3.28E-08	1.26E-04	3.15E-03	3.28E-08	1.26E-04	3.15E-03	3.28E-08	3.46E-05	8.65E-04	9.00E-09	3.12E-04	7.79E-03	8.10E-08
benzene	0.03	0.0033	1.35	0.00135	1.35E-05	4.50E-04	4.46E-08	1.35E-05	4.50E-04	4.46E-08	1.35E-05	4.50E-04	4.46E-08	3.71E-06	1.24E-04	1.22E-08	3.34E-05	1.11E-03	1.10E-07
toluene	3.8	-	6.61	0.00661	6.61E-05	1.74E-05		6.61E-05	1.74E-05		6.61E-05	1.74E-05		1.82E-05	4.78E-06		1.63E-04	4.30E-05	
PHC F1	1.19		5830	5.83	5.83E-02	4.90E-02		5.83E-02	4.90E-02		5.83E-02	4.90E-02		1.60E-02	1.35E-02		1.44E-01	1.21E-01	
Aliphatic C6-C8	18.4	-		0															
Aliphatic C8-C10	1	-		0															
Aromatic C8-C10	0.2	-		0															
PHC F2	0.56		972	0.972	9.72E-03	1.75E-02		9.72E-03	1.75E-02		9.72E-03	1.75E-02		2.67E-03	4.81E-03		2.40E-02	4.33E-02	
Aliphatic C10-C12	1	-		0															
Aliphatic C12-C16	1	-		0															
Aromatic C10-C12	0.2	-		0															
Aromatic C12-C16	0.2	-		0															
ethylbenzene	1	-	0.434	0.000434	4.34E-06	4.34E-06		4.34E-06	4.34E-06		4.34E-06	4.34E-06		1.19E-06	1.19E-06		1.07E-05	1.07E-05	
o-xylene	-			0															
m-xylene	-			0															
p-xylene	-			0															
total xylenes	0.18	-	1.74	0.00174	1.74E-05	9.67E-05		1.74E-05	9.67E-05		1.74E-05	9.67E-05		4.78E-06	2.66E-05		4.30E-05	2.39E-04	
1,3,5-trimethylbenzene	0.02	-	2.46	0.00246	2.46E-05	1.23E-03		2.46E-05	1.23E-03		2.46E-05	1.23E-03		6.76E-06	3.38E-04		6.08E-05	3.04E-03	
1,2,4-trimethylbenzene	0.02	-	2.46	0.00246	2.46E-05	1.23E-03		2.46E-05	1.23E-03		2.46E-05	1.23E-03		6.76E-06	3.38E-04		6.08E-05	3.04E-03	
hexane	0.7	-	7.14	0.00714	7.14E-05	1.02E-04		7.14E-05	1.02E-04		7.14E-05	1.02E-04		1.96E-05	2.80E-05		1.77E-04	2.52E-04	
heptane	0.4	-	1.92	0.00192	1.92E-05	4.80E-05		1.92E-05	4.80E-05		1.92E-05	4.80E-05		5.27E-06	1.32E-05		4.75E-05	1.19E-04	
cyclohexane	6	-	92.6	0.0926	9.26E-04	1.54E-04		9.26E-04	1.54E-04		9.26E-04	1.54E-04		2.54E-04	4.24E-05		2.29E-03	3.82E-04	
tetrahydrofuran	2	-	1.18	0.00118	1.18E-05	5.90E-06		1.18E-05	5.90E-06		1.18E-05	5.90E-06		3.24E-06	1.62E-06		2.92E-05	1.46E-05	
propene	3	-	89.2	0.0892	8.92E-04	2.97E-04		8.92E-04	2.97E-04		8.92E-04	2.97E-04		2.45E-04	8.17E-05		2.21E-03	7.35E-04	
2,2,4-trimethylpentane	64.2	-	8.17	0.00817	8.17E-05	1.27E-06		8.17E-05	1.27E-06		8.17E-05	1.27E-06		2.24E-05	3.50E-07		2.02E-04	3.15E-06	
carbon disulfide	0.1	-	25.7	0.0257	2.57E-04	2.57E-03		2.57E-04	2.57E-03		2.57E-04	2.57E-03		7.06E-05	7.06E-04		6.35E-04	6.35E-03	

Notes:
Bold and Shaded Criteria exceeds HQ value of 0.2 or Cancer Risk Value of 1 x 10-5
Methane screening was completed in accordance with Table 7, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services) and was therefore not included in the Risk Evaluation.

Table C6 Soil Vapour Risk Evaluation by Probe Location (Primary Contaminants of Concern - Residential Recptor)

Sample ID	**Units**	**Soil Vapour Probes**												
		VW-01	**VW-03**	**VW-05**		**XCG-1(SVP)**	**XCG-2(SVP)**	**XCG-4(SVP)**	**XCG-5(SVP)**	**XCG-6(SVP)**	**XCG-9(SVP)**	**XCG-10(SVP)**	**XCG-12(SVP)**	**XCG-13(SVP)**
Laboratory		**Maxxam**	**Maxxam**	**Maxxam**		**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**	**Maxxam**
Canister number		**332**	**1280**	**1800**	**3017**	**1470**	**243**	**1281**	**1380**	**238**	**333**	**354**	**262**	**354**
Laboratory ID		**EBG095**	**EBG097**	**EBG090**	**EBG091**	**EBG092**	**EBG089**	**EBG086**	**EBG085**	**EBG088**	**EBG096**	EBG094	**EBG087**	**EBG093**
Date Sampled		**12-Mar-17**	**12-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**11-Mar-17**	**14-Mar-17**	**14-Mar-17**	**13-Mar-17**	**11-Mar-17**	**12-Mar-17**	**14-Mar-17**	**12-Mar-17**
Vinyl Chloride (Measured Soil Vapour Concentration)	ug/m3	<0.256	<0.256	**1180**	**1250**	<0.256	<0.256	21.8	<0.256	**154**	<0.256	<0.10	<0.256	**114**
Hazard Quotient		NA	NA	0.12	0.13	NA	NA	0.002	NA	0.02	NA	NA	NA	0.01
Cancer Risk		NA	NA	**1.04E-04**	**1.10E-04**	NA	NA	1.92E-06	NA	**1.36E-05**	NA	NA	NA	**1.00E-05**
cis-1,2-Dichloroethylene (Measured Soil Vapour Concentration)	ug/m3	<0.396	1.39	91.0	90.6	<0.396	<0.396	<0.396	<0.396	6.99	<0.396	0.59	<0.396	**223**
Hazard Quotient		NA	0.0016	0.1017	0.1012	NA	NA	NA	NA	0.0078	NA	0.0007	NA	**0.249**
Cancer Risk		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Notes:														
Bold and Shaded	Criteria exceeds HQ value of 0.2 or Cancer Risk Value of 1 x 10-5													

Toxicity Reference Values

Chemical	**Tolerable Concentration (TC) (mg/m^3)**	**Inhalation Unit Risk (UR) (mg/m^3)$^{-1}$**
Vinyl Chloride	0.1	0.0088
cis-1,2-dichloroethylene	0.009	-

Table C7 Indoor Air Risk Evaluation

Indoor Air Criteria Calculation

Non Cancer

$$\text{Allowable Indoor Air Concentration} = \frac{\text{TC X SAF X C}}{\text{Non Cancer Pro-rating Factor}}$$

Cancer

$$\text{Allowable Indoor Air Concentration} = \frac{\text{CRL x C}}{\text{Cancer Pro-rating Factor x IUR}}$$

where:

Indoor Air Concentration	$\mu g/m^3$	Allowable Indoor Air Concentration
TC	mg/m^3	Tolerable Concentration
IUR	$(mg/m^3)^{-1}$	Inhalation Unit Risk
SAF		Source Allocation Factor
CRL		Cancer Risk Level (assume 1×10^{-5})
C		1,000 µg/mg conversion factor
Pro-rating Factor		Assume no pro-rating for residential setting = 1 (24 hours/day, 365 days year)

Risk Calculation

Non-Cancer Hazard Quotient

Hazard Quotient (HQ) = Indoor Air Conc./Tolerable Concentration

Acceptable HQ is less than 0.2

Cancer Risk

Cancer Risk = Inhalation Unit Risk x Indoor Air Conc.

Acceptable Cancer Risk is less than 1 x 10-5

						Residential Exposure		
Chemical	**Tolerable Concentration (TC) (mg/m^3)**	**Inhalation Unit Risk (UR) ($(mg/m^3)^{-1}$)**	**Indoor Air Criteria (ug/m3)**			**Maximum Measured Indoor Air (ug/m3)**	**Hazard Quotient**	**Cancer Risk**
			threshold	**non-threshold**	**Lowest Risk Level**	**(mg/m^3)**		
Vinyl Chloride	0.1	0.0088	2.00E+01	1.14E+00	1.14E+00	< 0.000051	< 0.00051	< 4.49E-07
cis-1,2-dichloroethylene	0.009	-	1.79E+00		1.79E+00	< 0.0002	< 0.022	

Notes:

Bold and Shaded Criteria exceeds HQ value of 1 or Cancer Risk Value of 1 x 10-5

Methane screening was completed in accordance with Table 7, Draft Soil and Building Methane Gas Management Guide, Oct 2013, (Alberta Health Services) and was therefore not included in Risk Evaluation.

Table C8 - Exposure and Risk Calculations for Inhalation of Outdoor Air Sourced from Soil (In Trench)

Table C8.1 Exposure and Risk Calculations - Inhalation of Outdoor Air - Construction Workers in Trench

Substance	Effective Molecular Diffusion through Cell (Deff) (cm2/s)	Volatilization Factor (L/m3)	Maximum Groundwater Concentration (µg/L)	Calculated Air Concentration (mg/m3) (mg/m^3)	Pro-rate Exposure Concentration (Construction Worker) (mg/m^3)
Vinyl Chloride	2.68E-02	3.00E-03	39	1.17E-04	**3.22E-05**
1,4-dichlorobenzene	1.74E-04	1.69E-06	1.2	2.03E-09	**5.56E-10**
trichloroethylene (updated)	4.52E-03	1.79E-04	7.4	1.33E-06	**3.65E-07**
benzene	1.30E-03	2.90E-05	4.8	1.39E-07	**3.82E-08**
ethylbenzene	2.77E-02	8.78E-04	58	5.09E-05	**1.40E-05**
total xylenes	4.81E-04	1.28E-05	45	5.78E-07	**1.59E-07**

Table C8.2 Chemical and Physical Properties for Exposure and Risk Calculations - Construction Workers in Trench

Substance	Henry's Law Coefficient, 15 degrees C (H)	Molecular Diffusion Constant in Air (Da)	Molecular Diffusion Constant in Water (Dw)	Organic Carbon-Water Sorption Coefficient (Adjusted Koc)
Trichloroethylene	4.03E-01	7.90E-02	9.10E-06	1.35E+02
1,4-dichlorobenzene	9.85E-02	6.90E-02	7.90E-06	8.68E+02
Vinyl Chloride	1.14E+00	1.06E-01	1.23E-06	4.75E+01
Benzene	2.27E-01	8.80E-02	9.89E-06	3.31E+02
Ethylbenzene	3.22E-01	7.50E-02	7.80E-06	1.56E-05
Xylenes	2.71E-01	7.14E-02	9.34E-06	8.86E+02

APPENDIX D

XCG'S STANDARD OPERATING PROCEDURES (SOPS)

BOREHOLE DRILLING

1. PURPOSE

The purpose of borehole drilling is to collect representative soil samples to determine soil quality, determine subsurface geologic conditions for hydrogeological and geotechnical evaluation, and facilitate installation of groundwater monitoring wells.

2. RELATED SOPS

The following SOPs should also be reviewed prior to the commencement of the works:

- Field Screening,
- Soil Sampling,
- Sample Handling, and
- Monitoring Well Installation.

3. PRIOR PLANNING AND PREPARATION

The following activities must be completed before starting a borehole drilling program.

- Review the work program, project documents, and the health and safety requirements with the Project Coordinator/Manager.
- Assemble all necessary equipment and supplies.
- Obtain a site plan and any previous stratigraphic logs. Determine the exact number and location of boreholes to be installed and the anticipated depths of samples for chemical analysis.
- Contact designated laboratory subcontractor to arrange/determine sample jars, coolers, and shipping details.
- Establish borehole locations in field using available landmarks or by surveying, if necessary.
- Arrange for utility clearance of public and private utilities.
- Determine notification needs with the Project Coordinator/Manager. Have client, landowner, XCG personnel, laboratory, and appropriate regulatory group (if necessary) been informed of the drilling event?
- Arrange for the necessary site access/coordinate field activities with the site owner's and/or site tenants' representative(s).
- Establish a water source for drilling and decontamination activities. Determine the methods for handling and disposal of drill cuttings, wash waters, and spent decontamination fluids.

In addition to the above-noted activities, the following activities should be completed at the site during completion of the utility marking activities or prior to starting the drilling program:

- Locating and marking of all borehole locations (if not already completed); and

- Final visual examination of proposed drilling area for buried and/or overhead utility conflicts.

Prior to starting the drilling program, the proposed borehole locations should be located in the field and staked or marked with paint (on paved surfaces). On most sites, this should be done several days in advance of the drill rig arriving on site, during completion of utility locates.

Once the final location for each proposed borehole has been selected and utility clearances are complete, one last visual check of the immediate area should be performed before drilling proceeds. This last visual check should confirm the locations of any adjacent utilities (subsurface or overhead) and verification of adequate clearance. If gravity sewers or conduits exist in the area, any access manholes or chambers should be opened and the conduit/sewer alignments confirmed. Do not enter manholes unless confined space procedures are followed.

If deemed necessary, a hand auger or hand posthole digging equipment can be advanced to a sufficient depth to confirm that there are no buried utilities or services. Alternatively, a Hydrovac truck can vacuum a large diameter hole to check for utilities, although soils/slurry generated during hydrovacing may require containment on site/special off-site disposal (e.g. as liquid waste). This procedure should clear the area to the full diameter of the drilling equipment which will follow.

If it is necessary to relocate any proposed borehole due to terrain, utilities, access, etc., the Project Coordinator/Manager must be notified and an alternate location will be selected.

If the drilling location has to be relocated following completion of utility locates, additional utility locates may have to be completed at the new location prior to commencing drilling activities. Check with Project Coordinator/Manager.

4. PROCEDURE

4.1 MECHANICAL SAMPLERS (SUBSURFACE SOIL, CORE)

Mechanical samplers are used with a drill rig (or a direct push rig) and are used for soil sampling at depth. Methods used to access soils at depth so they can be sampled include hollow stem auger (HSA) drilling, solid stem auger (SSA) drilling, resonant sonic drilling and direct push sampling. Most samplers are designed to sample soils ahead of the drilling bit. Commonly used samplers include split-spoon (split-barrel) sampler, thin-wall sampler (Shelby tube) and continuous tube.

4.1.1 Split-Spoon (Split-Barrel) Sampler

The split-spoon sampler is a long cylinder, 0.46 to 0.6 metres (18 to 24) inches in length that splits in half lengthwise. The sampler is advanced in front of the soil cutting surface using a manual or hydraulic 63.5-kilogram (140-pound) hammer.

During sampling, the number of blows applied in each 0.15-metre (6-inch) increment is counted until one of the following occurs:

- A total of 50 blows have been applied during any one of the 0.15-metre (6-inch) increments described above;
- A total of 100 blows have been applied;
- There is no advancement of the sampler during the application of ten successive blows of the hammer (i.e. the spoon is "bouncing" on a stone or bedrock); or
- The sampler has advanced the complete 0.45 or 0.60 metres (18 or 24 inches) without the limiting blow counts occurring as described above.

In some cases where the limiting number of blow counts has been exceeded, XCG may direct the driller to attempt to drive the sampler deeper if collection of a greater sample length is essential.

On the XCG standard borehoe log, record the number of blows required to drive each 0.15-metre (6-inch) increment of penetration. The first 0.15 metres (6 inches) is considered to be a seating drive. The sum of the number of blows required for the second and third 0.15 metres (6 inches) of penetration is termed the "standard penetration resistance" or the "N-value".

After being driven in advance of the auger, the split-spoon sampling tube is retrieved. The soil sample that is removed from the split-spoon can be used for identifying the various stratigraphic units encountered and describing the geologic and hydrogeologic conditions at the site to assist with generating the borehole log. Soil should be described using the Unified Soil Classification System (USCS), with assistance from the field guides provided to all field personnel.

Once the split-spoon is opened, soil recovery is calculated and noted on the XCG standard borehole log. Soil classification and observations are made of the core and recorded in the borehole log. Note that soil observations should be made on a freshly exposed surface of the core sample.

When sampling of the soil core taken using a split-spoon sampler, a decontaminated putty knife, stainless steel spoon or similar implement should be used to remove any smeared soil on the outer layer of the core prior to collecting a soil sample for chemical analysis (to limit the potential for cross-contamination). If possible, the sample core should be split longitudinally, along the length of the split-spoon sampler. If varying levels of contamination and/or varying soil types are observed within the length of the split-spoon core sample, then a sample should be taken from each distinct zone within the split-spoon sample.

Specific methodologies for field screening of retrieved soil samples and collection of samples for laboratory analysis are provided in the Field Screening, Soil Sampling and Soil Handling SOPs, which should be referred to.

4.1.2 Thin-Wall Sampler (Shelby Tube)

A thin-wall sampler is used for collecting undisturbed, in situ soil samples from cohesive soil deposits (i.e. soft to stiff clayey soils). The thickness of the sampling tube should be less than 2.5 percent of the total outside diameter of the sampling tube. The thin-wall and wide diameter of the sampler causes minimal sample disturbance. The sampler is attached to drill rods and pushed into the soil ahead of the auger. It is more suited to cohesive soils and may not work in sandy soils. Due to the low structural strength of the thin-wall sampler, it may collapse when sampling compact soils with “N” values of 30 or larger.

The undisturbed samples collected using a thin-walled tube sampler are typically used for certain laboratory tests of structural properties (consolidation, hydraulic conductivity, shear strength) or other tests that might be influenced by sample disturbance. Procedures for conducting thin-walled tube sampling are provided in ASTM D1587, and are briefly described below.

- The soil deposit being sampled must be cohesive in nature, and relatively free of gravel and cobble materials, as contact with these materials will damage the sampler;
- Clean out the borehole to the sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed.
- Place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler into the formation without rotation by a continuous and relatively rapid motion; usually hydraulic pressure is applied to the top of the drill rods;
- Determine the depth of advance by the resistance and condition of the formation, but the depth shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays;
- In no case should the depth of advance be greater than the sample tube length minus an allowance for the sampler head and a minimum of 7.5 centimetres (3 inches) for cuttings.
- The tube may be rotated to shear the bottom of the sample two to three minutes after pressing in, and prior to retrieval to ensure the sample does not slide out of the tube. Lift the weight of the rods off of the tube prior to rotating.
- Withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

Once the sample has been retrieved, remove any sloughed material from the top of the sample using a knife or similar long bladed instrument. If it is not possible to distinguish sloughed soil from intact soil, do not remove. Following removal of sloughed material, measure the tube length and the air space in the tube above the sample and record the difference as the sample recovery. Seal the top and bottom of the sample with wax (wax is normally provided and prepared by the driller). First pour the liquefied wax into the top of the sample to a thickness of about 2.54 centimetres (1 inch). Once this is cooled, remove approximately 1.27 centimetres (1/2 inch) of soil from bottom of sample (unless there is already a cavity at bottom of sample) and seal similarly. Fill the remaining air space above the sample with loose soil to prevent the sample from shifting in the tube, and then cap both ends of the sample with plastic caps. Tape the caps on using duct tape. Write the sample identification number on the cap using an indelible marker. Shelby tubes containing soft clays and wet silts need to be handled with care to avoid damage to the sample. Keep samples in an upright position at all times and transport either in a specifically designed cushioned box or position in your vehicle with cushioning under and around the individual tubes.

4.1.3 Continuous Sampling Tube

The continuous sampling tube can be used with standard hollow stem augers or other rotary methods. A thin-wall tube, 1.5 metres (5 feet) in length is attached to a drilling rod with a bearing head and is continuously advanced ahead of the augers while drilling. The sample column can be retrieved when fully through the hollow stem. It enables fast and efficient sample collection and is suited to sampling depths greater than 30 metres (100 feet). It is more suited to fine-grained or cohesive soils. It is applicable for collection of undisturbed soil cores for hydraulic conductivity and other physical parameters. Standard Penetration Testing cannot be done in the soil interval sampled.

4.1.4 Direct Push Sampling

Soil samples can be collected from a discrete depth using direct push sampling systems. In general, the sampling device consists of a hollow sampling tube with a retractable drive point. The drive point is connected to a narrow piston rod that runs the length of the sampler tube. Once removed to the ground surface, the discrete soil sampler is opened by removal of the cutting shoe, and the soil liner (with recovered soil) is extracted from the sampler body. The soil liner is placed into a holder and cut lengthwise to expose the collected soil core.

Inspection of the soil core is conducted in a similar manner to soil samples retrieved from a split spoon sampler. Soil screening and sampling requirements are further described in the applicable SOP.

4.1.5 Soil Sampling Principles for Boreholes

Detailed methodologies for screening of retrieved soil samples and collection of samples for chemical analysis are provided in the Field Screening, Soil Sampling and Soil Handling SOPs; however, the following provides general guidance for selection of soil samples for chemical analysis.

For boreholes, it is good practice that, a minimum, of one sample per borehole be sent to the laboratory for analysis of the contaminants of concern:

- If contamination is not detected in the borehole samples based on field screening observations or measurements (i.e. physical observations or soil headspace vapour screening results), one sample should be submitted from the borehole. The sample interval should be confirmed with the Project Coordinator/Manager.
- If contamination is detected in the borehole samples based on field screening observations or measurements, the sample with the suspected highest contamination should be selected for laboratory analysis. In addition, a sample from the first suspected non-impacted interval underneath the contaminated zone should be selected for laboratory analysis to provide vertical delineation of the contamination. The requirement of the delineation sample should be confirmed by referring to the project work program and sampling plan.
- Whenever possible, drilling work should be completed by starting at the least contaminated area(s).

Samples being submitted to the laboratory for volatile organic compounds (VOCs) analysis should be collected in accordance with the methodologies outlined in the sample collection SOP to ensure sample integrity and laboratory preservation requirements.

Site conditions may make the use of mechanical subsurface sampling devices impractical (e.g. cobbles or glacial till may make it impossible to drive the sampler). While it is preferred to utilize another borehole drilling method at such sites (e.g. Resonant Sonic), in some case this is not possible. Under these conditions, the Qualified Person should try to obtain the best possible soil samples with the standard equipment available at the site (e.g. take disturbed soil samples from the auger flights if it is only possible to collect this type of soil sample).

5. DECONTAMINATION PROCEDURES

Decontamination procedures are important for preventing cross-contamination between samples/sampling intervals and borehole locations.

Laboratory sample bottles should be stored in a clean environment in the field, away from potential contaminant sources. Chemical resistant gloves should be worn by sampling personnel during soil sampling activities. Gloves should be changed for each sample collected and submitted for laboratory analysis as well as between each drilling interval that is retrieved and logged.

Soil sampling equipment should be properly decontaminated between each soil sample taken. Down-hole drilling equipment (e.g. auger flights) should be decontaminated between each borehole drilled. The Qualified Person should evaluate decontamination requirements on a site-specific basis.

The following presents a discussion of general practices for decontamination of manual sampling tools, down-hole sampling equipment, down-hole drilling equipment, and excavator buckets. The general decontamination procedures when sampling for trace organic chemicals are also described below.

5.1 MANUAL SAMPLING TOOLS AND DOWN-HOLE SAMPLING EQUIPMENT

The following decontamination procedures are for manual sampling tools, such as knives or spatulas, manual soil coring or augering tools, and down-hole sampling equipment:

- Visible soil debris should be brushed from the equipment;
- The equipment should be washed with phosphate-free detergent, until all soil adhering to the equipment has been removed and then rinsed with potable water;
- If organic residue cannot be removed from the hand tool using this methodology, the equipment should then be rinsed with methanol after the potable water rinse;
- The equipment should be allowed to air-dry before sampling. Alternatively, clean paper towels can be used to dry the equipment (this practice is especially useful in winter conditions, to avoid the problem of water freezing on the hand tool); and
- The soil and water residues generated by this decontamination activity should be disposed of appropriately.

5.2 DOWN-HOLE DRILLING EQUIPMENT

The following decontamination procedure is recommended for down-hole drilling equipment:

- Gross soil should be removed from all drilling equipment with a brush;
- The plug and any auger flights that may come into contact with groundwater should be thoroughly cleaned. In practice, this means that the plug and at least the first two to three auger flights need to undergo additional cleaning consisting of scrubbing the equipment with a brush and soapy water to remove organic residuals and soil. The equipment being cleaned should then either be steam cleaned or pressure washed with potable water; and
- If organic residues or residual soil are still adhering to the drilling equipment and cannot be removed, the contaminated equipment should be set aside and not used for the remainder of the drilling. The equipment should be properly cleaned before reuse.

5.3 BACKHOE/EXCAVATOR BUCKETS

When advancing a test pit through a contaminated zone, the bucket of the backhoe or excavator (which is acting both as the soil removal equipment and sampling tool) may have contaminated soil adhering to the bucket. In order to avoid cross-contamination between different strata in the same test pit, or between different test pits, the bucket should be banged on the ground periodically to remove as much soil as possible from the bucket.

5.4 DECONTAMINATION PROCEDURES WHEN SAMPLING FOR TRACE ORGANICS

The general procedures for decontamination when sampling for trace organics are described below. Please note that nitrile gloves should be worn at all times during the soil sampling program when contact with retrieved soil samples is required (i.e. logging, screening, and collection of samples for chemical analysis).

5.4.1 Control of Cross-Contamination

Soil sampling for trace organic contaminants requires special techniques in order to avoid contamination, both from other samples and from sampling equipment and containers. When potentially high concentrations of contaminants are suspected, protective gloves made of solvent-resistant material (e.g. latex) should be worn. However, neither gloves should contact the sample directly. Rather than transferring the soil cores from the corer to the sample container with gloved fingers, a stainless steel spatula or knife, or other approved sampling tool (e.g. EnCore sampler, should be used). The sample tool selected should be cleaned between each sample collected and at the sample program conclusions.

5.4.2 Equipment Cleaning Procedure

As a minimum, sampling equipment (split spoons, dual tubes, sampling knives, spatulas, etc.) should be washed with clean potable water and phosphate-free detergent using a brush, if necessary, to remove any particles or surface films. For equipment that cannot be adequately cleaned with a brush, such as internal mechanisms or piping, the decontamination solutions should be circulated through the equipment. Equipment should be rinsed with potable water followed by deionized water.

The frequency of sampling to demonstrate the completeness of equipment decontamination is dependent upon the objectives of the project and will be determined by the Project Manager.

If conducting sampling and analysis of highly contaminated soils, a more rigorous cleaning procedure may be required. This procedure may involve the use of an organic solvent, such as methanol.

All cleaning agents and rinse waters require capture, containment, and appropriate disposal in accordance with local and provincial requirements.

6. ATTACHMENTS

- Drilling/Borehole/Excavation Checklist
- Unified Soil Classification System
- Borehole Log Template

XCG
Environmental Engineers & Scientists

Document ID: SOP – Borehole Drilling Checklist	Revised: V1 – 23/03/11
Procedure Authority:	Page: 1

DRILLING BOREHOLE CHECKLIST

Site Location Name: ______________________ **Project No.:** ______________

Project Scope: ______________________ **Date:** ______________

____

Contractor: ______________________ **Subcontractor:** ______________

Supervisor: ______________________

Activity	Yes	No/ N/A	Comments Including Justification if a Response is No or N/A
Workers properly briefed on potential site/work hazards and safety. Sub-surface and overhead clearance protocols have been reviewed with all site personnel involved in subsurface disturbance activities.			
All applicable permits and access agreements have been obtained.			
Site access/permission has been secured. Landowner/occupant has been contacted.			
Most recent as-built drawings and/or site plans, surveys (including UST product and vent lines) obtained, if available.			
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, right-of-ways, historical plot plans, previous site investigations, soil surveys, borehole logs, etc.)			
Utility locates have been performed by public utility company(s). One-call companies within required timeframe. Locates clear/visible.			
Overhead and subsurface structure locates performed by private locate company within required timeframe. Locates clear/visible.			
Location of on-site indicators of underground utilities (i.e., yard light, gas mains, hydro, telecommunications, water lines, drains, sewer manholes , etc,) identified			
Orientation, arrangement, location, sizes of underground storage tanks, identified. Burial depth of tank determined if relevant.			
Presence of underground pipelines associated with pumps and pump galleries, manifolds, tank fields, compressors, production wells, loading racks, and equipment identified.			
Presence and tracing of process/storm sewers identified/understood. If other cement, fiberglass, untraced PVC lines are potentially in the ground disturbance area, identify means of identification in comments section.			

DRILLING BOREHOLE CHECKLIST

Activity	Yes	No/ N/A	Comments Including Justification if a Response is No or N/A
Clearance methods reviewed with project manager.			
Critical zones – 5 metres of pipeline crossing area or the distance defined in the pipeline crossing agreement. 3-metre distance from edge of tank pumps and pump galleries, manifolds, or below grade transformers, production wells, and suspected utilities, product lines, and other subsurface structure and entire area between tank field and dispensers at retail sites, have been identified. Identify critical zones in comments section.			
Locations of potential interference with proposed investigative locations reviewed and revised (if necessary) by project manager.			
Work area is secured. Site work permits have been obtained. Emergency shut-off switch is located. Fire extinguishers warning signs/barriers are present. Signage in place of overhead power lines. Other safety equipment as needed.			
In conducting borehole advancement activities in critical zones: First 1.2 metres or identified depth of utility or critical feature has been delineated utilizing most effective method (e.g. vacuum digging, probing, hand digging, etc.). Note methods used in comments.			
If subsurface structures exposed, extra precautions have been taken to ensure structural integrity.			

Document ID:	Revised:
SOP – Borehole Drilling Checklist	V1 – 23/03/11
Procedure Authority:	Page: 3

DRILLING BOREHOLE CHECKLIST

Comments/Findings	Actions to Close Out Items	Person Completing/Date

Completed by

Name (print)

Company

Signature

Date

USCS (MODIFIED) SOIL CLASSIFICATION

1.	**SOIL GROUP SYMBOL**	ML, SM, GW, CH, OL
2.	**MAJOR CONSTITUENT**	(CLAY)
3.	**SECONDARY SOIL DESCRIPTOR**	FILL or TILL
4.	**DESCRIPTION & ESTIMATED PROPORTIONS OF CONSTITUENTS**	

and	50 – 36%
some	35 – 21%
little	20 – 11%
trace	10 – 1%

ie. clay and silt, some sand, little gravel

5.	**NON-COHESIVE – relative density**	loose, compact, dense
	COHESIVE – consistency	soft, firm, stiff, hard
6.	**NON-COHESIVE – grain size**	fine, medium, coarse
	COHESIVE – plasticity	low, medium, high
7.	**NON-COHESIVE – gradation**	uniform, poorly, gap, well high variability
	COHESIVE – structure	blocky, plattly, nuggetty, layered, varved, fissured, massive
8.	**COLOUR**	
9.	**MOISTURE**	dry, slightly moist, moist very moist, wet, saturated, supersaturated
10.	**SUPPLEMENTARY DESCRIPTORS**	odour, oxidation, inclusions eg rootlets

EXAMPLE

CL (CLAY) TILL	some silt, little sand, trace gravel, hard, low plastic, massive, grey-brown, moist, vertical fissures to 12', oxidized, slight petroleum odour

CONVENTIONAL SOIL DESCRIPTIONS

COHESIVE (clays and silts)

Consistency	'N' blows/ft
very soft	0 – 2
soft	2 – 4
firm	4 – 8
stiff	8 – 15
very stiff	15 – 30
hard	30

NON-COHESIVE (granular)

Relative Density	'N' blows/ft
very loose	0 – 3
loose	4 – 9
medium dense	10 – 29
dense	30 – 49
very dense	50 – 80
extremely dense	80

GRAIN SIZE CLASSIFICATION

COBBLE	above 3 in.
GRAVEL	3 in. to No. 4 (4.76mm)
coarse gravel	3 in. to ¾ in.
fine gravel	¾ in. to No. 4 (4.76mm)
SAND	No. 4 (4.76mm) to No. 200 (0.074mm)
coarse sand	No. 4 (4.76mm) to No. 10 (2.0mm)
medium sand	No. 10 (2.0mm) to No. 40 (0.42mm)
fine sand	No. 40 (0.42mm) to No. 200 (0.074mm)
SILT	No. 200 (0.074mm) to 0.002mm
CLAY	less than 0.002mm

XCG Consultants Ltd.

FIELD BOREHOLE LOG

BOREHOLE ID ____________________

DATE ______________________________

PROJECT NO. ________________________

SITE ADDRESS ________________________

DRILLING COMPANY ______________________________

DRILLING EQUIPMENT ______________________________

SAMPLING METHOD ______________________________

BOREHOLE DIAMETER ____________________

SCREENING TOOL ________________________

LOGGED BY ______________________________

FROM	AT	TO	SOIL DESCRIPTION ORDER OF DESCRIPTORS: PRIMARY/SECONDARY COMPONENTS, RELATIVE DENSITY/CONSISTENCY, GRAIN SIZE/PLASTICITY, GRADATION/STRUCTURE, COLOUR, MOISTURE, SUPPLEMENTARY DESCRIPTORS	SAMPLE INTERVAL	N Value 6 12 18 24	RECOVERY (L or %)	HEAD SPACE (ppm)	CHEMICAL ANALYSIS

ADDITIONAL COMMENTS / WELL INSTALLATION DETAILS

MONITORING WELL INSTALLATION

1. PURPOSE

The purpose of monitoring well installation is to obtain representative hydraulic and geochemical information of the water bearing zone(s) and/or aquifers beneath a site.

It is important that the drilling method or methods used, minimize disturbance of subsurface materials and hydraulic properties of the water bearing zone(s), do not contaminate the subsurface soils and groundwater, and do not provide a hydraulic link between different hydrogeologic units. Samples collected from installed monitoring wells must not be contaminated by drilling fluids or by the drilling procedures.

2. RELATED SOPS

The following SOPs should also be reviewed prior to the commencement of the works:

- Borehole Drilling.
- Field Screening.

3. PRIOR PLANNING AND PREPARATION

When designing and constructing monitoring wells, the following questions shall be considered:

- What is the purpose of the well(s)? Are wells going to serve for monitoring, pumping test, extraction, or injection purposes? What contaminants are to be monitored?
- What kinds of analyses are needed?
- What geologic/hydrogeologic conditions are present or expected at the site?
- What is the anticipated total depth of the well?
- What types of well construction materials are to be used?
- What are the potential health and safety hazards?

4. PROCEDURE

4.1 MONITORING WELL DESIGN

A monitoring well is comprised of two key elements: the well casing and the well screen. The well casing provides access from the surface to a sampling location (i.e. the well screen) in the subsurface. The well casing is also commonly referred to as the well riser. The well casing (and associated seals and grout) prevents collapse of the borehole and inter-zonal hydraulic connection. The monitoring well casing and screen provide access to the groundwater at the zone of interest in the subsurface.

The fundamental parameters associated with the design of a monitoring well include:

- Borehole and well diameters;
- Screen length and location;

- Well casing and screen materials; and
- Screen slot size and filter pack.

Other features of monitoring wells, such as annular sealing around the well and completion of the well at ground surface, are discussed in Subsection 3.2 Well Installation. The installation of the monitoring wells must also be in accordance with Ontario Regulation 903, which provides well drilling contractors guidance on well installation parameters.

4.1.1 Borehole and Well Diameters

The monitoring well is installed within a borehole drilled into the ground to allow for monitoring within a specific hydrostratigraphic unit of interest. The diameter of the borehole should be sufficiently large to accommodate the monitoring well casing, annular materials, and tremie pipes used for filter pack or seal placement.

The diameter of the monitoring well (installed within the borehole) will be governed by the purpose of the installation. In general, wells installed for monitoring groundwater should be at least 2.5 centimetres (1 inch) in diameter, and are typically 5 centimetres (2 inches) in diameter. This allows small diameter bladder pumps, bailers, or inertial pumps to be installed. Wells of smaller diameter should be avoided unless they are solely used for hydraulic monitoring.

4.1.2 Screen Length and Placement

The monitoring well screen length should be consistent with the desired monitored interval and geologic conditions encountered (i.e. stratigraphy and water table elevation). Screens should not straddle multiple hydrostratigraphic units, and must be properly sized and placed to avoid creating preferential pathways for contaminants to migrate between hydrostratigraphic units.

Typical well screens are 1.5 to 3.0 metres (5 to 10 feet) in length. Issues that may require consideration when designing the length or placement of a well screen include:

- Monitoring for Liquid non-aqueous phase liquid (LNAPL) above the water table may require longer well screens because of seasonal fluctuations in water table elevations;
- Monitoring for evidence of dense non-aqueous phase liquid (DNAPL) in an aquifer typically involves placement of well screens at the bottom of the aquifer, directly above the aquitard;
- Monitoring for geochemical parameters may require shorter well screens in aquifers where geochemical conditions vary significantly with depth, to reduce the potential for mixing of water from distinct vertical geochemical zones; and
- Well screens that are excessively long in the saturated zone may misrepresent the chemistry of a dissolved contaminant plume by mixing impacted and non-impacted groundwater from different depths within the aquifer. The potential for well bore dilution should be considered by the Qualified Person in the design of all wells. O. Reg. 511/09 specifies the maximum saturated length of the well screen as 3.1 metres

It is recommended that shallow water-bearing horizons be characterized first before drilling into deeper formations, if groundwater characterization of the deeper formations is required. It may be necessary to seal the shallower formations by grouting, casing, or inflatable packers to prevent cross-contamination.

4.1.3 Well Casing and Screen Materials

It is important to choose well casing and screen materials that do not sorb or leach contaminants from the groundwater. Improper selection of casing and screen materials could lead to “false negative” or “false positive” results being reported for the chemical analysis of the groundwater.

The monitoring well casing and screen should maintain their structural integrity, should be resistant to chemical and microbiological degradation and should not chemically alter the groundwater (in particular, with respect to potential contaminants of concern). The main classes of materials used for monitoring well construction are thermoplastics, metallics (e.g. stainless steel), and fluoropolymers.

Polyvinyl chloride (PVC) is a thermoplastic material most commonly used for well construction in Ontario. It is made of sturdy, lightweight construction and can easily be threaded for joining casing sections.

High (parts-per-thousand) concentrations of some organic chemicals may degrade PVC. In cases where conditions are too harsh to use PVC casings, the Qualified Person should consider the use of stainless steel or polytetrafluoroethylene (Teflon) casings (the choice will depend on subsurface conditions).

4.1.4 Well Screen Slot Size and Filter Pack

The well screen slot size should be designed based on the materials used in the filter pack (also referred to as a sandpack) adjacent to the screen. The filter pack is intended to minimize the entry of soil particles into the well during sampling and is selected based on the geologic materials in which the monitoring well is screened. The filter pack is an inert granular material with a grain size and gradation selected to stabilize the hydrogeologic unit adjacent to the screen. ASTM Standard D5092-90 (ASTM, 2001) provides specifications for designing the well screen slot size and filter pack.

The elevation of the top of the filter pack is to be selected in the field based upon the geologic conditions encountered. For shallow overburden wells, it is common to extend the filter pack to above the top of the water table to account for the anticipated fluctuation of the water table due to seasonal effects. In deeper overburden wells, the filter pack should span the length of the specific hydrogeologic unit that will be monitored. The filter pack should not extend through a confining layer, causing two or more separate permeable layers to become connected. Where practical, the filter pack should extend a minimum of 0.6 metres (2 feet) above the top of the well screen. In addition, the filter pack should extend a minimum of 0.15 metres (6 inches) below the bottom of the well screen to provide a firm footing.

As a general practice, filter socks should not be installed over monitoring well screens. The filter sock may reduce the measured hydraulic conductivity (especially when performing slug tests) in coarse-grained formations and can physically entrap contaminants with high viscosity.

4.1.5 Well Nests

In some cases, sampling from multiple discrete intervals at a given location may be required. Monitoring wells may be installed as well nests (multiple boreholes with one well installed in each closely-spaced borehole), multi-level wells (multiple sampling tubes placed within the well casing, isolated with packers or grout), or configurations with a series of single-riser wells within one borehole. Preference should be given to installing separate wells (i.e. one well per borehole).

Monitoring well nests are the preferred method for sampling at multiple levels at a given location. The other two methods (i.e. multi-level wells and multiple risers within a single borehole) may have problems due to improper placement or settlement of seals or filter packs.

Where well nests are used and the direction of groundwater flow is known or can be estimated, the shallower wells should be placed hydraulically up-gradient of the deeper wells. This will minimize the potential for the grout seal from the deeper well to chemically influence the formation water sampled by the screen or the disruption of groundwater flow patterns, which are possible when the deeper wells are installed hydraulically up-gradient of the shallower wells.

4.2 WELL INSTALLATION

The truck-mounted hollow stem auger drilling method is the most commonly used drilling technique for installing groundwater monitoring wells for a Phase II ESA purposes. This method is preferred because it is simple to use and does not require any drilling fluids or air that could affect groundwater quality. Portable, solid stem drilling rigs or direct-push drilling equipment can be used for shallow sampling or when truck-mounted drilling equipment cannot be used.

Other drilling methods include air/water/mud rotary drilling techniques. These methods may be used in difficult conditions (e.g. bouldery terrain) or for bedrock investigation, but their use for a Phase II ESA is less common. These methods introduce air and fluids, which can affect groundwater quality; hence, the monitoring wells should be properly developed prior to sampling. In addition, air rotary drilling may result in the stripping of VOCs and further migration of contaminants.

Whichever borehole drilling method is used should be compatible with the groundwater monitoring wells to be installed and should ensure that future data measurements or samples collected from the well are representative of the zone of interest.

If monitoring wells are installed in grossly contaminated areas, suitable drilling and well installation measures should be implemented to prevent migration of contamination from the soil to the water table and further into lower hydrostratigraphic units. Whenever possible drilling work should be completed by starting at the least contaminated area(s).

Well construction materials should not be stored directly on the ground, nor in the vicinity of potentially contaminating materials (e.g. soil cuttings, waste drums, near idling site vehicles, etc.). To minimize the potential for well material contamination prior to completion of the monitoring well, keep monitoring well materials (e.g. PVC risers and screens) in the original manufacturer's plastic sleeves as long as possible during installation. Latex, nitrile, or cotton gloves are recommended for use while handling monitoring well materials and should be discarded if they become contaminated.

A typical well installation procedure is described below, based on the use of a hollow stem auger drill rig.

4.2.1 Well Casing and Screen

The borehole should be drilled as close to vertical as possible unless the well is intended and designed to be angled (e.g. to access beneath a building or other structure).

Prior to insertion into the augers or borehole, the well assembly (i.e. well screen and riser components) should be measured to record its exact total length, and the length of each component. Once this length is known, well placement may proceed.

If the borehole is significantly deeper than the desired well screen interval, then the base of the borehole should be filled with bentonite chips to an appropriate depth below the bottom of the well screen. Hydration of the bentonite is not required because this section of the borehole should be saturated.

Before the casing and well screen are placed on the bottom of the borehole, at least 0.15 metres (6 inches) of filter pack material should be placed at the bottom to serve as a footing. An exception to this configuration may occur when DNAPL is being monitored. In the case where bentonite chips are used to backfill the borehole prior to well placement, additional filter pack material should be placed on top of the bentonite chips (i.e. 0.3 metres) to prevent swelling of the bentonite and infiltration/clogging of the bottom of the well screen.

The well casings and the well screen should be placed into the borehole and plumbed. Where critical, centralizers may be used to aid in the well installation. If centralizers are used to plumb the well, then they should be placed so that the placement of the filter pack, bentonite seal, and annular grout will not be hindered. Monitoring wells less than 15 metres (50 feet) deep do not require centralizers. If centralizers are to be used, they should be placed below the well screen and above the bentonite seal.

No lubricating oils or grease should be used on casing threads. Teflon tape may be used to wrap the threads to ensure a tight fit and minimize leakage. No glue of any type should be used to secure casing joints. Welded joint construction is also acceptable.

An end cap should be used at the bottom of the monitoring well screen and should be constructed of the same material as the well screen. If the well screen installed is of a standard length, then the use of a screw-on end cap is recommended. If the well screen length should be cut to a non-standard length to accommodate its installation, slip-on end caps will need to be installed. It is also recommended that any well cap being installed should be equipped with a weep hole at the bottom, to allow perched water to drain from the well screen if the groundwater level drops below the bottom of the well screen, due to seasonal fluctuations in groundwater levels or other factors.

4.2.2 Filter Pack

When placing the filter pack into the borehole, a minimum of 0.15 metres (6 inches) of the filter pack material should be placed under the bottom of the well screen to provide a firm footing. <u>An exception to this configuration may occur when DNAPL is being monitored.</u> The elevation for the top of the filter pack should be selected in the field based upon the geologic conditions encountered..

A tremie pipe (a 25-millimetre diameter rigid tube) may be used to introduce the filter pack to the well annulus. In this situation, the tremie pipe is placed at the bottom of the borehole and the filter pack is added through a funnel to the pipe; this minimizes bridging or void formation within the filter pack. The tremie pipe is raised periodically to allow the filter pack material to evenly fill the annular space.

If filter pack materials are added using gravity free fall, then the materials should be added slowly to minimize bridging or void formation within the filter pack. Periodic sounding of the annular space with a weighted tape measure is recommended as a method to ensure that bridging of the sand is not occurring in this space.

Filter pack placement should be carefully performed concurrent with the removal of the augers when collapsing borehole conditions exist. The filter pack level should be maintained within the augers or temporary casing to ensure a proper filter pack “envelope” around the well screen.

Filter pack placement is typically a delicate operation, requiring a careful balance between:

- Placement of too much sand and locking the well components within the augers; and
- Placement of an insufficient amount of sand which then allows formation materials to collapse around the well screen area.

On occasion, it may be necessary to add potable water and/or drilling muds within the augers to maintain a positive pressure head on the formation materials, which (when certain conditions are encountered) will flow into the auger string in an effort to equilibrate with exterior levels. If potable water or drilling mud is added, the volume used <u>must</u> be recorded and additional purging volumes may be required.

4.2.3 Bentonite Plug and Annular Seal

After the filter pack has been installed, a bentonite plug should be placed directly on top of the filter pack to prevent water draining from the annular seal into the well screen and affecting the monitoring results. The annular seal is a low permeability material which is placed above the bentonite plug between the well casing (i.e. riser pipe) and the borehole wall to maintain alignment of the well.

4.2.3.1 Bentonite Plug

The bentonite plug consists of hydrated bentonite chips/pellets and should be placed above the filter pack to the specified depth or a minimum of at least 0.6 metres (2 feet) above the filter pack. Bentonite chips can be added to the annulus using gravity free fall in shallow boreholes (less than 15 metres (50 feet)) where the annular space is large enough to prevent bridging. Sounding measurements, using a weighted tape measure to confirm that the bentonite has been placed at the proper depth. Care should be taken to add the bentonite chips slowly to prevent bridging.

It is necessary to allow the bentonite to hydrate before installing the annular seal. If the water table is temporarily below the bentonite seal interval during well installation, potable water should be used to hydrate the bentonite. Potable water should be added for every 50 to 100 centimetres of bentonite added to the annular space. The bentonite plug should be allowed to hydrate for a reasonable amount of time. For deeper boreholes, the tremie method should be used to place the bentonite plug.

4.2.3.2 Annular Seal

The annular space above the bentonite plug should be filled with a bentonite/cement grout (recommended) or hydrated bentonite chips. Silica sand or soil cuttings from the existing borehole should not be used in any portion of the annular space.

If bentonite chips are being used, the chips should be added carefully to the annulus, so that bridging (and leaving a void space in the annulus) is avoided. If installed above the water table, potable water should be added for every 50 to 100 centimetres of bentonite added to the annular space, in order to hydrate the bentonite chips.

Gravity free fall is only applicable for bentonite chips. If gravity free fall is used, then periodic sounding of the annular space with a weighted tape measure is recommended to ensure that bridging of the sealant material is not occurring in this space.

A tremie can be used for bentonite or cement/bentonite grout. If the tremie method is used, the end of the tremie pipe should always be submerged in the grout to ensure positive displacement.

Addition of a bentonite slurry is not recommended. The water associated with this slurry can cause chemical alteration of the adjacent formation water and bring into question the representativeness of water samples collected from the well.

If a bentonite/cement grout is used as the annular sealant, the top 1 metre (3 feet) of the borehole should be sealed with bentonite clay chips. Again, potable tap water can be used to hydrate the bentonite and should be added for every 50 to 100 centimetres of bentonite added to the annular space. This section of bentonite acts as a seal, to prevent surface water from entering the monitoring well annulus.

Temporary casings or augers should be removed in short increments, as the annular sealant (or filter pack) is added. This will prevent borehole collapse or material sloughing from the borehole wall from mixing with the filter pack or annular sealant.

For unconsolidated materials (i.e. non-cohesive soils), the temporary casing or hollow stem auger should be withdrawn until the bottom of the auger or casing is approximately 0.3 metres (1 foot) to 0.6 metres (2 feet) below the annulus material being filled.

For consolidated materials (i.e. cohesive soils), the temporary casing or hollow stem auger should be withdrawn until the bottom of the auger or casing is approximately 0.6 metres (2 feet) to 3 metres (10 feet) below the annulus material being filled.

4.2.4 Surface Completion

The ground surface around the monitoring well should be sloped to drain surface water away from the well. A protective casing and lockable well cap should be installed to protect the well and prevent unauthorized access.

Aboveground installations (monument casings) and flush mount casings are available. Leaving an unprotected PVC riser sticking above the ground surface is not recommended, unless the site is secure and has no vehicular traffic in the area of the monitoring wells.

4.2.4.1 Monument Casings

Aboveground installations, such as monument casings, are often preferred. These offer the advantages of better visibility, less maintenance, and fewer problems associated with water intrusion and freezing within the casing. Monument casings can be installed to a greater depth below ground surface, and are therefore less susceptible to frost heave.

The aboveground riser should extend above the ground surface a minimum of 2.5 feet (0.75 m). A protective casing should be installed over the completed well and grouted into place. The outer protective casing should be of steel construction with a hinged, locking cap that is waterproof and tamper proof. The protective casing should have sufficient clearance around the inner well casing, so that the outer protective casing will not come into contact with the inner well casing after installation. A concrete security collar should be installed flush with the ground surface around the outer protective casing at a depth below the frost penetration. The protective casings should have a minimum of two weep holes for drainage. These weep holes should be a minimum 1/4 inch (6.4 mm) in diameter and drilled into the protective casing just above the top of the level of concrete inside to prevent standing water inside the protective casing. The weep holes will also allow internal air pressure to be in equilibrium with the atmospheric conditions. Dry bentonite pellets, granules, or chips can be placed in the annular space below ground level within the protective casing with a coarse sand or pea gravel placed in the annular space above the dry bentonite pellets and above the weep hole to prevent entry of insects.

4.2.4.2 Flush Mount Casings

Flush mount installations are usually necessary in areas with vehicular or pedestrian traffic. They are also preferred in some sites for aesthetic reasons. A lockable cap should be installed atop the riser, inside the flush mount casing. This will discourage vandalism of the monitoring well. When installed in the street or any other area with high vehicular traffic, the flush mount casing should have sufficient strength to avoid being damaged.

Flush mount well installations are typically more problematic and maintenance intensive than aboveground installations. Aluminum installations and steel installations are available. Steel installations are easily detected with a metal detector when snow or ice cover exists. Aluminum covers are not detectable by a metal detector, as such, a well magnets should be placed inside each casing, the location of each well surveyed using a hand-held GPS unit and/or well location should be tied-in to permanent site features.

4.2.5 Wells in Confined Aquifers (Unconsolidated)

If a monitoring well is being installed in an unconsolidated confined aquifer, the following additional criteria are recommended for the design and installation of the well:

- The well screen should not extend into the confining layer;
- A permanent steel casing should be considered to isolate the confined aquifer if groundwater is encountered above the confining layer, or if a contaminated zone is encountered above the confining layer. The steel casing should be set a minimum of 0.6 metres (2 feet) into the confining layer;
- Cement or cement/bentonite grout should be allowed to cure a minimum of 24 hours before drilling continues below the confining layer; and
- Annular grout should be placed the entire length of the casing, up to approximately 0.3 metres (1 foot) below ground surface.

4.2.6 Bedrock Wells

The installation of monitoring wells into bedrock may be accomplished in two ways:

a) The first method is to drill a pilot borehole through the overburden into the bedrock. An outer casing is then installed into the borehole by setting it into the bedrock and grouting it into place as described in the previous section.

After the grout has set, the borehole may then be advanced through the grout seal into the bedrock. The borehole is typically advanced into the bedrock by the rock coring method. Rock coring makes a smooth, round hole through the seal and into the bedrock without cracking and/or shattering the seal. The advantages of the coring technique are that it provides a continuous core of the rock penetration, allowing for proper formation and fracture identification and providing a sample for the geologic record. When the drilling is complete, the finished well consists of an open borehole from the casing end to the bottom of the well. There is no inner casing. The open rock interval serves as the monitoring zone. The outer casing installed down into bedrock extends above ground surface and can also serve as the protective casing. If the protective casing becomes cracked or is sheared off at the ground surface, the well is open to any contamination from the ground surface and will have to be repaired immediately or abandoned. It may be more desirable to install a protective casing over the outer casing as an extra precaution.

For wells installed to monitor bedrock units below the uppermost layers, a second casing would be installed to the top of the desired monitoring interval. Thereafter, the borehole would be extended through the casings into the bedrock interval selected to be monitored.

b) The second method of installing a monitoring well into bedrock is to install the outer casing and drill the borehole into the bedrock, and then install an inner casing and well screen and backfill with the filter pack, bentonite plug, and grout. This well installation method enables isolation of the monitoring zone after the hole has been drilled. This method may also be needed in cases where the bedrock continually collapses into the open corehole.

5. ATTACHMENTS

- Drilling/Borehole/Excavation Checklist
- Borehole Log Template

DRILLING BOREHOLE CHECKLIST

Site Location Name: ____________________ **Project No.:** ____________________

Project Scope: ____________________ **Date:** ____________________

____

Contractor: ____________________ **Subcontractor:** ____________________

Supervisor: ____________________

Activity	Yes	No/ N/A	Comments Including Justification if a Response is No or N/A
Workers properly briefed on potential site/work hazards and safety. Sub-surface and overhead clearance protocols have been reviewed with all site personnel involved in subsurface disturbance activities.			
All applicable permits and access agreements have been obtained.			
Site access/permission has been secured. Landowner/occupant has been contacted.			
Most recent as-built drawings and/or site plans, surveys (including UST product and vent lines) obtained, if available.			
Reviewed site information to identify subsurface structures relevant to planned site activities (easements, right-of-ways, historical plot plans, previous site investigations, soil surveys, borehole logs, etc.)			
Utility locates have been performed by public utility company(s). One-call companies within required timeframe. Locates clear/visible.			
Overhead and subsurface structure locates performed by private locate company within required timeframe. Locates clear/visible.			
Location of on-site indicators of underground utilities (i.e., yard light, gas mains, hydro, telecommunications, water lines, drains, sewer manholes , etc,) identified			
Orientation, arrangement, location, sizes of underground storage tanks, identified. Burial depth of tank determined if relevant.			
Presence of underground pipelines associated with pumps and pump galleries, manifolds, tank fields, compressors, production wells, loading racks, and equipment identified.			
Presence and tracing of process/storm sewers identified/understood. If other cement, fiberglass, untraced PVC lines are potentially in the ground disturbance area, identify means of identification in comments section.			

DRILLING BOREHOLE CHECKLIST

Activity	Yes	No/ N/A	Comments Including Justification if a Response is No or N/A
Clearance methods reviewed with project manager.			
Critical zones – 5 metres of pipeline crossing area or the distance defined in the pipeline crossing agreement. 3-metre distance from edge of tank pumps and pump galleries, manifolds, or below grade transformers, production wells, and suspected utilities, product lines, and other subsurface structure and entire area between tank field and dispensers at retail sites, have been identified. Identify critical zones in comments section.			
Locations of potential interference with proposed investigative locations reviewed and revised (if necessary) by project manager.			
Work area is secured. Site work permits have been obtained. Emergency shut-off switch is located. Fire extinguishers warning signs/barriers are present. Signage in place of overhead power lines. Other safety equipment as needed.			
In conducting borehole advancement activities in critical zones: First 1.2 metres or identified depth of utility or critical feature has been delineated utilizing most effective method (e.g. vacuum digging, probing, hand digging, etc.). Note methods used in comments.			
If subsurface structures exposed, extra precautions have been taken to ensure structural integrity.			

DRILLING BOREHOLE CHECKLIST

Comments/Findings	Actions to Close Out Items	Person Completing/Date

Completed by

Name (print) Company

Signature Date

XCG

XCG Consultants Ltd.

FIELD BOREHOLE LOG

BOREHOLE ID ____________________

DATE ______________________________

PROJECT NO. ________________________

SITE ADDRESS ________________________

DRILLING COMPANY ______________________________

DRILLING EQUIPMENT ______________________________

SAMPLING METHOD ______________________________

BOREHOLE DIAMETER ____________________

SCREENING TOOL ______________________

LOGGED BY ______________________________

FROM	AT	TO	SOIL DESCRIPTION ORDER OF DESCRIPTORS: PRIMARY/SECONDARY COMPONENTS, RELATIVE DENSITY/CONSISTENCY, GRAIN SIZE/PLASTICITY, GRADATION/STRUCTURE, COLOUR, MOISTURE, SUPPLEMENTARY DESCRIPTORS	SAMPLE INTERVAL	N Value 6 12 18 24	RECOVERY (L or %)	HEAD SPACE (ppm)	CHEMICAL ANALYSIS

ADDITIONAL COMMENTS / WELL INSTALLATION DETAILS

SOIL VAPOUR PROBE INSTALLATION

This Standard Operating Procedure (SOP) has been developed based on the Suggested Operating Procedure: Soil Gas Probe Installation, from the Reference Handbook for Site-Specific Assessment of Subsurface Vapour Intrusion to Indoor Air, EPRI, March 2005.

1. PURPOSE

The purpose of soil gas probe installation is to allow for the collection of soil vapour samples and pneumatic monitoring data to assess the potential for human health risks due to subsurface vapour intrusion into indoor air and subsequent inhalation exposures.

Soil vapour probes can be constructed of a variety of materials and placed using a variety of drilling or driving methods. Selection among the various methods and designs should be made with knowledge of site-specific conditions, primarily, the depth of interest, the geologic materials, the gas-permeability of the sampled strata, and access constraints. This protocol emphasizes methods that will yield high quality monitoring data for a wide variety of site-specific conditions and provides guidance for the selection between methods to accommodate site-specific conditions.

2. SCOPE

This SOP describes the minimum requirements for installing soil vapour probes.

3. PROCEDURE AND SITE CHARACTERIZATION

Soil vapour intrusion sampling investigations should be conducted after all potential vapour sources (e.g. non-aqueous phase liquids, contaminated soil and groundwater, background sources of volatiles in indoor air) have been identified and characterized. In addition, the physical setting of the site should also be known, including (if applicable):

- Geology (soil textures, stratigraphy);
- Hydrogeology (depth to groundwater, groundwater flow direction, vertical and lateral gradients, hydraulic conductivity);
- Vadose zone characteristics including water content, porosity, fraction of organic carbon, bulk density and soil-air permeability;
- Preferential pathways such as subsurface utilities;
- Building construction, both present and future (location, use, size, height, foundation type, foundation characteristics, heating, ventilation, and air conditioning (HVAC); and
- Vertical and lateral distance from soil vapour sources to buildings or potential future buildings.

Furthermore, site conditions should be sufficiently characterized to ascertain whether vapour sources and the vapour profile in the subsurface are at steady-state. This is to maximize the chances that any assessment of risk will represent both current and future conditions.

A sufficient number of vapour sampling events must be completed so that fluctuations in vapour concentrations can be evaluated. These fluctuations could result from seasonal effects, changes in building conditions (e.g. HVAC operation), or changes in source strength (e.g., due to water table fluctuation). Investigators must provide sufficient rationale or evidence to show that the number of sampling events completed is adequate to identify and characterize worst-case soil vapour concentrations.

The Ministry of the Environment and Climate Change (MOECC) generally considers that at least two rounds of sampling (e.g. summer and winter) are required to assess any potential seasonal or temporal fluctuations in soil vapour concentrations. In limited cases, however, the MOECC may consider one sampling event to be sufficient. One sampling event may be acceptable in situations where the investigator can provide evidence to rule out significant fluctuations in source and site conditions, and when predicted indoor and outdoor air concentrations are a minimum of one order of magnitude less than corresponding acceptable air concentrations.

4. DRILLING/CORING

The drilling/coring method will depend on the target depth, geologic materials, and access constraints. Hollow-stem auger drilling is feasible in most overburden and soft bedrock materials to depths of interest for vapor intrusion studies. The most common size for hollow stem augers is nominal 20-centimetre (7-inch) outside diameter (O.D.), and 10-centimetre ($4^{1/4}$-inch) inside diameter (I.D.). Smaller boreholes or coreholes are often preferred, to minimize disturbance of the natural materials, especially for shallow probes designed to provide discrete resolution of vertical concentration profiles. Boreholes can be advanced using percussive/direct-push technology (e.g. GeoProbe™ or similar, slide-hammers, jackhammers, etc.), where the percussive technology is used to advance a soil sampler to collect a core and create a space for installing a probe, filter pack and seal. Percussive technologies can also be used for directly driving a soil vapour probe (direct-push probes) although the potential for leakage along the outside of the probe cannot be reliably tested, which may not meet the data quality objectives required for human health risk assessment. Direct-push soil vapour probes may provide representative samples assuming that the following conditions are met:

i. The gas permeability of the subsurface materials is moderate-to-high,

ii. The materials are sufficiently cohesionless to collapse around the probe,

iii. Proper seals are in place,

iv. The depth below ground surface is generally more than about 1.5 metres (5 feet),

v. The purge volume is minimal, and

vi. The vacuum exerted during purging is very low.

That said, it is difficult, if not impossible, to verify the air-tightness of soil vapour probes installed using direct-push method. Therefore, the recommended method for installing soil vapour probes is based on using a borehole or corehole that have sand-pack around the screens and a slurry seal in the annulus above the sand pack.

In addition, direct-push probes usually do not provide soil core, so they should only be used where the stratigraphy is well-known in advance and other drilling or coring methods are impracticable, for example due to rig access constraints.

Bedrock that is too hard to be drilled using augers will generally require an air rotary drilling or coring method. Air-rotary drilling or coring is feasible, but an inert tracer gas (e.g. Helium) should be added to the drill air. After the probe is installed and the seals have set, vapour should be purged from the probe until the concentration of the tracer gas falls below 1% of the concentration injected into the drill air. This assures that the remaining soil vapour is >99% from the subsurface. Water rotary or mud rotary methods will leave a filter cake on the borehole wall that will not be possible to remove through conventional vapour probe development techniques for intervals above the water table, so these methods are not recommended.

The optimal borehole diameter will vary depending on site-specific factors. In general, the borehole diameter must be large enough to allow careful placement of the sand-pack around the soil vapour probe intake, and seals above the sand-pack. Larger diameters will be needed for multi-level installations with more than one probe per borehole. Standard hollow stem augers (0.2-cmetre/8-inch outside diameter [OD], 0.1-metre/4.25-inch inside diameter [ID]) can easily be used to install one 50-mm/2-inch diameter soil gas probe, or up to three 2.5-centimetre/1-inch diameter probes, or a bundle of five 0.6-centimetre/1/4-inch diameter tubing probes, fastened around a 25-mm/1-inch diameter center pipe. Standard solid-stem augers (0.1-metre/4-inch OD) can be used for similar installations, where the geologic materials will not collapse and the borehole remains open after the augers are withdrawn. Drill- or core-hole diameters should allow sufficient space to place seals and verify their placement using a tamping rod or weighted measuring tape.

When drilling boreholes, refer to XCG’s SOP for Borehole Drilling.

5. GEOLOGICAL LOGGING

The geologic materials retrieved by drilling or coring should be visually inspected and recorded on XCG’s borehole log forms. If the probes are installed in close proximity to each other, or if previous stratigraphic information is already available, the geologic materials may not need to be logged for each probe location. Where nested soil vapour probes are planned, logging should be done for the materials in the deepest borehole only.

Soil samples should be collected for laboratory analysis of moisture content, fraction of organic carbon, and grain size distribution.

Soil cores should be visually inspected for color, texture, plasticity, relative moisture, and any indications of staining from oils, fuels or solvents. If any soil is observed with freely-draining water from depths of more than 1 metre/3 feet above the water table, this may indicate a presence of perched water condition. The presence of perched water in the soil is very significant with respect to the assessment of upward vapor transport. Porous media with greater than about 70% water saturation may act as an effective barrier to vapor transport (Weeks et. al., 1982).

6. PROBE PLACEMENT

Probe placement is an important consideration when planning a soil vapour study. Factors include the contaminants of concern, the size of the plume, the number and spacing of buildings, the thickness of the building foundations/floor slab, the footprint of the building "zone of disturbance" and utility conduits. Additional information on the number, placement and spacing of probes is provided in the MOECC *Draft Technical Guidance Soil Vapour Intrusion Assessment* (September 2013), which should be consulted prior to planning a drilling program. Note that sumps or pits are included in the measurement of the distance between the building foundation and the vapour contamination source.

7. PROBE DESIGN AND INSTALLATION

The most common soil vapour probe assemblies will be constructed of clean, inert materials HDPE, Teflon™ or Nylon tubing, or pre-fabricated polyvinyl chloride (PVC) well screen and casing, although use of stainless steel, copper, or brass pipe are also acceptable. If using PVC, it is generally recommended that sampling not occur on freshly cut pipe for several days after installation if vinyl chloride is a contaminant of concern.

Probes may be installed in individual boreholes in close proximity (nested installations), or with more than one probe in a single borehole (multi-level installations). The selection of whether to use a single probe or multiple probes to provide a vertical profile of data must be made on a site-specific and/or project-specific basis.

If off-gassing from groundwater is the suspected source of vapors to the unsaturated zone, it is often useful to collect shallow groundwater samples. Note that the most shallow probe depth is to be at least 1.5 metres/5 feet to the *top of the screen* if the MGRA model is to be used. Typical monitoring well designs are appropriate, although the screened interval must extend above the water table to ensure that the uppermost groundwater can be sampled, even if the water table fluctuates with climatic or seasonal changes. The screened interval should not extend below the water table, but rather should be placed between 0.5 metres/1.5 foot and 1.0 metres/3.3 feet above the highest seasonal water table. The screened interval itself should measure between 0.15 metres/1/2 foot and 0.3 metres/1 foot in length. If the screened interval extends above the water table, it will be possible to draw a vacuum on the well and extract deep soil vapour, provided the stagnant air in the well casing is adequately purged prior to sampling (by removing at least a few casing volumes of air), with confirmation by stabilization of field screening readings using portable instruments to monitor VOC concentrations, O_2, and CO_2 (see SOP for Vapour Sampling Using Summa Canisters). Using water-table monitoring wells for the dual purpose of collecting shallow groundwater and deep soil vapour samples provides a data that can be used to assess whether and to what extent there are any impediments to off-gassing of vapors from groundwater, which may be an important element of the conceptual site model.

As with any sampling instrumentation, shorter screened intervals provide more discrete profiles of concentration and are therefore generally preferred. The length of the screen may be proportional to the thickness of the unsaturated zone; for example, a 3-metre/10-foot screen in a 30-metre/100-foot thick vadose zone provides comparable resolution to a 0.3-metre/1-foot screen in a 3-metre/10-foot thick vadose zone. Screened intervals may often be designed to correspond with stratigraphic intervals, which can be mapped by soil coring prior to probe construction. If a low-permeability layer is present in the unsaturated zone, and if infiltration is sufficient to maintain a high moisture content within or perched water above this layer, the low-permeability layer may act as a partial or complete vapor barrier, so selective screen placement may be very important in some cases. Examples of various probe designs are shown in Figure 1.

The top of a soil vapour probe must be sealed with an air-tight valve or cap to avoid ambient air entry, which could be caused by barometric pressure fluctuations. The valves should be lubricant-free brass or stainless steel ball valves, since these impose minimal resistance to flow when fully open. Needle valves and gate valves should be avoided. The valves may have compression fittings (preferable) or barbed fittings (provided the tubing fits snug and at least three barbs are covered). Probes constructed of threaded PVC pipe should have a threaded cap, with the valve threaded into the cap, with all threads sealed with Teflon™ tape. Probes constructed of HDPE, Teflon™ or nylon tubing should preferably have valves with compression fittings. Barbed valves can be used as long as the tubing is securely fitted over at least three barbs, which can be difficult with these inert tubing materials because they have very limited flexibility.

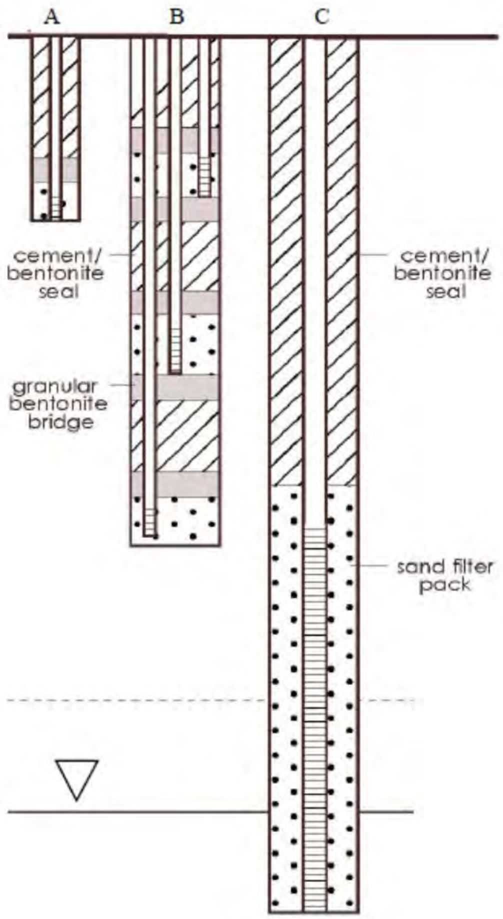


Figure 1 – Options for Soil Vapour Probe Designs: A) Single Probe, B) Multi-Level Probes, and C) Combination Deep Soil Vapour and Shallow Groundwater Probe (Source: Reference Handbook for Site-Specific Assessment of Subsurface Vapour Intrusion to Indoor Air, EPRI, March 2005).

7.1 PVC WELL SCREEN AND RISER PIPE

Prefabricated PVC well screen and riser pipe is readily available, and comes in convenient lengths (typically 1.5-metre/5-foot and 3-metre/10-foot sections) and diameters (25.4 mm/1-inch and 50.8 mm/2-inch). The optimal length of the screen may vary according to site-specific conditions. The screen length should generally be small relative to the depth of the screen, so as to provide discrete vertical profiles of soil vapour chemistry and pneumatic properties. For example, shallow probes (<1.5 metres/5 feet), should generally have screens of 0.15 metres/1/2 foot to 0.3 metres/1 foot in length. Deeper probes may have similar screen lengths, or they may have longer screened intervals. To maintain reasonable vertical resolution, the screen lengths of soil vapour probes generally should not exceed roughly 1/10th of their depth (i.e. a 1.5-metre/3-foot screen would be acceptable for a 15-metre/ 50-foot deep probe), plus or minus a factor of 2, depending on the degree of vertical resolution that is desired. A convenient screen slot size is 2.54 mm/0.1 inch, although soil vapour probes are not subject to influx of soil particles, so larger slot sizes or drilled holes can be used, provided they are smaller than the filter sand particle size or are wrapped with nylon mesh. Additionally, there are stainless steel mesh screens designed to be suspended by Teflon tubing which are available. See section 8.3 for more details.

To customize the probe design to the target depth, it will often be necessary to cut the prefabricated screen or casing materials to lengths different than the typical 1.5-metre/5-foot to 3-metre/10-foot lengths. A hacksaw is the best tool for cutting the PVC, but it is important to use a clean (preferably new) blade. A friction-fit slip cap may be used as the bottom plug to seal the bottom of the screen. The top of the probe must have a valve secured to the probe with an air-tight fitting. It is usually preferable to cut a thread into the outside of the riser pipe using a die of matching diameter, with standard NPT threads. A threaded cap should be placed over the top of the riser pipe, with a threaded fitting for the valve at the top of the probe. Threaded couplings for the cap and the flush-threaded couplings between the riser pipe segments and screen should be wrapped with Teflon™ tape and fastened tightly to prevent leaks. Glued couplings are not appropriate/should not be used because glues will contribute vapors. Clean nitrile gloves should be used to handle the probe, and it should be kept on or in clean plastic sheeting until installation.

For multi-level installations of rigid pipe soil vapour probes, it is generally preferable to have each probe installed separately, with sufficient distance between the probes to allow seals to surround each probe completely. If probes are in contact, it may block seals from completely filling all voids, and potentially result in a leak.

7.2 HDPE, TEFLON™, OR NYLON TUBING

HDPE, Teflon™, or Nylon tubing is generally preferable to PVC pipe for shallow soil vapour probes (<1.5-metre/5-foot depth), but may also be used for deeper probes. A diameter of 6 mm to 12 mm/ ¼- to ½-inch diameter will allow soil vapour sampling and pneumatic testing with acceptably low line-losses. Smaller diameters can be appealing for minimal purging; however, such small tubes are limited in their usefulness for larger volume purging and pneumatic testing because of line-losses at higher flow rates, and therefore, should be used selectively.

The screened interval of tubing probes can be constructed in the field by drilling small diameter holes in the tubing using a 1.5- to 3-mm/1/8- to 1/16-inch drill bit. Roughly a dozen holes per 0.10-metre interval are sufficient to allow soil vapour flow at rates appropriate for sampling. Valves for the top of plastic tubing probes may be made of brass or stainless steel. Compression fittings are preferred, but barbed fitting are also acceptable, providing at least three barbs are inserted into the tubing for a secure fit. It may be necessary to heat the tubing to allow the barbs to seat deeper, especially for tubing that is very rigid or in cold weather.

7.3 STAINLESS STEEL SCREENS

Prefabricated stainless steel screens which can be threaded to tubing, and used as an alternative to drilled holes at the probe tip are also commercially available. Most drillers can provide these materials, if requested.

8. BACKFILLING

The dominant concern with soil vapour sampling is leakage that allows ambient air to enter the sample. Therefore, the integrity of the seal between the soil vapour probe and the inner wall of the borehole in which the probe is installed (the borehole annulus) is of paramount importance. For example, a seal placed only at the ground surface will not prevent annular leakage between different depth intervals within the subsurface; therefore, the seal should be installed from just above the top of the soil vapour probe screen to the ground surface. This is generally easy to accomplish in a borehole that is larger in diameter than the probe, where geologic materials have been removed by drilling or coring.

The borehole backfill should consist of sand around the screen of the probe, a bridge of at least 0.15 metres/6 inches of granular bentonite above the sand-pack, and a thick slurry of bentonite and water from above the bridge to within about 0.3 metres/1 foot of ground surface. For multi-level installations, the slurry should be placed to about 0.15 metres/6 inches below the bottom of the screen of the overlying probe, to allow another 0.15-metre/6-inch granular bentonite bridge below the sand pack. If the multi-level screens are within 1 metre/3 feet of each other, it may be best to use multiple lifts of granular bentonite and water as seals in lieu of a slurry.

The sand filter pack surrounding the probes screen must be more permeable than the surrounding geologic materials to enable pneumatic testing to determine the vapour-permeability of the natural geologic materials. In contrast to groundwater monitoring wells, the filter sands can be considerably more coarse-textured than the surrounding material without risking undesirable turbidity. Coarse sand to fine gravel-sized filter sand is preferred.

If the probe is constructed of tubing, a thin layer (approximately 50 mmm/2 inches) of filter sand should be placed at the bottom of the borehole before the soil vapour probe tube or pipe is emplaced. This will prevent plugging of the bottom of the probe with any cohesive geologic materials at the bottom of the borehole. Once the soil vapour probe is emplaced, sand should be added to surround the screen, and extend a minimum of 0.1 metres/4 inches above the top of the screen. The position of the sand filter pack should be measured with a weighted tape and recorded on the soil vapour probe installation log.

Immediately above the hydrated sand pack, a bridge of dry granular bentonite should be placed, a minimum of 50 mm/2 inches thick. Granular bentonite has a texture like coarse sand particles, which is ideal because it will fall in the borehole with minimal risks of bridging above the top of the sand-pack, but it will also hydrate almost instantaneously with the addition of water. In fact, it is typically impossible to hydrate more than the upper few centimetres/a couple of inches of granular bentonite, so it should not be added in lifts of more 0.15 metres/4 inches at a time without hydrating in between. A weighted tape or tamping rod should be used to ensure the granular bentonite bridge has been set to the desired level prior to hydrating. Above the granular bentonite bridge, a thick slurry of powdered bentonite and water can be used to seal the remainder of the borehole. If a single probe is installed in each borehole, this is relatively simple to implement using methods familiar to drillers for the placement of water well seals. A tremmie pipe should be used to place the slurry, especially where multi-level probes are specified, otherwise, the borehole walls and probe screens may become fouled.

For multi-level probes, a cement/bentonite slurry seal between probe intervals may not provide sufficient structural support to bear the weight of the overlying sand pack, in which case, bentonite chips should be added to the slurry to provide inter-granular friction, and sufficient bentonite powder should be added to make the mixture as thick as practicable. Prior to placement of a sand-pack above a slurry seal, another bridge of granular bentonite should be emplaced and hydrated, followed by at least a 50 mm/2 inches of sand before the next probe screen is placed. The position of the sand lifts should be verified using a weighted measuring tape or tamping rod.

For vertical profiling with tubing, it can be very difficult to place multiple tubes into a single borehole independently, because of the tendency for the tubing to coil. One option is to feed the tubing down through a tremmie pipe of relatively narrow diameter (e.g. 25-mm/1-inch), which will prevent coiling. The tip is set in filter sand as the tremmie pipe is slowly withdrawn, and after the granular bentonite bridge is set above the filterpack, the tremmie pipe can then be withdrawn, and be reused to install the next probe. Thick bentonite-slurry seals should be used between sampling intervals, isolated from the probe screens and filter packed intervals by a bridge of at least 0.15 metres/6 inches of granular bentonite.

9. PROTECTIVE CASINGS

In cases where soil vapour probes may be used for potential future monitoring events, they should be protected with a cover that will inhibit tampering or vandalism. The methods in this SOP are otherwise equally applicable for installation of permanent or temporary probes.

Protective casing should be used to provide protection from tampering, rainwater, traffic, or other potential threats to the integrity of the soil vapour probe. Prefabricated units are available from suppliers of well casing materials. They may be either flush to grade or have a portion that stands above grade, depending on traffic, vegetation, and landowners preferences.

There must be sufficient space within the protective casings for access to the valves on top of the soil vapour probes. For nested installations, it may be necessary to allow for 0.20 metres/8 inches or larger diameter casings. The casings should be set in a minimum of 0.45 metres/18 inches of concrete for permanence, and more if there is a portion above grade.

For flush-mount protective casings, the seal in the borehole should terminate at least 0.15 metres/6 inches below the bottom of the protective casing, and sand backfill should be placed to the target depth of the bottom of the protective casing, as well as within the protective casing to a height of about 0.3 metres/1 foot below grade. This sand lift will allow for drainage of any water that might accumulate inside the protective casing. Most flush-mount protective casings are supplied with a rubber gasket that should minimize water entry, but this drainage layer provides additional assurance that the soil vapour probe integrity will not be compromised in the event of heavy rains.

10. DEVELOPMENT AND EQUILIBRATION

Soil vapour probes should be purged of a certain volume of soil vapour after installation and before initial sampling is conducted to remove ambient air that may have entered the borehole during the drilling and installation procedure, and to promote the collection of reproducible samples of soil vapour during subsequent sampling. Following the development, a period of time should be allowed for equilibration prior to the initial sampling event.

The volume to be purged during development and the time required for equilibration prior to sampling depend on site-specific factors. If probes were installed using augers, the volume of air in the augured hole should be removed during development, at a minimum. This can be calculated using:

$$V = pr^2h$$

where r is the radius of the borehole, h is the depth, and π is 3.14.

It is generally preferable to perform field screening of the soil vapour purged during the development procedure using portable instruments, which will typically include at least a photoionization detector (PID), or flame ionization detector (FID) for screening concentrations of total volatile organic compound (VOC) vapours. Landfill gas meters are also useful for screening concentrations of O_2 and CO_2, especially if the subsurface vapors of concern at a particular site can be degraded by soil microbes under aerobic conditions (e.g. hydrocarbons). If probes were installed using air-rotary drilling and helium or other tracer gas, development should continue until the concentration of tracer in the extracted soil vapour is less than 1% of the concentration used in the drilling air.

Field screening readings should stabilize as development progresses. As a rule of thumb, one field screening reading should be taken for each casing volume of soil vapour removed, although where casing volumes are small, this may not be practical. A casing volume is defined as the volume of vapour in the soil vapour probe, and does not include the volume of soil vapour in the sand-pack materials surrounding the screen of the probe. In most cases, development will be complete after 3 to 5 casing volumes of soil vapour are removed. Field screening readings should stabilize within a factor of about 10%, with no consistent increasing or decreasing trend over the course of 3 to 5 successive readings. Field screening samples should be collected in a Tedlar™ bag using a lung box, according to the procedure described in XCG's SOP for Soil Vapour Sampling Using Summa Canisters.

11. DOCUMENTATION

A soil vapour testing record form is attached. One form should be filled out for each soil vapour probe sampling event. The volume of air removed during development should be recorded, as well as the stable flow rate and vacuum. A log of geologic material properties should also be prepared, using a standard borehole logging template.

12. REFERENCES

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13. CONVERSION OF SOIL GAS ANALYTICAL RESULTS (PPBV TO µG/M^3)

Soil gas analytical results are typically reported in two different sets of units. These units are volume per volume (e.g. parts per billion volume [ppbv]) and mass per volume (e.g. micrograms per cubic meter [µg/m3]). Unlike aqueous samples, these two sets of units are not equivalent. The conversion of a gas concentration from ppbv to ug/m3 is accomplished by assuming that the gas is an ideal gas:

PV=nRT
where:
P [atm] = ambient pressure (1 atm)
V [L] = volume
n = moles of air
R [L-atm/mol-K] = universal gas constant = 0.0821
T [K] = standard temperature (273 K)
MW [g/mol] = molecular weight of the individual chemical of concern.

At standard temperature and pressure (i.e. 273 K and 1 atm), one mole of air occupies 22.4 litres in volume. The ppbv concentration is moles of chemical of concern per 109 moles of air. The conversion equation is then:

$$\left(\frac{Cug}{m^3}\right) = (C\,ppbv) \times \frac{1mol\ COC}{10^9 mol\ air - ppbv} \times 1\ mol\,\frac{air}{22.4L} \times \frac{273K}{298K} \times \frac{10^3 L}{1m^3} \times MW \times \frac{g}{mol\ COC} \times 10^6 ug/g$$

$$\left(\frac{Cug}{m^3}\right) = (C\,ppbv) \times \frac{1}{22.4} \times \frac{273}{298} \times MW$$

$$\left(\frac{Cug}{m^3}\right) = (C\,ppbv) \times 0.04 \times MW$$

Soil Vapour Testing Record

Project Name:	
Project Number:	
Field Technician:	
Date:	

Well ID:		**Temperature (C):**	
Well Depth (m):		**Wind Speed (km/hr), Direction:**	
Well Volume (L):		**Ambient Pressure (kPa):**	
Summa Tag #:		**Regulator Tag #**	

Sampling train leak test assembly (in-Hg for 3 minutes):	

Time	**Initial Pressure/Vacuum in Vapour Monitoring Well Prior to Pumping (in-H_2O)**	**Vacuum ___ or Pressure ___**

Initial Helium Tank pressure: ________	**Final Helium Tank pressure: ________**	
Helium Concentration in Shroud (%):		
Helium Concentration in Tedlar (% or ppm):		

Ambient Air PID/FID readings (5 in 1 minute):				

Pump Flow Rate:_____________

Time	Well Head Vacuum (inches H_2O)	Cumulative Volume (litres)	VOCs by PID (ppmv)	Helium (% or ppm)	Oxygen (%)	Methane (%)	CO_2 (%)

Sampling:

Starting Time	Starting Vacuum	Finish Time	Final Vacuum

Comments:

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SAMPLE HANDLING

1. PURPOSE

The purpose of sample collection and handling procedures is to ensure that sample integrity is maintained from the time the sample is collected and placed in the laboratory-supplied sample container to the point the sample is delivered to the laboratory for chemical analysis. Strict adherence to sampling protocols must be maintained to ensure valid data is generated for all environmental investigations conducted.

2. RELATED SOPS

The following SOPs should also be reviewed prior to the commencement of the works:

- Field Screening.
- Soil Sampling.
- Groundwater Sampling.

3. PRIOR PLANNING AND PREPARATION

Prior to conducting the soil sampling program, the following questions should be considered:

- What are the sample container requirements for each parameter to be included in the sampling program?
- What are the maximum hold times for each parameter from the time of sample collection to delivery to the analytical laboratory?
- What health and safety considerations are associated with the specific sample preservatives present in the sampling containers/supplied by the laboratory?
- What is the quality assurance/quality control (QA/QC) sample frequency that will be adhered to?
- Is there specific field sampling equipment or excess field preservation chemicals that must be brought out into the field?
- Is there any available on-site refrigeration for sample storage during the sampling program?

4. PROCEDURE

Soil samples that are being bottled to be sent to the laboratory for chemical analyses should not be touched with the bare hand or by gloves that may be contaminated. Contact or handling of the soil should be minimized at all times. Sampling gloves (nitrile) should be changed between each sampling interval and between all sample locations (borehole, sediment samples, monitoring wells, surface water stations, etc.) to prevent cross-contamination.

Plastic residues could be transferred onto the soil core before soil is conveyed into the appropriate sample container. For soil being analyzed for organics with very low regulatory limits [such as polyaromatic hydrocarbons (PAHs), pesticides, herbicides, and dioxins/furans], the soil should not be touched by a glove made from a plastic material (e.g. latex and nitrile). For these parameters, the soil should only be in contact with a clean stainless steel sampling device (e.g. a trowel or a spoon). For soil being analyzed for organics with higher regulatory limits [such as total petroleum hydrocarbons (TPHs) and benzene, toluene, ethylene, xylenes (BTEX)], contact with the soil by clean glove materials is acceptable, but such contact should be minimized. Metal sampling devices used should not be plated. For example, chrome plated sampling devices should not be used for metals sampling.

Samples being submitted to the laboratory for VOC analysis (e.g. BTEX or TPH F1 fractions) and PAHs should not be composited or mixed in the field. Discrete grab samples should be taken from soil that best represents the contamination of the sampling location and then transferred directly into containers.

The proposed analytical methods for VOCs and light fraction PHC (F1) analysis include the use of hermetic sampling devices and/or preservation of samples in field. Hermetic sampling requires collection of 5 grams of soil in an airtight container such as EnCore Sampler. Field preservation (or field stabilization) technique requires placing a weighed amount of soil (~10 grams) into a vial with a premeasured amount of preservative (methanol). When one of these soil sampling methods is used, the sample for laboratory VOCs analysis should be collected at the time of initial sampling. As noted in the Soil Sampling SOP, the portion of the sample not utilized for field vapour screening can then be used to fill the remaining sample containers for analysis of other parameters of concern (i.e. metals, PAHs, etc.).

Soil from field vapour screening (e.g. soil in plastic bags or soil screening jars) should not be reused for laboratory analysis, if possible. If there is insufficient recovery of soil to segregate into separate storage bags for both vapour and chemical analyses, the soil should be submitted for chemical analysis without conducting a field vapour screening measurement. Soil previously used for field vapour screening can be submitted to the laboratory for the analysis of inorganic parameters (e.g. salinity, metals) or physical parameters (e.g. grain size analysis).

4.1 SAMPLE CONTAINERS AND PRESERVATION

The analytical methods and quality control protocols set out in the Ministry publication “Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the *Environmental Protection Act*” address matters such as sampling requirements, sample containers and preservation, quality control and quality assurance, the protocol for accepting analytical results, and reporting of data. Make sure to review the sample volume requirements from the analytical laboratory to ensure that sufficient soil volume is submitted for chemical analysis. In some instances, the laboratory can use soil from one sample container for analysis of multiple parameters (i.e. metals, PHCs F2 to F4, PAHs).

For storage of samples for chemical analysis, either jarred or temporarily bagged, it is recommended that temperatures be maintained at <4°C, but it is recognized that many situations can occur where fluctuations to above this temperature are extremely difficult to avoid. Coolers filled with ice should be brought into the field to maintain sample temperature during the sampling activities.

Since temperatures slightly above 4°C for very short periods of time are unlikely to significantly affect sample quality, the maximum temperature is set at 10°C. Some microbiological activity occurs at the above temperatures, so the possibility of breakdown of organics exists. Analysis for both organic and inorganic parameters should occur within hold times specified in the Ministry publication “Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the *Environmental Protection Act*” dated March 9, 2004, as amended.

4.2 CHAIN-OF-CUSTODY RECORDS

Chain-of-Custody (CoC) forms must be completed for all samples collected and submitted for laboratory analysis. Completed CoC forms are legal documents. They should be completed and handled accordingly to the instructions printed on the forms and/or following instructions.

The CoC form, completed at the time of sampling, must contain at least the sample number, date and time of sampling, the name of the sampler, the analysis required, and the number of bottles/containers submitted for each sample. Contact information must also be provided. The CoC document must be signed and dated by the sampler when transferring the samples from the sampler's custody to custody of others. Any changes to the CoC must be initiated by the person making the changes.

All samples stored, transferred, and shipped must be accompanied by a CoC form. The CoC form should consist of multiple copies that can be distributed to the shipper, laboratory, and client. When releasing samples from his or her custody, the sampler must keep a copy of the CoC indicating when the samples were released, who released the samples, and who the samples were released to.

GROUNDWATER SAMPLING

1. PURPOSE

The purpose of developing a standard operating procedure to collection of groundwater samples is to ensure samples are properly collected and handled, and to maintain the integrity of the samples arriving at the laboratory for analysis.

2. RELATED SOPS

The following SOPs should also be reviewed prior to the commencement of the works:

- Sample Handling.

3. PRIOR PLANNING AND PREPARATION

The following shall be considered prior to groundwater sampling:

- Assemble site plan, well logs, and previous sampling/purging data that will be required for the planned sample event. Determine the exact number and locations of the wells to be sampled.
- Determine analytical requirements, arrange for appropriate analytical sample containers, and appropriate development/purging and samples methods to be used, including any extra required field equipment/supplies (i.e. water quality checker, in-line filters, etc.).
- Determine well development/purging fluid disposal requirements before sampling activities start.
- Determine sampling methodology to be used for groundwater sampling program and make sure methods are consistent throughout the program.
- Pre-plan sampling sequence to ensure that "clean" wells are sampled before "dirty" wells to reduce cross-contamination potential.
- Pre-plan the sampling sequence to ensure that "dry" wells fit into the overall sampling schedule to reduce the need for extension of the sampling period.

4. PROCEDURE

Sampling methods should consider the nature of the water bearing unit to be sampled (i.e. gravel, sand, silt), the depth of sampling and the parameters being sampled for and match this with the appropriate sampling equipment/devices and sampling procedures. Certain pre-sampling activities are also normally required prior to obtaining a groundwater sample for analysis.

4.1 PRE-SAMPLING ACTIVITIES

A number of pre-sampling activities or measurements are often required prior to obtaining a groundwater sample for analysis. Prior to conducting any sampling activities, the monitoring well should be accurately identified to ensure no mislabelling occurs and the condition of the well should be inspected to ensure it is suitable for collecting a representative groundwater sample. Any significant damage to the protective casing or surface seal (indicating that well integrity may have been compromised) should be reported to the Project Coordinator/Manager.

4.1.1 Headspace Monitoring

Field vapour measurements should be taken from inside the casing of a monitoring well using a combustible vapour detector (operated in methane exclusion mode) or organic vapour meter, to indicate the potential for contamination of the groundwater by VOCs. These data are only semi-quantitative and should not be used for risk assessment (e.g. for human health, ecological, or explosive risks) or compliance reporting purposes. The results do not truly represent the concentration of volatile hydrocarbons in the headspace above the air/groundwater interface. At some sites, the presence of natural gas in the formation can cause high vapour concentrations measured in the well headspace that are unrelated to groundwater quality.

Vapour measurements (in monitoring wells) should be done to alert field staff to their potential exposure to volatiles while sampling the wells, allowing them to take the proper safety precautions. They should also be performed at sites where there is an explosive risk due to the collection of volatile organic vapours in a confined space (e.g. a nearby basement or sewer). The potential for explosive risk in the actual monitoring well is generally considered to be low.

The vapour concentration is measured by placing the combustible vapour detector nozzle inside the monitoring well casing no less than 15 centimetres (6 inches) below the top of pipe (TOP). The combustible vapour detector reading should be taken immediately after the cap has been removed from the top of the monitoring well casing in order to minimize the loss of volatiles from within the casing. The peak reading should be recorded.

4.1.2 Water Level Measurement/Well Depth Sounding

Static water levels should be obtained prior to monitoring well sampling each time the monitoring well is sampled. Water levels in piezometers or monitoring wells should be allowed to stabilize a minimum of 24 hours after well construction and/or development before measurement.

Water levels should be accurately measured, using an industry accepted electronic water level detector, measuring tape or other device with similar accuracy.

Groundwater levels should be measured from the permanent water level measurement location mark at the top of pipe (TOP), which has been surveyed as the well reference elevation point. The top of the well casing should be notched to indicate the exact point of measurement. To ensure reproducible data, all subsequent readings should be taken from the same notched point in the well casing.

Water level measurements should start at wells located in uncontaminated areas first. Then measurements should be made from wells in contaminated areas, with wells containing the least contaminated groundwater being measured first and wells containing the most contaminated groundwater being measured last.

Measurement of the groundwater level should be conducted prior to purging of the monitoring well. Monitoring well water levels rarely return quickly to the original water level after purging of the monitoring well so the measurement after purging would not represent the true equilibrated water table elevation.

If possible, all water level measurements used to define a water table or potentiometric surface should be collected within a 24-hour period in order to minimize the effects of changing barometric pressure. Water levels taken during a sampling event determine the height of the water table (relative to top of pipe) prior to sample collection. The measurement is converted to a groundwater elevation and compared with data from other wells in the monitoring program.

Well depth sounding should also be conducted at monitoring well locations that have not been sampled for a significant length of time (i.e. greater than six months). The well depth sounding will help to determine the amount/depth of sediment in the well casing by comparison to original well log. Presence of sediment at the bottom of the well in the amount of 1/3 or more of the well screen will require redevelopment or well flushing, prior to sample collection. Sounding is typically performed with a weighted measuring tape lowered to the base of the well and comparing the reading with the installed depth of the well.

Decontamination of water level measurement equipment, using the manufacturer’s recommended cleaning method for the probe, should be completed after each measurement in order to prevent cross-contamination between monitoring wells. A more rigorous cleaning procedure should be followed if the probe has come into contact with any non-aqueous phase liquids (NAPL) in the well.

Latex gloves should be worn during use of the groundwater level measurement equipment. Contact between the latex gloves and the measurement probe should be minimized. Any hydrocarbon-contaminated gloves should be disposed of.

4.1.3 NAPL Layer Detection

At sites with potential non-aqueous phase liquid (NAPL) contamination, NAPL and its thickness can be detected in conjunction with water level measurement by using an industry accepted interface probe. NAPL monitoring should be performed at these sites every time that a monitoring well is sampled. Measurements of NAPL thickness and water level should be completed twice at each location to confirm initial readings.

The interface meter should be properly cleaned after each measurement to prevent cross-contamination between each reading and/or each monitoring well.

A transparent bailer fitted with a bottom-draw valve and lowered slowly into the well to withdraw a sample from the top of the water column to provide visual confirmation of the presence of light NAPL (LNAPL), such as fuel or aliphatic/aromatic solvents. This method is often superior to the interface probe in detecting the presence of a very small thickness of NAPL or sheen. The bailer should however only be used after the interface probe measurement is taken. The bailer is used to confirm the negative interface probe reading or, if a positive reading is obtained, to give a rough estimate of the thickness of the free product.

Monitoring well measurements of NAPL should include depth to the NAPL phase, depth to water table, and the thickness of the NAPL layer. This measurement should be performed before the NAPL is removed or the monitoring well is purged.

4.1.4 Well Development

Following monitoring well installation or a substantial length of time between sampling events (i.e. greater than one year), monitoring wells should be developed to achieve the following objectives:

- Rectify clogging or smearing of formation materials following borehole drilling;
- Stabilize the formation and filter pack materials;
- Recover lost drilling fluids;
- Improve well efficiency; and
- Grade the filter pack to effectively trap fine particles that may otherwise interfere with water quality analyses.

Prior to commencing well development activities, the volume of water in the well must be known to evaluate the number of well volumes to be removed. A well volume is defined as the volume of water contained within the well screen and casing. To determine the water volume in a well, calculate the length of water column (i.e. distance from the bottom of the well to the static water level) and use the following ratio to determine the volume:

Typical '1-Metre' Casing Volumes

Diameter		Litres per Metre of Casing
(inches)	(cm)	
1.5	3	1.1
2	5	2.0
4	10	8.1
6	15	18.2

Well development typically consists of removal of between 5 and 10 well volumes using any of the sampling equipment described in Section 3.3. Well development can also be considered complete if three well volumes have been removed and the well allowed to fully recover between well volume removal, in the case of poorly recharging monitoring wells.

4.1.5 Well Purging

Water standing in a well may not be representative of the conditions within the water-bearing formation. Standing well water in contact with the well construction materials for an extended period of time may have differences in temperature, pH, redox potential, and contaminant of concern concentrations compared to the formation water. The objective of well purging is to pump the well until water that is representative of the formation water is obtained.

During purging of the monitoring well, water that is geochemically representative of the formation water enters the well through the screen and is available for sampling. After purging and prior to sampling, the groundwater should be allowed to recover to at least 90 percent of static levels (whenever this is practical). If the well is sampled before static levels are reached (i.e. the groundwater is stressed), inaccuracies in determining the actual concentrations of chemical parameters in the formation water may occur.

It is not possible to pre-determine a specific purge volume for all situations. This depends on the objective of the sampling program, the chemistry being dealt with and the purge technique being employed. Three to five bore volumes is generally considered to be acceptable when using standing purging techniques such as inertial foot valves, bailers or other high capacity pumping methods. Purging may be done at the static level elevation or at the screen base elevation when pumps are used. The location of the purge point may influence the number of purge volumes needed to obtain representative samples.

Wells screened in formations with low transmissivity will likely go dry before the required water volume can be removed. It is recommended that the well be purged dry and the sample be collected after the well recovers enough to provide the water volume required for sampling.

In addition, every effort should be made to ensure that the groundwater is free from sediment and readings of field parameters including pH, temperature and specific conductance have stabilized. Groundwater stabilization is considered complete when three consecutive well volume measurements of temperature and specific conductance are approximately plus or minus 10 percent and if the pH values are within 1 pH unit of the last three value averages.

The measurement of only field parameters may cause an excessive volume of water to be purged where groundwater is slow to stabilize. Alternatively, if the groundwater is very quick to stabilize, the purged water volume will be quite low and the water sample may not be representative of groundwater quality in the formation. Field measurements may not be indicative of representative sampling conditions when volatile organic chemicals are the contaminants of concern.

4.1.5.1 Low-Flow Purging

Low-flow purging and sampling refers to sampling methodologies that minimize the velocity of the formation water entering the well screen. Drawdown flow rates will depend on the formation. They can range from 1 litre per minute in very coarse-grained formations (e.g. gravels), down to 0.1 litre per minute in fine-grained formations (e.g. silts and clays). The goal is to ensure that water inside the well screen and in the formation is minimally disturbed while obtaining representative formation water. This helps to minimize losses of volatile contaminants in groundwater samples compared to samples taken using conventional purging and sampling.

During low-flow purging activities, the pump flow rate should be set to minimize drawdown. The maximum allowable drawdown should be approximately 25 percent of the distance between the top of the well screen (or static water level, which is lower) and the pump intake. Typically, the intake would be placed at the mid-point of the well screen resulting in the following maximum allowable drawdown for the following screen lengths:

Screen Length (m)	Pump Inlet Setting (m below top of screen)	Maximum Allowable Drawdown (m)
1.5	0.75	0.20
3.0	1.5	0.40
4.6	2.3	0.60

In addition to minimizing drawdown, field parameters should be measured to ensure that water quality indicator parameters have stabilized prior to sample collection. Indicator parameters can be considered stable when three consecutive readings made several minutes apart fall within the range presented below:

Parameter	Stabilization Criteria
pH	± 0.2 pH units
Conductivity	± 3% of reading
Dissolved Oxygen	± 10% of reading or ± 0.2 mg/L (whichever is greater)
Eh or ORP	± 20 mV

In certain circumstances, the solids associated with highly turbid samples can result in false positive results for dissolved PAH, extractable hydrocarbon, or metals concentrations in the groundwater sample. Note that silt should not be filtered out of samples that are being sent for organics analysis. If significant silt and/or sediment is observed in sample bottled to be submitted for analysis for PAHs, an extra sample bottle should be filled and instructions provided to the analytical laboratory to conduct laboratory filtration on the sample prior to analysis.

Low-flow purging and sampling should be considered in critical situations, where the positive biases caused by high turbidity samples or negative biases due to volatile losses may impact upon regulatory compliance. Low-flow purging is generally done for geochemical analysis when it is necessary to evaluate reduction oxidation conditions.

4.2 SAMPLING PROCEDURES

The key objective of groundwater sampling is to obtain a sample representative of groundwater conditions within the formation the well is screened in. Decisions about sampling methodology and procedures should consider the properties of the contaminants of concern, well configuration (screen depth and length), and should be designed to mitigate potential effects on the integrity of the groundwater sample. The Project Manager will provide direction regarding the sampling methodology for each program and the selected method must be followed throughout the sampling program to ensure consistency of the data generated.

4.2.1 Equilibrium Conditions

The monitoring well should be allowed to reach 90 percent of static water level equilibrium before sampling, whenever this is practical.

Low recovery wells (e.g. clay formations) should be sampled at the end of the day, whatever percentage of the static water level equilibrium has been reached. The exception to this practice is when the field technician is returning to the site the next day. In this case, sampling of the monitoring well the next morning is also acceptable (this will give the well more time to recover) even for volatile organic parameters.

4.2.2 Sample Collection

The groundwater sample should be taken from the centre of the saturated zone within the monitoring well screen interval. This will ensure that the groundwater sample will be representative of the entire screened water column.

Samples should generally be collected or containerized in the order of the following volatilization sensitivity:

- Volatile organic compounds (VOCs);
- Semi-volatile organic compounds (SVOCs);
- Total organic carbon;
- Total organic halogens;
- Extractable organics (PHCs F2 to F4, etc.);
- Total metals;
- Dissolved metals;
- Phenols;
- Cyanide;
- Sulphate and chloride;
- Nitrate and ammonia; and
- Radionuclides.

Aspiration of the groundwater sample should be kept to a minimum when sampling for volatiles. When using inertial pumps, a split VOC sampling tube for the inertial pump should be used when sampling volatiles in order to minimize volatile losses from the sampling process.

Any odours (e.g. petroleum hydrocarbon or solvent odours) that are observed in the normal course of collection of the groundwater samples should be recorded. For health reasons, samples should not be deliberately smelled in order to further quantify or distinguish the odours. Similarly, any reported concerns with objectionable taste in nearby potable water wells from possible contaminants should be noted, but for health reasons, samples should not be tasted at any time in order to identify the presence of contaminants.

If the volume of water recovered from the groundwater well permits, all groundwater sample bottles (even those submitted for semi-volatile and non-volatile parameters) are to be filled to zero headspace.

The collection of groundwater samples from water seeping into excavations or test pits and submitting these samples for laboratory analysis is not an accepted practice. These samples are generally not representative of the quality of the formation water. However, these samples could be used for screening purposes.

LNAPL sampling should be completed with a bottom-filling bailer equipped with a check-valve. This should be performed with minimal disturbance, to prevent emulsion or remixing of the oil layer with water. DNAPL should be sampled using a bottom-filling bailer, a dual check-valve bailer, or a bladder pump.

Groundwater samples should be placed in an ice-chilled cooler immediately after sampling and kept at 0 to 10°C (target of 4°C) until delivery to the laboratory. Collecting the samples throughout the day and then placing them all in a cooler at the end of the day is not an acceptable practice.

4.2.3 Field Filtration

There are situations for which sample filtration is required prior to analysis, and there are circumstances where samples should not be filtered. Filtration may affect the chemical composition of a sample by alteration of the physical state through removal of particulate and any adsorbed material. On the other hand, dissolved phase components may be the only feature of interest in the sample and low turbidity samples may be essential to the analytical technique being used.

For Phase II ESAs being performed in Ontario, the generic groundwater standards have been derived for dissolved metal concentrations. Thus, groundwater samples submitted for metals analysis must be field-filtered. Groundwater samples being analyzed for organic parameters should not be field-filtered. As noted above, when samples are being analyzed for SVOCs and significant sediment is observed in the sample bottle, a second bottle should be filled and submitted for analysis, with instruction to complete laboratory filtration prior to analysis.

In-line, positive-pressure filtration should be used. Vacuum-filtration is not considered acceptable due to degassing effects. The standard filtration device is the 0.45-µm filter, commonly used with an inertial pump (foot valve) and tubing. The manufacturer's instructions for filters should be followed. If sufficient groundwater is available, conditioning the 0.45-µm disposable in-line filter with groundwater before taking the sample is a recommended practice.

In general, a volume of twice the capacity of the filter should be flushed through the filter and discarded before the sample is collected. Filters should be used to draw one sample from one sampling location and then they should be discarded. After filtration through the in-line filter, the groundwater sample should be directly introduced into the sample bottle which should already have the proper preservative added.

Although it is not recommended practice, if field filtration cannot be completed, the preservative should be discarded and the sample bottled rinsed several times with groundwater prior to filling the bottle. The unpreserved sample should be taken the laboratory as soon as possible for laboratory filtration. Specific instructions regarding filtration by the laboratory must be noted on the chain-of-custody.

4.2.4 Sample Splitting

Sample splitting is usually done for field QA/QC samples, or for peer-review/second party verification of sampling results. Splitting of water samples should be done as follows:

- For non-volatile or semi-volatile parameters, the first sample container should be partially filled, then the second container. Continue to fill by alternating back and forth between bottles, repeating the procedure until both containers are full; and
- For VOC samples, each sample bottle should be completely filled and capped. Then the split or duplicate sample bottle should be filled. This methodology will minimize volatiles losses from the groundwater samples during the sampling process.

4.2.5 Sample Containers and Preservation

The preservation of samples is a measure designed to stop or slow the ongoing effects of chemical and biological change once a sample has been collected. Since sample analysis is very specific, the preservation techniques required to ensure sample integrity are also specific. Preservation methods should be determined in consultation with the analytical laboratory and should be done in accordance with the requirements set out in the Ministry publication “Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the *Environmental Protection Act*” dated March 9, 2004.

4.2.6 Chain-of-Custody Records

Chain-of-Custody (CoC) forms must be completed for all samples collected and submitted for laboratory analysis. Completed CoC forms are legal documents. They should be completed and handled accordingly to the instructions printed on the forms and/or following instructions.

The CoC form, completed at the time of sampling, must contain at least the sample number, date and time of sampling, the name of the sampler, the analysis required, and the number of bottles/containers submitted for each sample. Contact information must also be provided. The chain-of-custody document must be signed and dated by the sampler when transferring the samples from sampler's custody to custody of others. Any changes to the CoC must be initiated by the person making the changes.

All samples stored, transferred, and shipped must be accompanied by a CoC form. The CoC form should consist of multiple copies that can be distributed to the shipper, laboratory, and client. When releasing samples from his or her custody, sampler must keep a copy of the CoC form indicating when the samples were released, who released the samples, and who the samples were released to.

4.3 SAMPLING EQUIPMENT

The choice of sampling equipment or devices will be based partly on availability, cost, portability, and ease of decontamination. However, certain devices are less suited to certain parameters and/or well depths. Important factors that play a role in the collection of representative groundwater samples include:

- Groundwater sample device (choice of pump or sampler, and flow rate used);
- Care and skill used in sample handling/transfer to sample bottle; and
- Use of suitable pump and tubing materials.

The most important consideration in designing and completing a successful groundwater investigation program may be the choice of the sampling device. The sampling device has the potential to alter the chemical composition of the groundwater sample, and as such the materials used, method of operation, ease of maintenance and field operation are some of the considerations which go into determining which sampling device is appropriate.

4.3.1 Inertial Pump (Foot Valves)

Inertial pumps can be used for groundwater well purging and sampling. They are inexpensive, can be used in wells as small as 1.25 centimetres (0.5 inches) in diameter, can be dedicated to each monitoring well, and do not require a power source (unless a mechanical actuator is used).

Inertial pumps can be used for development of low to moderate yield monitoring wells by over-pumping. The typical manual purge rate is 2 to 8 litres per minute. However, inertial pumps are labour-intensive, the foot valve is prone to clogging from silt or fine sand and they are mainly suitable for shallow well installations (<20 metres). In addition, since inertial pumps excessively disturb the water column, it is very difficult to collect sediment-free samples.

4.3.2 Bailers

Bailers are inexpensive, easily portable, can be decontaminated, and require no external power source. Their disadvantages are that they are labour-intensive, and can alter the groundwater sample from degassing, volatilization, or aeration. Loss of VOCs can occur when bailers are used, they produce more variability in VOC sampling results and results may be more operator-dependant than with other devices (e.g. mechanical pumps).

Bailers should be constructed of inert material such as Teflon, PVC or stainless steel. Single or double check-valve bailers can be used for LNAPL and DNAPL sampling, respectively. It is preferable to use a bottom emptying device with a valve to minimize aeration. Bailers should never be dropped into a well, but lowered slowly to prevent aeration or disturbance of the water.

The lines used with bailers can be a source of cross-contamination if the bailer is not dedicated to the well. If a stainless steel bailer is used for sampling, the bailer must be thoroughly decontaminated between sampling locations and new line should be provided at each new location.

In general, bailers can produce good results for VOCs in shallow wells with careful operation and handling. However, they have been shown to bias results for volatile analytes and analytes that are readily oxidized, if used without due care.

4.3.3 Peristaltic Pump

A peristaltic pump can be used for groundwater well purging and sampling. Like most suction pumps, the peristaltic pump is only capable of lifting water from a depth of up to 7.62 metres (25 feet) below the pump level. A peristaltic pump is a self-priming, low-volume suction pump which consists of a rotor with ball-bearing rollers. Flexible tubing (silicone) is inserted around the pump rotor and squeezed by the heads as they revolve in a circular pattern. Additional rigid tubing is attached to the flexible tubing and placed into the well within the water column. The sample tubing should be dedicated to that well location for future use. Tubing must not be reused at other sampling locations due to the cross-contamination that would occur.

The peristaltic pump moves the liquid within the sample tubing by creating a vacuum as the rotor head turns. No part of the pump comes in contact with the liquid, eliminating the need for decontamination of the pump between sample locations. A peristaltic pump provides a low sampling rate with less agitation, resulting in the ability to collect sediment-free more readily than other sampling methods. Peristaltic pumps are suitable for sampling a wide range of contaminants at Phase II ESA sites.

4.3.4 Small Diameter Submersible Centrifugal Pumps

These pumps were developed for contaminated site applications and can be used in small diameter monitoring wells. Higher flow rates can be used for well development and lower flow rates (0.1 litre per minute) for well sampling.

Care and control of pumping rate is a critical factor in sample quality. Pumps must be thoroughly cleaned between uses at different sampling locations to avoid potential issues with cross-contamination. Although there is potential for cross-contamination from metals from pump materials, these types of pumps are considered applicable for most contaminants of concern at Phase II ESA sites.

4.3.5 Bladder Pumps

Bladder pumps are typically used in applications where a low-flow rate is required. Often, low-turbidity samples can be obtained without filtration. Flow rates higher than 100 millilitres per minute can increase the loss of volatile constituents. Use of bladder pumps reduces the water-purge volume requiring treatment but they can also be time-consuming for low-flow applications. In addition, the pumps are difficult to decontaminate between sampling locations. Bladder pumps are suitable for sampling a wide range of contaminants at Phase II ESA sites.

4.3.6 Tubing and Accessories

Numerous (flexible) materials are available for use with groundwater samplers. Tubing of some kind is required for all pump devices.

Polyethylene tubing is commonly used with submersible pumps and inertial pumps. Although polyethylene, in particular low density polyethylene (LDPE), does adsorb organics to a greater degree than Teflon, and some other materials, representative samples are obtained using this material. Polyethylene is commonly used in the industry and is considered an acceptable material for well sampling. If utilizing LDPE tubing when sampling for VOCs, acceptable results can be obtained if the precaution of first flushing the tubing with groundwater from the well is taken.

In general, all sampling tubing should be dedicated to a single groundwater monitoring well. Alternatively, it should be disposed of after one use at a monitoring well.

5. ATTACHMENT

- Low Flow Monitoring Sheet

Site Location	XCG Project Number	XCG Field Staff	Date

XCG

XCG Consultants Ltd.

Low-Flow Monitoring Sheet

Page ___ of ___

Flow Rate = _____ mL/min

Stabilization Criteria			*± 0.2*	*± 3%*	*± 10% or ± 1.0*	*± 10% or ± 0.2*		*± 20 mV*
Well ID	**Time**	**GW Depth**	**pH**	**Cond**	**Turb**	**DO**	**Temp**	**ORP**
	minutes	**mbTOP**		**mS/cm**	**NTU**	**mg/L**	**º C**	**mV**
	0							
	3							
	6							
	9							
	12							
	15							
	18							
	21							
	24							
	0							
	3							
	6							
	9							
	12							
	15							
	18							
	21							
	24							
	0							
	3							
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	24							

SOIL VAPOUR SAMPLING USING SUMMA® CANISTERS

1. BACKGROUND

Soil vapour is often evaluated at contaminated sites where existing buildings or potential future buildings may be impacted by volatile or semi-volatile chemicals. Assessment of contaminant concentrations in soil vapour, as well as potentially in the indoor air of the building, may be important exposure pathways to consider when evaluating potential human health risks at a site.

2. PURPOSE

The collection of soil vapour samples using a Summa® canister allows for multiple VOCs to be analyzed using one sample. Samples can be reanalyzed because of the stability of the sample in the canister and the small amount of sample which is required for analyses. Summa® canister sampling is ideal for grab samples, short term sampling (e.g. 10 minutes) or time-weighted average (TWA) sampling (e.g. 24 hours, 7 days). In addition, it is not required that the range of concentrations be known prior to sampling, although if high concentrations are expected, it is best to inform the laboratory ahead of time. In cases where concentrations are potentially high, they may recommend the use of borosilicate glass canisters.

3. SCOPE

This document describes the procedure for sampling from a soil vapour piezometer using a Summa® canister. Refer to the SOP for Soil Gas Probe Installation for details on installing a soil vapour probe. Additional information can be found in the EPA Method TO-15.

4. SITE CHARACTERIZATION

Soil vapour sampling should be conducted after all potential vapour sources (e.g. non-aqueous phase liquids, contaminated soil and groundwater) have been characterized. In addition, the physical setting of the site should be known, including (if applicable):

- Geology (soil textures, stratigraphy);
- Hydrogeology (depth to groundwater, groundwater flow direction, vertical and lateral gradients, hydraulic conductivity);
- Vadose zone characteristics including water content, porosity, fraction of organic carbon, bulk density and soil-air permeability;
- Preferential pathways such as subsurface utilities;
- Building construction, both present and future (location, use, size, height, foundation type, foundation characteristics, heating, ventilation and air conditioning (HVAC);
- Vertical and lateral distance from soil vapour sources to buildings or potential buildings.

5. WEATHER

Plan according to the weather - frost, snow cover, pressure systems, and rain need to be factored in. This depends on depth of sampling and ground cover. The MOE does not like sampling to occur in the rain or within 24 hours following a rainfall event. Avoid sampling in areas where water is ponded on the surface. If it has rained more than 0.5" in the preceding five days, it is recommended that you sample with caution. Exercise caution when sampling during and prior to high pressure weather fronts - wait until they have passed. If you are uncertain of sampling conditions, consult with the Project Manager.

6. EQUIPMENT

Laboratories need several days notice to deliver SUMMA® canisters. The usual size is 1.4 litres, ideally keep the canister this size for near surface <1.54 metres (<5 feet) wells or probes. The canisters can go up to 6 litres in size. If you are sampling at a different altitude, let the project manager know so that the flow controller can be adjusted to reflect this difference.

Soil types and sampling times:

- Subslab or gravel or sandy soil- 10 minute flow controller (140 mL/min);
- Silty/clay soil- 60 minute flow controller (23 mL/min); and
- Flow rates should always be less than 200 mL/min. Ambient air intrusion is minimized with a low flow rate

Note: we tend to use 10-minute flow controllers for the majority of the projects. Consult with Project Manager if you have any questions.

Required from the Laboratory:

- Travel blank composed of purified air that is taken to the field, but not opened;
- One Summa® canister field duplicate for every 10 samples;
- One Y-splitter for each field duplicate;
- One Extended T-joint with Swagelok® nuts on both ends;
- One Swagelok® 1/4" steel bellows valve for the top of each Summa® canister;
- One Swagelok® 1/4" brass plug secured to inlet of the valve of each Summa® canister; and
- One flow regulator for each Summa® canister (not including the duplicate canister).

Required from a Rental Company (e.g. Maxim Environmental):

- TEFLON® FEP tubing (1/4" outer diameter, 5/8" inner diameter);
- Quick Connect valves- need at least two per well or probe, but having extras is good;
- PET "collared" T-joints;
- Tedlar® bag (1 per site);
- 103-litre helium tank (lab grade as this contains minimal impurities);

- Helium regulator, multi-flow;
- Portable helium detector;
- Gilair pump and associated low flow module (calibrated at 200 mL/min);
- Vac-U Chamber lung box with window and polypropylene fittings;
- Plastic shroud;
  - Well or probe caps tapped with quick connect female valves (if not already in place on site); and
  - Manometer (pressure meter).

Additional Equipment which should be Present in the "Soil Vapour Sampling Kit:"

- 2 x 9/16" wrenches;
- Teflon® tape;
- Silicone tubing;
- Tube clamps;
- Tube cutters;
- Quick set concrete (if required to seal the well or probe caps);
- Bucket or Ziplocs for mixing concrete (if applicable);
- Putty knife for spreading concrete (if applicable);
- Assorted tools;
- PID or FID;
- Nitrile Gloves;
- Flashlight; and
- 60-mL syringe.

Important Notes:

- Teflon® tubing is expensive. Attempt to use as little as practical.
- Helium is also expensive. Each helium test will use approximately 10 litres of helium. It is sold in 103-litre canisters. Please turn off the helium when not in use. A full canister will register as approximately 1,000 psi on the regulator, depending on the temperature.
- Hand tighten the Swagelok® joints, and then use a 9/16" wrench to make a quarter turn. The joints seem to be the most air-tight when Teflon® tape is used on each threaded piece.

- Do not use glues or adhesives. Silicone tubing MAY be used in areas beyond the shroud to make connections (i.e. in areas beyond the actual sampling train).
- Do not smoke, pump gas, use hand sanitizer or handle any solvents prior to handling the Summa® canisters or any of the equipment. Avoid these activities on the day of sampling.
- When possible, avoid sampling for chlorinated solvents in wells or probes with freshly cut or scratched PVC pipe.

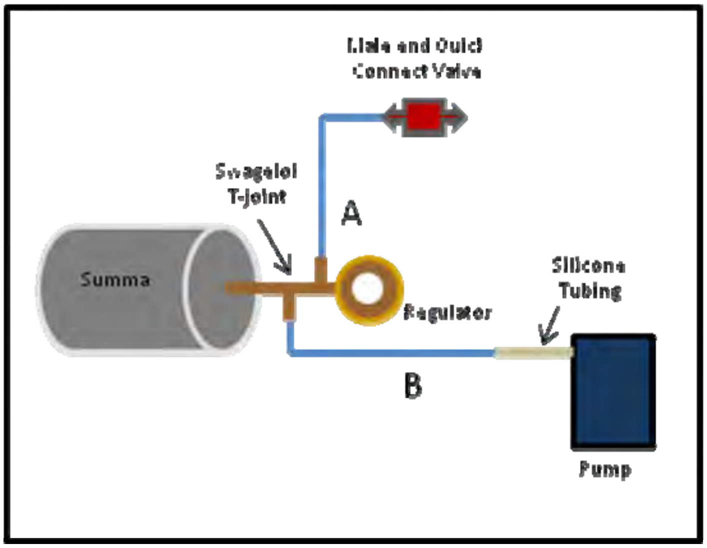
7. PRE-FIELD LEAK TEST:

Perform a vacuum check on components which can be assembled ahead of sampling. Canister must read at least at 25 inches of Hg. Ensure that the valve on the top of the canister is closed and tightened clockwise.

Please refer to Figure 1.

1. Remove the brass nut on the top of the canister. Using Teflon® tape, attach the lab supplied stainless T-joint and straight piece with two nuts to the top of the canister by hand and then use the wrench for a ¼ turn (possibly more). Attach the regulator on top of the T-joint. For the assembly of the canisters destined to be the duplicate, see Section 13 - Performing a Duplicate Sample (below).
2. Take the laboratory supplied Teflon® tubing with the two Swagelok® nuts on each end and cut it into two pieces. Section A will connect the regulator to the well or probe and Section B will need to run toward the non-valved port on the shroud (see Figure 3). Keep this in mind when you are deciding how long to cut the pieces as Section A should be much shorter. Attach the ends with the Swagelok® nuts to the two outlets between the regulator and the Summa® canister (use Teflon® tape, hand tighten and then use the wrench for a ¼ turn). Ensure that Section A is running from the connection closest to the regulator.
3. Attach a male end quick connect valve to the other end of section A. Attach the end of section B to the pump or 60-mL syringe (you will need to use a small section of silicone tubing here- feed a tube clamp onto it prior to inserting the end on to the pump or syringe). At this point, section A and your Summa® canister are “dead ends" because they are not allowing any flow to go through them (assuming that the quick connect is properly valved).
4. Turn on the pump and let it run or evacuate the sampling train by pulling on the syringe until the regulator gauge registers a reading (e.g. -10). Turn off the pump. Tighten the tube clamp on the tubing between the pump/syringe and Section B. Sometimes the pump is a source of leaks so it is a good idea to eliminate it from the leak test at this point. The reading on the regulator should remain constant or close to constant for three minutes. If it is not constant, there is a leak. Keep tightening the joints and valves and try again until there are no leaks.

Figure 1 Pre-field Leak Test Assembly



5. Calculate your purge times based on evacuating three volumes from the well or probe. Verify the sampling rate with the laboratory- the flow controller will be pre-set to allow a specific volume of gas to pass through in a set amount of time. This mechanism relies on a diaphragm. As the pressure differential decreases, the diaphragm opens to allow more air to flow through. Because the flow controller controls the actual flow rate if it is in-line, the amount of time required to purge the well or probe will be based on the flow controller setting and not the pump. For instance, a flow controller set to fill a 1.4-litre canister in 10 minutes will allow 140 mL of flow per minute. Therefore, this rate would be less than the pump in most situations because they are normally about 200 mL/min. Ensure that you account for this when you calculate your purge time.

Note that for tubing that is 5/32" with respect to the inner diameter, you need to account for a purge volume of 4mL for every foot of tubing.

8. SAMPLING:

General Notes:

- Keep all tubing dry and clean at all times. If you notice water or condensation in the tubing, do not attach the SUMMA® or immediately close it
- Label the paper tag affixed to the SUMMA® with the sample number, as well as which regulator will be associated with it.
- Label the field notes with the SUMMA® identification number and the regulator number as well as the initial SUMMA® vacuum and the final SUMMA® vacuum.
- Check all joints and fittings which are together prior to shipping as these can loosen during transport.

9. LEAK TEST AND SAMPLING TRAIN SET-UP:

1. Assemble the helium detector and probe as shown in Figure 2.

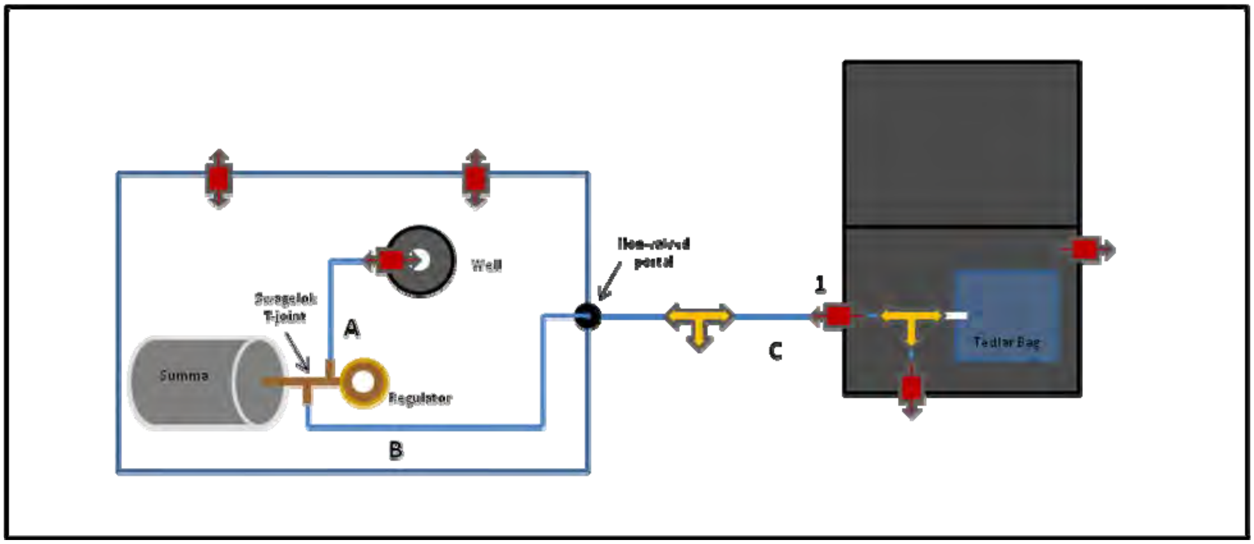
Figure 1 Helium Detector Assembly

Turn on the helium detector. It requires several minutes to "warm up."

A tracer test should now be performed to check for leaks within the sampling configuration as well as the well or probe seal itself. Set up the equipment as shown in Figures 3 to 6. **Keep the Summa® Canister Swagelok® Valve Closed Until Instructed to Open it.**

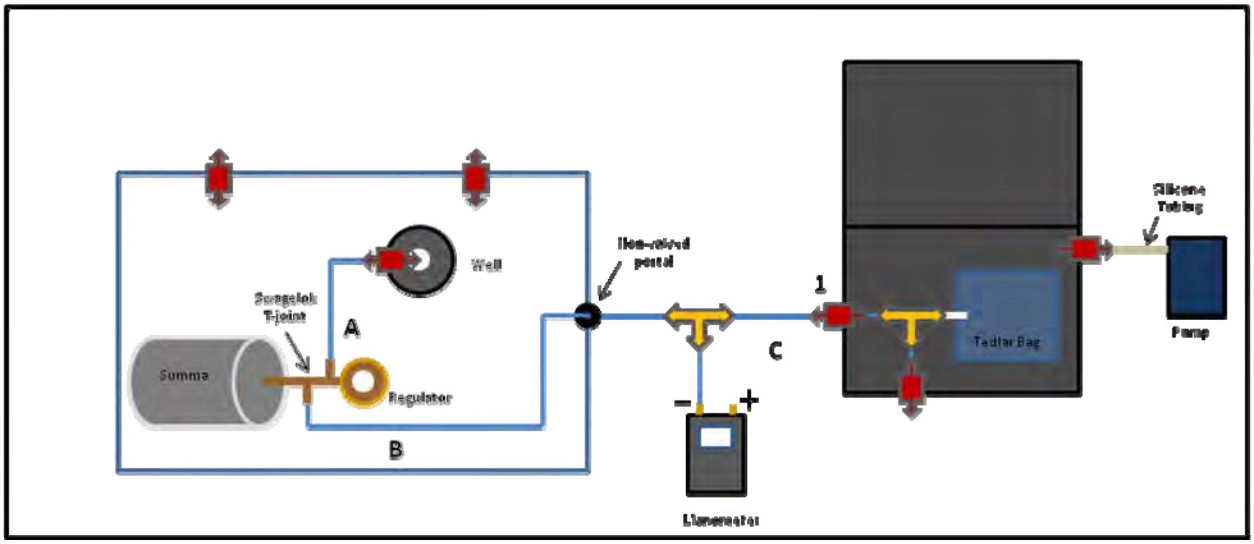
2. Open the lung box and ensure that the connections are all tight for the interior tubing. Connect the Tedlar® bag to the free end of the interior T-joint. Note that using the same Tedlar® bag for all of the helium tests on one site is permissible, but the Tedlar® bags should be changed between sites.
3. Position the Summa® canister with the regulator and the tubing next to the well or probe. Ensure that tubing section A (closest to the regulator) will reach the valve on the well or probe cap. Do NOT connect it to the well or probe at this time. Both sides of this valve are closed off when they are not connected together.
4. Feed Section B through the non-valved portal on the shroud. Install the collared T-joint on to the end. Ensure that you push the tubing in far enough to engage the o-ring.

Figure 2 Shroud and Lung Box Set Up



5. Take a small section of tubing (section C) and install it between the T-joint and the valve on the lung box (labelled "1" in Figure 3, although depending on the lung box, it may be in a different position on the box). Again, ensure that you push the tubing in really far to engage the o-ring. Using silicone tubing on the end of the negative port on the manometer, attach the manometer to the T-joint with short length of Teflon® tubing.
6. Attach a short length of Teflon® tubing to the collared port on the lung box and attach the pump to the other end (see Figure 4). You may need to use silicone tubing between the Teflon® and the pump- install the tube clamp on this piece of silicone. Ensure that the tubing is pressed in tightly to the internal o-ring (note: to remove this tubing later, you will need to press down on the collar and pull on the tubing simultaneously).

Figure 3 Shroud and Lung Box Set up



7. Pressure Check: Keeping the Summa® canister closed as well as the line to the well or probe unattached (assuming that the quick connect valve is closed), open the valve on the Tedlar® bag. Turn on the manometer and note the reading. Turn the pump on and let it run for a few minutes in order to build up pressure in the lung box. The reading on the manometer should change if all of the connections are intact and there are no leaks to the outside of the train.

8. Turn the pump off and place a clamp over the tubing near the pump. The vacuum should hold or change very gradually. If it changes rapidly, there is a leak. Check the connections again. Note that if you did a pre-field leak test on the connections between the regulator and the canister, you should start isolating other parts of the train first in order to determine when the leak is. Perform this test until the manometer can hold a reading. In addition, the regulator attached to the Summa® should also register a negative reading and should be able to hold that reading for a few minutes. You can isolate various parts of the sampling train if necessary using the valves and clamps.

10. EQUIPMENT BLANK

An equipment blank should be performed **once per day**, preferably prior to the first sample being taken. This section can be skipped for any additional samples.

1. Once you are confident that the sampling train is intact, you can perform an equipment blank to ensure that the equipment and tubing are clean. Assuming that the valve on the end of Section A is shut when it is not connected, attach a clean female end valve to the male end on section A. The tubing should now be open to the atmosphere on that end of the sampling train. Note: use zero air when in polluted and heavy traffic areas, or do the assembly and leak checks elsewhere prior to arriving on site.

2. Ensure that the Tedlar® bag is open. Close the lung box and turn on the pump. Allow the Tedlar® to partially fill.

3. Take an ambient air reading near the end of Section A using the PID and record the value on your field sheet.

4. Open the lung box-you may need to insert the male end of a quick-connect valve into port 4 to release the vacuum prior to opening the lung box.

5. Close the valve on the Tedlar® bag. Detach the Tedlar® from the sampling train and insert the end of the PID meter into the tubing leading from the Tedlar®. Open the Tedlar® and allow air from it to pass through the PID meter. Record the reading. Perform steps 1-5 of this section once more.

6. If the readings are comparable to the ambient air reading, your equipment blank is successful and you may proceed. Otherwise, you may need to change out some components of your sampling train to avoid cross contamination of the samples.

7. Detach the extraneous female valve from the end of Section A.

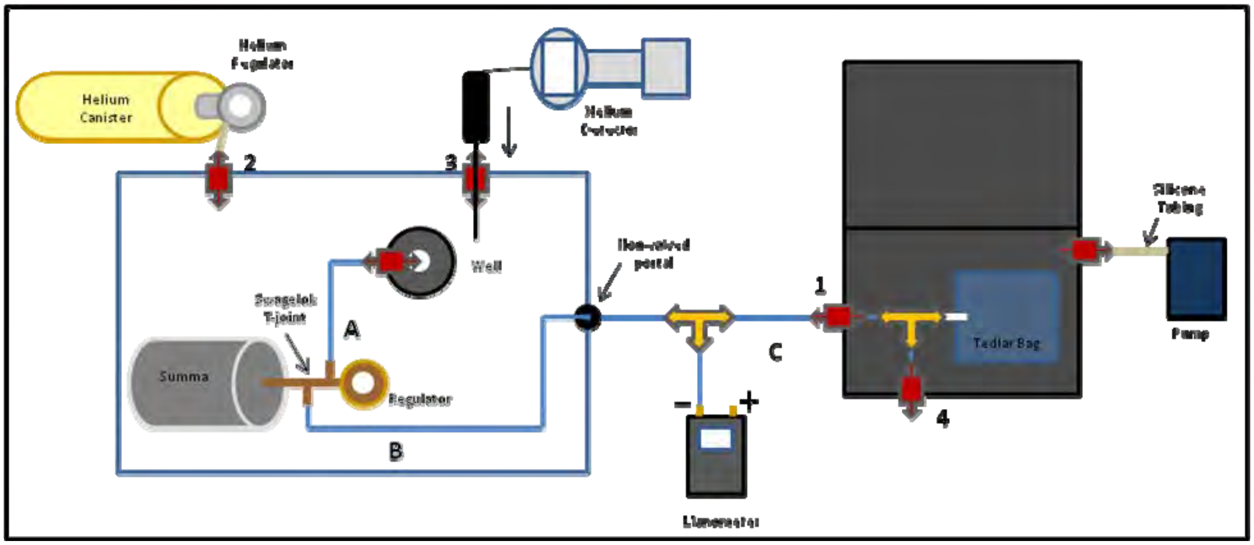
11. CHECKING THE PRESSURE OR VACUUM OF THE WELL OR PROBE

1. Prior to opening any of the wells or probes, the pressure or vacuum which exists within the well or probe must be assessed. Use a short length of tubing dedicated to the site attached to the manometer with silicone tubing (low flow tubing used for groundwater sampling would be fine for this purpose, as material inertness is not a concern).
2. Place a male end valve on the other end of the tubing using both the compression and barbed fitting to secure it. Turn on the manometer and ensure that it read "0".
3. Attach the valve to the well or probe and record the reading on the field sheet. Note the presence of the "-" or "+" sign on the sheet as well.

12. PURGING AND PERFORMING A HELIUM TEST:

1. Attach tubing section A to the well or probe cap, but keep the Summa® closed. Ensure that the valve on the Tedlar® bag is open. Shut the lung box. Place the shroud over the well or probe and the Summa® canister. (Always purge through the regulator attached to the Summa® canister to ensure that the purging occurs at the same rate as the sampling.)
2. Turn on the pump and record the time. Note that the standard Tedlar® bag is 1L so every time that it is full, you have purged 1L from the well or probe.
3. Feed the helium detector probe in through port 3 (you may need to use silicone tubing). Attach the helium regulator to the helium canister and attach it to port 2 (you may need to use silicone tubing at the port end as well as the regulator end). Keep the helium off for now.

Figure 4 Shroud and Lung Box set up



SOIL VAPOUR SAMPLING USING SUMMA® CANISTERS

1. Once the manometer is reading about -10, you can start introducing helium into the shroud. At this point, the lung box should be under enough vacuum that the Tedlar® bag will start filling shortly because the vacuum is sufficient. Keep the lung box closed; otherwise, you will need to start again. This part of the instructions may need to vary a little depending on the soil conditions, so adjust accordingly. If the Tedlar fills prior to the introduction of helium into the shroud, count that volume towards your purge volume and empty the Tedlar® to start again, this time introducing helium sooner. It may take some time to get this process right because each site will be different.

2. Allow helium gas to flow into the shroud at a concentration of about 15% v/v- this is best accomplished by setting the helium regulator located at the top of the tank to 8 L/min for the first 8 to 10 seconds of filling and dropping it to 0.3L/min after that. You may be able to turn the helium regulator to "0" and just give it a small blast every so often when the concentration drops off. This will depend on how windy it is and how leaky your shroud is. Try to get the concentration to stabilize [i.e. within +/- 40,000 ppm (4% v/v)]. Wrapping a towel around the base of the shroud may facilitate keeping the helium in the shroud on uneven ground.

3. Once the Tedlar® is full, you can turn off the helium. Open the lung box -you may need to insert the male end of a quick-connect valve into port 4 to release the vacuum prior to opening the lung box.

4. Close the Tedlar® valve. Remove the helium detector from the shroud and let it re-equilibrate with ambient air. Keep the shroud in place.

5. Open the valve on the Tedlar® and insert the tip of the helium detector into the silicone attached to the bag. Gently squeeze the contents of the Tedlar® out and record the reading. The contents of the Tedlar® should be at ambient pressure, otherwise the flow rate through the instrument may result in variable readings. Observe the reading. It should be less than 10% of the concentration of helium in the shroud (e.g. if you had about 14% v/v in the shroud, your helium reading should be less than 1.4% v/v in the Tedlar® bag) (NOTE: 10,000 ppm = 1%). If your helium concentration is higher than 10% v/v of what was in the shroud, but the manometer test in the Leak Test and Sampling Train Set-up Procedure held pressure, the well or probe seal is not intact. This will need to be remedied prior to continuing. Quick set concrete may help to create a better seal.

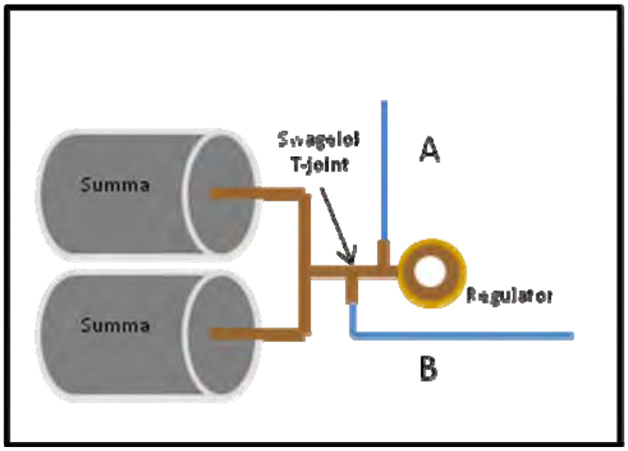
6. If the helium concentration is less than 10% of what was in the shroud, attach the PID to the Tedlar® and obtain a reading of the soil vapour. At this point, start again with Step 4 to perform the helium test and PID reading one more time. If 2 litres of air is a sufficient volume to meet the requirements for a purge of 3 well or probe volumes, you can proceed with Step 10 at this time. Note that if the Tedlar® is taking a very long time to fill, you can do steps 9 to 15 with a partially full Tedlar® bag. Continue to run the pump for the necessary remaining duration to purge the well or probe of three volumes of air either through the lung box and open Tedlar® or just using the pump. In certain soil conditions, it will be easier for the pump to draw soil vapour if the lungbox is in-line. This process and timing may take some adjustment for each site depending on the soil conditions. As long as you are purging through the regulator, you are drawing soil vapour at a rate of whatever the regulator is set to (i.e. standard rate is 140 mL/min).

7. Shut off the pump.
8. Disconnect the lung box from the train by removing tubing Section B from the Summa® assembly. Attach the brass nut that is connected to the Summa® over the opening where Section B was attached using a wrench and Teflon® tape.
9. Using a handheld PID or FID, test the ambient air near the well or probe for a period of at least one minute. Record the range of readings over this time period. Non-detect concentrations should be observed. If not, this information may help to identify background conditions and evaluate potential biases. Note that this step can be carried out while the well or probe is being purged.
10. Connect section A to the well or probe and open the Swagelok® valve a half-turn on the Summa® canister. Record the reading on the regulator- it should be between -30 and -27 inches of Hg (NB: gauges are calibrated at the altitude of Southern Ontario unless otherwise specified). Record the time. Record the serial number of the Summa® canister as well as the flow regulator in your notes as you will need these for the Chain of Custody.
11. Let the sampling continue for several minutes, until the regulator reads about -5 inches Hg. **Do not allow the regulator to reach a value of 0 inches Hg.** Record the final reading. Close the Summa® canister by turning the Swagelok® valve clockwise. Remove the vacuum gauge. Using your fingers, replace the brass nut. Use the wrench to turn it a 1/4 turn.
12. Summa® canisters do not need to be kept cold and can be shipped via airplanes and couriers. Hold time is 30 days (NB: some jurisdictions say 14 days depending on the compound in question).

13. PERFORMING A DUPLICATE SAMPLE:

1. Attach the Y-splitter to the tops of the two Summa® canisters using Teflon® tape and a wrench.
2. Install the Swagelok® t-joint above the Y-splitter and attach the tubing sections A and B as above (see Figure 6).
3. Perform the same leak check tests as above.
4. At step 13, open both Summa® canisters at the same time. Record the time, pressure and serial numbers of both canisters and the serial number of the flow regulator.
5. The sampling will take approximately twice as long.

Figure 5 Assembling Hardware for a Duplicate Sample



14. CHECKING YOUR DATA:

Data reported in:

- ppbv (independent of P & T)
- µg/m^3 (at 1 atm, 25 degrees C)
- 1 atm and 25 degrees C may not be representative of conditions at your site > results can be altered using the Gas Law Constant
- NB these do NOT correspond directly to water concentration units

Note that soil vapour often contains methane and/ or carbon tetrachloride, so checking these concentrations during laboratory analyses can help to determine if ambient air is present in your sample. It is difficult to avoid ambient air intrusion in shallow well or probes.

Ambient Air is composed of the following gases commonly known as "matrix gases" that should be analyzed and properly reflected on the Chain of Custody:

- Nitrogen 78%
- Oxygen 21%
- 1% CO2, argon, helium

As your depth below ground surface increases, so does the CO_2 concentration.

In addition, methane should be analyzed because it is present in soil gas.

Attachment:

- Soil Vapour Testing Record.

1. SOIL GAS MONITORING PROTOCOLS

The purpose of this program is to monitor for the presence of combustible gases in the surficial soils adjacent to the landfill.

Gas monitoring will include the following tasks, carried out at the designated monitoring locations:

- Measurement of static pressure;
- Measurement of combustible gas, carbon dioxide, and oxygen concentrations; and
- Measurement of the water level within the probe.

1.1 EQUIPMENT

The following field instruments shall be used for soil gas monitoring:

- Portable gas analyzer equipped with combustible gas, carbon dioxide, and oxygen sensors;
- Digital manometer; and
- Electronic water level indicator.

1.1.1 Portable Gas Analyzer

The gas analyser shall meet the following minimum requirements.

Combustible Gas Sensor

The combustible gas meter shall be a non-dispersive infrared (NDIR) combustible gas sensor equipped with an intrinsically safe pump. The sensor shall operate at the following scales:

- 0-100 percent methane (volumetric basis) with an accuracy of 3 percent; and
- 0-100 percent LEL with an accuracy of 0.3 percent.

In the majority of landfills, the combustible gas of concern is methane; however, it is noted that combustible gas sensing devices usually respond to all combustible gases present. Therefore, concentrations measured during monitoring are normally expressed as an equivalent to a known calibration gas (typically methane for landfill applications). For the purpose of soil gas monitoring, the sensor should be calibrated to a 2.5 percent methane (50 percent LEL) span gas. Calibrations with other combustible gases shall be converted to methane equivalents.

It is noted that catalytic combustible gas sensor equipment is not suitable for this application as methane concentrations greater than 5 percent (as can readily occur on LFG) may poison the sensor. In addition, the sensor requires oxygen to function, which may not be present in a LFG atmosphere.

In addition, it is noted that flame ionization detection (FID) equipment is not appropriate due to the fact that low levels of oxygen can cause a "flame out" in the FID and that the unit's sensitivity is impacted by elevated levels of carbon dioxide.

It is further noted that photo ionization detectors (PID) are not suitable for this application due to the potential for elevated concentrations of methane to accumulate in the probe casing which can “quench” the PID signal, resulting in a reading biased low.

Carbon Dioxide Gas Sensor

The carbon dioxide gas sensor shall be a NDIR gas sensor equipped with an intrinsically safe pump. The sensor shall have at a minimum the following operating ranges:

- 0-5 percent carbon dioxide (volumetric basis) with an accuracy of 0.3 percent.
- 0-60 percent carbon dioxide (volumetric basis) with an accuracy of 3 percent.

Oxygen Sensor

The oxygen sensor shall be an electrochemical or paramagnetic sensor with a range of 0-21 percent (volumetric basis) and an accuracy of one percent full scale.

It is noted that the portable gas analyzer should be field calibrated daily, prior to the commencement of sampling activities.

Digital Manometer

The measurement of the in-situ pressure at soil gas monitoring probes provides useful data for assessing the migration of combustible gas. A portable digital manometer shall be used to measure in-situ pressure. This device shall have a minimum resolution of 2.0 pascals (0.01 inches water column) and pressure hysteresis of 0.1 percent, and manual pressure zeroing capacity.

Water Level Meter

Water level meters are utilized to measure the depth of water in gas probes to record seasonal fluctuations in the groundwater table and ensure that the probes screened interval is not blinded. The water level meter shall be a coaxial cable type water level meter, capable of insertion into a 19 millimetre diameter PVC pipe.

1.2 SAMPLING PROTOCOLS

The following section presents the sampling protocols to be implemented for gas monitoring.

1.2.1 Gas Probe Sampling Procedures

Gas probe sampling shall strictly adhere to the following sequence of execution:

- Probe inspection;
- In-situ pressure measurement;
- Soil gas sampling; and
- Water level measurement.

Gas Probe Inspection

Prior to undertaking field sampling activities, a thorough inspection of the gas probe shall be undertaken to ensure that the probe has not been damaged or tampered with and that the probe labcock is in the closed position. Any cracking of the surface well seal should be noted, as well as any surface water ponding in the vicinity of the probe.

Pressure Measurement

> *In-situ gas pressure should always be measured and recorded prior to gas sampling activities or measuring groundwater elevation, as these tasks will affect the in-situ gas pressure within and adjacent to the probe. At monitoring locations consisting of multiple nested probes, all pressure measurements shall be conducted first.*

The following pressure measurement protocols shall be strictly adhered to:

1. Zero the digital manometer.
2. Connect “positive” sample port on the digital manometer to the probe labcock hose barb, while ensuring a tight seal at all connections.
3. Open the labcock.
4. Record pressure measurement and pressure units.
5. Close the labcock.
6. Disconnect digital manometer and ensure that the static pressure has returned to zero. If not zero, repeat procedure.

Combustible Gas Concentration Measurement

To monitor combustible gas concentration in the gas probe, the following steps shall be taken:

1. Turn on gas meter(s) prior to commencing sampling and allow the unit(s) to warm up.
2. Purge unit(s) with fresh air and ensure the unit is zeroed (methane and carbon dioxide read 0 percent, oxygen reads 20.9 percent on a volumetric basis). If the unit(s) are not zeroed, field calibrate prior to commencing sampling program.
3. Connect the analyzer sampling hose to the hose barb labcock. Ensure that all connections are tight.
4. Open labcock and turn on analyzer pump.
5. Two well volumes shall be purged at a flow rate not to exceed 0.5 litres per minute prior to sampling or recording measurements. As a general rule, a minimum of 100 percent and maximum of 300 percent of the probe and granular filter pack volume should be purged prior to undertaking sampling and/or measurement activities. In addition, purging shall continue until the reading has stabilized.
6. Record analyzer measurements and note any fluctuations (including the range of fluctuations).
7. Shut off analyzer pump, close probe labcock, and disconnect hose.
8. Purge unit(s) with fresh air to ensure the unit(s) are still zeroed. If not zeroed, calibrate unit(s) and repeat procedure.

Water Level Measurements

The measurement of water level in gas probes is the final measurement to be undertaken at a given probe location and is critical to the determination of the installations operability (i.e. is the screened interval in the probe installation flooded?) and to assist in the evaluation of LFG migration potential by delineating the depth of the vadose zone.

Due to the narrow soil gas probe pipe diameter, the water level is measured with a coaxial electronic water level indicator. Measurements are undertaken within the gas probe by removing the slip cap assembly from the top of the riser pipe. The depth to water is recorded relative to the top of casing (TOC). If no water is encountered in the probe, “dry” is recorded on the data sheet.

Upon completion of water level measurement at a given probe location, the slip cap is cleaned, greased with a non-petroleum based lubricant, and fitted snuggly to the top of the probe riser pipe.

> *Prior to closing and locking the probe’s steel protective casing, ensure that the labcock is in the closed position.*

Data Recording

All data measured during the gas monitoring program shall be recorded. The recorded data should, at a minimum, include the following information:

- Probe #;
- Time and date of measurement;
- Pressure;
- Purge time;
- Methane concentration;
- Carbon dioxide concentration;
- Oxygen;
- Depth to water table; and
- Status of probe (i.e. damage, evidence of tampering, or labcock open).

Data Evaluation

Upon completion of each monitoring event, the recorded data collected shall be reviewed in consideration of the following objectives:

- Verify that trigger levels have not been exceeded; and
- Identify maintenance issues, and contact appropriate landfill personnel to initiate appropriate remedial actions.

Annually the recorded data collected shall be reviewed in consideration of the following:

- Identify significant changes in measurements (typically greater than 20 percent relative to the previous year’s data);

- Identify trends which may be indicative of LFG migration or damage to the liner;
- Asses the performance of the engineered control systems, remedial measures or contingency actions (if implemented); and
- Consider if modifications to the monitoring program are deemed appropriate.

INDOOR AIR QUALITY SAMPLING USING SUMMA® CANISTERS

1. BACKGROUND

Indoor air quality is often evaluated at contaminated sites where existing buildings may be impacted by volatile or semi-volatile chemicals. Assessment of contaminant concentrations in the indoor air of the building may be an important exposure pathway to consider when evaluating potential human health risks at a site.

2. PURPOSE

The collection of indoor air quality samples using a Summa® canister allows for multiple VOCs to be analyzed using one sample. Samples can be reanalyzed because of the stability of the sample in the canister, and the small amount of sample which is required for analyses. Summa® canister sampling is ideal for time-weighted average (TWA) sampling (e.g. 8 hours, 24 hours). In addition, it is not required that the range of concentrations be known prior to sampling, although if high concentrations are expected, it is best to inform the laboratory ahead of time. In cases where concentrations are potentially high, they may recommend the use of borosilicate glass canisters.

3. SCOPE

This document describes the procedure for sampling indoor air quality using a Summa® canister.

4. SITE CHARACTERIZATION

Indoor air quality sampling should be conducted after all potential vapour sources (e.g. non-aqueous phase liquids, contaminated soil, and groundwater) have been characterized. In addition, the physical setting of the site should be known, including (if applicable):

- Geology (soil textures, stratigraphy);
- Hydrogeology (depth to groundwater, groundwater flow direction, vertical and lateral gradients, hydraulic conductivity);
- Vadose zone characteristics including water content, porosity, fraction of organic carbon, bulk density, and soil-air permeability;
- Preferential pathways, such as subsurface utilities;
- Building construction [location, use, size, height, foundation type, foundation characteristics, heating, ventilation, and air conditioning (HVAC)]; and
- Vertical and lateral distance from soil vapour sources to buildings.

5. SITE CONDITIONS

The MOECC may require that indoor air quality samples are collected at a time when the surrounding ground is frozen, as well as at another time when it is not frozen. On the day of sampling, weather conditions including outdoor and indoor air temperatures will be recorded. Information on barometric pressure and relative humidity during the sample collection period will be obtained from the nearest Environment Canada (or other) weather station, if the data is publically available.

6. LENGTH OF TIME

Eight hour flow regulators should be used for commercial, institutional and industrial indoor air quality sampling. Residential applications require a 24 hour flow regulator.

7. EQUIPMENT

Laboratories need several days notice to deliver SUMMA® canisters. The usual size for indoor air quality is 6 litres. If you are sampling at a different altitude, let the project manager know so that the flow controller can be adjusted to reflect this difference.

Required from the Laboratory:

- One travel blank SUMMA® canister filled with purified air that is taken to the field, but not opened;
- One Summa® canister for each sample required, as well as an additional field duplicate for every 10 samples; and
- One flow regulator for each Summa® canister (see section 6 for the required length of time).

Additional Equipment:

- 2 x 9/16" wrenches;
- Barometer, Thermometer, and Hygrometer;
- PID or FID; and
- Nitrile Gloves.

Important Notes:

- Instruct the clients not to use glues, adhesives, paints, floor wax, or strong cleaners, etc, in the vicinity of the sampling for several days prior to sampling.
- Do not smoke, pump gas, use hand sanitizer, or handle any solvents prior to handling the Summa® canisters or any of the equipment. Avoid these activities on the day of sampling.

8. SAMPLING:

1. To attach the regulator on to the SUMMA® canister, remove the brass nut on the top and then hand-tighten the Swagelok® regulator nut on to the SUMMA® canister. Use a 9/16" wrench to make a quarter turn to tighten the regulator.
2. Label the paper tag affixed to the SUMMA® with the sample number, as well as which regulator will be associated with it.

3. Label the field notes with the SUMMA® identification number and the regulator number, as well as the initial SUMMA® vacuum and the final SUMMA® vacuum.
4. Record indoor and outdoor meteorological data for that time and date using the portable barometer, thermometer, and hygrometer, as well as Environment Canada (https://weather.gc.ca/canada_e.html).
5. Place the SUMMA® canister at a height of one to two metres above the ground, in an area that is away from doorways, HVAC outlets/inlets, and loading dock areas where idling vehicles might be present over the course of the day.
6. Open the SUMMA® canister by turning the Swagelok® valve counter-clockwise a quarter turn. Record the time and vacuum in the field notes.
7. Using the appropriate detector, record five ambient air readings taken over the course of a minute from either the PID or FID. Non-detect concentrations should be observed. This information may help to identify background conditions and evaluate potential biases.
8. Let the sampling continue for the appropriate length of time based on the regulator. Ideally, allow the sampling to continue for the full pre-determined period until the regulator reads between -8 inches Hg and -3 inches Hg. **Do not allow the regulator to reach a value of 0 inches Hg.** If sampling is progressing more quickly than expected, you may need to close the Swagelok® valve sooner than expected.
9. Prior to closing the Summa® canister, record five ambient air readings taken over the course of a minute from either the PID or FID.
10. Record the final vacuum reading and time. Close the Summa® canister by turning the Swagelok® valve clockwise. Remove the vacuum gauge. Using your fingers, replace the brass nut. Use the wrench to turn it a 1/4 turn.
11. If the sampling period was more than 1 hour, record indoor and outdoor meteorological data for that time and date using the portable barometer, thermometer, and hygrometer, as well as the Environment Canada website (https://weather.gc.ca/canada_e.html).
12. Summa® canisters do not need to be kept cold and can be shipped via airplanes and couriers. Hold time is 30 days (NB: some jurisdictions say 14 days depending on the compound in question).

9. PERFORMING A DUPLICATE SAMPLE:

1. A duplicate sample is taken by placing a secondary Summa® canister immediately adjacent to the primary Summa® canister. The outlets for both regulators should be as close together as possible. The sampling period does not change.

10. CHECKING YOUR DATA:

Data reported in:

- ppbv (independent of P & T);
- µg/m^3 (at 1 atm, 25 degrees C);
- 1 atm and 25 degrees C may not be representative of conditions at your site > results can be altered using the Gas Law Constant; and
- NB these do NOT correspond directly to water concentration units.

Ambient Air is composed of the following gases commonly known as "matrix gases" that do NOT need to be analyzed for indoor air quality sampling:

- Nitrogen 78%;
- Oxygen 21%; and
- 1% CO2, argon, helium.

11. ATTACHMENT

- Indoor Air Quality Field Sheet.

INDOOR AIR QUALITY SAMPLING USING SUMMA® CANISTERS

INDOOR AIR QUALITY- SUMMA CANISTER SAMPLING

Date:			
Technician:			
Project Number:			
Site Address:			
Lab Identifier:			
Canister Number(s):		Regulator Number:	

Starting Parameters:

Outdoor Barometric Pressure:			Indoor Barometric Pressure:		
Outdoor Temperature:			Indoor Temperature:		
Relative Humidity of Sampling Environment:			Wind Direction & Speed:		
PID readings - 5 in one minute:					
Start Time:			Starting Canister Vacuum:		

Sample Height:	
Description of Sample Location (i.e. room, position within a building, exit number, building number, etc):	
Additional notes about condition of the floor and/or foundation (i.e. cracks, spills, stains, sumps, drains, utility conduits):	
HVAC conditions during sampling:	
Fireplace, furnace, fans present?	

INDOOR AIR QUALITY SAMPLING USING SUMMA® CANISTERS

Indoor sources of VOCs noted during sampling:	
Description of doors and windows and their usage (open, closed, high traffic through the doors, i.e. how many times opened and closed in an hour)	

End Parameters:

<table>
<tr><td>Outdoor Barometric Pressure:</td><td colspan="2"></td><td>Indoor Barometric Pressure:</td><td colspan="2"></td></tr>
<tr><td>Outdoor Temperature:</td><td colspan="2"></td><td>Indoor Temperature:</td><td colspan="2"></td></tr>
<tr><td>Relative Humidity of Sampling Environment:</td><td colspan="2"></td><td>Wind Direction & Speed:</td><td colspan="2"></td></tr>
<tr><td>PID readings - 5 in one minute:</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>End Time:</td><td colspan="2"></td><td>End Canister Vacuum:</td><td colspan="2"></td></tr>
</table>

APPENDIX E

INDOOR AIR QUALITY INVESTIGATION FIELD NOTES

Outdoor ~~Indoor~~ Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence I

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.8	Indoor Barometric Pressure:	N/A
Outdoor Temperature:	-13°C (-21 WC)	Indoor Temperature:	N/A
Relative Humidity of Sampling Environment:	73%	Wind Direction & Speed:	18km/hr South

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.7	Indoor Barometric Pressure:	N/A
Outdoor Temperature:	1°C	Indoor Temperature:	N/A
Relative Humidity of Sampling Environment:	76%	Wind Direction & Speed:	12km/hr SSE

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

Ambient Sample

Lab Identifier:	OAQ				
Canister Number(s):	2595		Regulator Number:	955	
Starting PID readings- 5 in 1 minute:	0	1	1	0	1
Start Time:	11:00		Starting Canister Vacuum:	-26.5	
Ending PID readings- 5 in 1 minute:	0	1	0	1	2
End Time:	11:15		Ending Canister Vacuum:	-4.5	

Sample Height:	~2.3m above GS
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	on back patio @ Residence I on patio table.
HVAC conditions during sampling:	Type: N/A __(On)___(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	N/A.

CH_4 0.0
CO_2 0.0
O_2 20.9

Residence J

Preliminary Assessment:

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/No/NA)**
Gasoline storage cans	no	
Gas-powered equipment	no.	
Kerosene storage cans	no.	
Paints / thinners / strippers	yes - in garage	
Cleaning solvents	no.	
Oven cleaners	Yes - in kitchen.	
Carpet / upholstery cleaners	Resolve - not used in past few weeks.	
Other house cleaning products	Tide, toilet bowl, cleaner, etc.	yes.
Moth balls	maybe in garage	
Polishes / waxes	pledge	
Insecticides	in garage.	
Furniture / floor polish		
Nail polish / polish remover	in ensuite bathroom	
Hairspray	no	
Cologne / perfume	no	

laundry machine area.

Residence J

Air fresheners	no.	
Fuel tank (inside building)	no.	
Wood stove or fireplace	gas fireplace	
New furniture / upholstery	no	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	no.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall Floor material: Concrete Cracks? Epoxy or waterproof paint sealants? fine cracks where slab visible Spills or stains? not visible. Utility Conduits? yes through slab.

Residence J

Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no)
Floor Drains	✓(yes) __ (no) near furnace room/ laundry.
Fireplace, furnace or fans present?	
Is the room attached to a garage?	✓(yes) __ (no) upstairs. ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: 2 ____(m)
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, asphalt.
Is there a septic system on site?	__(yes) ✓(no)

Residence J

Commercial or Industrial Facility- where are the uniforms laundered? Type of cleaner?	N/A
Commercial or Industrial Facility- do any of the tools or equipment require sterilization? What process or chemical is used?	N/A
Other:	—

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence A
Time/Date:	530pm
Name of Person:	

Mon. night.

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	"	
Kerosene storage cans	"	
Paints / thinners / strippers	"	
Cleaning solvents	"	
Oven cleaners	"	
Carpet / upholstery cleaners	"	
Other house cleaning products	maybe bathroom	
Moth balls	no.	
Polishes / waxes	no	
Insecticides	no	
Furniture / floor polish	no	
Nail polish / polish remover	no.	
Hairspray	no	
Cologne / perfume	no	
Air fresheners	no	

Fuel tank (inside building)	no	
Wood stove or fireplace	no.	
New furniture / upholstery	no.	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	no.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. Floor material: carpet, tile . Cracks? Epoxy or waterproof paint sealants? unable to tell. Spills or stains? no. Utility Conduits? Senitary stack.
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A

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Residence A

Floor Drains	✓(yes) __ (no) basement, off furnace room.
Fireplace, furnace or fans present?	furnace.
Is the room attached to a garage?	__(yes) ✓(no) ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: _______(m) 8'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, driveway, hardscaping.
Is there a septic system on site?	__(yes) ✓(no)

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence B
Time/Date:	Dec 5 2016.
Name of Person:	

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	no	
Kerosene storage cans	no	
Paints / thinners / strippers	yes - cupboards in a different room.	
Cleaning solvents		
Oven cleaners	no.	
Carpet / upholstery cleaners		
Other house cleaning products	laundry detergent.	
Moth balls	yes.	
Polishes / waxes		
Insecticides	yes - Raid.	
Furniture / floor polish	no.	
Nail polish / polish remover	no	
Hairspray	no	
Cologne / perfume	n	
Air fresheners	fabric softener.	

Various cans of Raid, windex, etc. in laundry room.

Fuel tank (inside building)	no.	
~~Wood stove~~ [✓ or fireplace]	yes.	
New furniture / upholstery	no.	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	no.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. good condition. Floor material: carpeted. everywhere except utility room. good condition Cracks? Epoxy or waterproof paint sealants? none visible. Spills or stains? none visible Utility Conduits? yes - some pipes through slab in utility room.
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A.

Residence B

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Floor Drains	[✓ (yes)] __ (no) utility room.
Fireplace, furnace or fans present?	furnace.
Is the room attached to a garage?	__(yes) [✓ (no)] ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ___YES. Approx. Depth: ______(m) yes. 8'. all full height.
Maintenance and repairs- has any painting or staining been done in the past 6 months?	single board on Dec 4th. no more.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) [✓ (no)]
Ground cover surrounding building:	hardscaping, grass/garden, driveway.
Is there a septic system on site?	__(yes) [✓ (no)]

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence C
Time/Date:	4^{30} Dec 6/16.
Name of Person:	

Potential Sources	**Location(s)** no	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	''	
Gas-powered equipment	''	
Kerosene storage cans		
Paints / thinners / strippers	old paint can (1). acrylic paints } no odour closed long time.	
Cleaning solvents	no. (save bathroom cleaners).	
Oven cleaners	upstairs	
Carpet / upholstery cleaners	no.	
Other house cleaning products	see above.	
Moth balls	no.	
Polishes / waxes	no.	
Insecticides	few weeks - indoor ~~Raid~~ VOC-free	
Furniture / floor polish	no.	
Nail polish / polish remover	no	
Hairspray	no	
Cologne / perfume	no.	
Air fresheners	no.	

Residence C

Fuel tank (inside building)	no	
Wood stove or fireplace	yes - hasn't been on since Jan 2016	
New furniture / upholstery	no	
New carpeting / flooring	upstairs - new carpet 1 mth ago.	
Hobbies - glues, paints, etc.	acrylic paints,	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall - good condition. Floor material: carpet/painted slab - good condition. Cracks? Epoxy or waterproof paint sealants? no. Spills or stains? no. Utility Conduits? yes.
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes)✓__ (no) Water in sump:__(yes) __ (no) N/A.

Residence C

Floor Drains	✓(yes) __ (no)
Fireplace, furnace or fans present?	
Is the room attached to a garage?	✓(yes) __ (no) ___(car) upstairs ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	2
Are basements or crawlspaces present?	___(No) ___YES. Approx. Depth: ______(m) yes 8'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, driveway
Is there a septic system on site?	__(yes) ✓(no)

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence D
Time/Date:	Mon Dec 5/16 415
Name of Person:	

Basement

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	NO	
Gas-powered equipment	〃	
Kerosene storage cans	〃	
Paints / thinners / strippers	〃	
Cleaning solvents	〃	
Oven cleaners	〃	
Carpet / upholstery cleaners	〃	
Other house cleaning products	〃	
Moth balls	〃	
Polishes / waxes	〃	
Insecticides	〃	
Furniture / floor polish	〃	
Nail polish / polish remover	〃	
Hairspray	〃	
Cologne / perfume	〃	
Air fresheners	〃	

Residence D

Fuel tank (inside building)	no.	
Wood stove or fireplace	no.	
New furniture / upholstery	no.	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	no. = decades ago some paint/glue on floor. no odour.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. good condition Floor material: tile on slab. visible slab in good condition. Cracks? Epoxy or waterproof paint sealants? not visible. Spills or stains? ~~no~~ yes - see "hobbies" Utility Conduits?
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A.

sanitary stack runs down through basement flr.

Residence D

Floor Drains	__(yes) [✓ (no)]
Fireplace, furnace or fans present?	Gas Furnace.
Is the room attached to a garage?	__(yes) [✓ (no)] ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	2
Are basements or crawlspaces present?	__(No) [✓ YES]. Approx. Depth: ______(m) 8' reg. 5' crawl space.
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) [✓ (no)]
Ground cover surrounding building:	grass, asphalt driveway, garden.
Is there a septic system on site?	__(yes) [✓ (no)]

1/2 crawl space, 1/2 reg. height.

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence E
Time/Date:	6 Dec 16 5^{30}.
Name of Person:	

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	"	
Kerosene storage cans	"	
Paints / thinners / strippers	"	
Cleaning solvents	"	
Oven cleaners	"	
Carpet / upholstery cleaners	"	
Other house cleaning products	"	
Moth balls	"	
Polishes / waxes	"	
Insecticides	"	
Furniture / floor polish	"	
Nail polish / polish remover	"	
Hairspray	"	
Cologne / perfume	bedroom	
Air fresheners	no	

ductwork runs to garage from crawlspace => flaps in garage.

Fuel tank (inside building)	no.	
Wood stove or fireplace	no.	
New furniture / upholstery	no.	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	Sodering iron, photomounting (drymount) photo solutions	} not used recently

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. Floor material: carpet + bare slab. Cracks? Epoxy or waterproof paint sealants? yes. no sealant. Spills or stains? no. Utility Conduits? yes.
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A.

fresh air returns
↳ 4 upstairs or main level.

Residence E

Floor Drains	✓(yes) __ (no) furnace room
Fireplace, furnace or fans present?	furnace.
Is the room attached to a garage?	✓(yes) __ (no) ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	2 storey split.
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: ______(m) 6' cs, 9'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	indoor smoking.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, garden, driveway
Is there a septic system on site?	__(yes) ✓(no)

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Indoor Air Sampling - Preliminary Assessment:

Address:	Residence F
Time/Date:	6'5 Dec 6/16.
Name of Person:	

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	"	
Kerosene storage cans	"	
Paints / thinners / strippers	"	
Cleaning solvents	"	
Oven cleaners	"	
Carpet / upholstery cleaners	"	
Other house cleaning products	Yes => will move to garage.	
Moth balls	"	
Polishes / waxes	"	
Insecticides	"	
Furniture / floor polish	vinyl cleaner upstairs	- Rinse-Free Cleaner - Mennington.
Nail polish / polish remover	"	
Hairspray	"	
Cologne / perfume	"	
Air fresheners	"	

Glycol Ethers,
Alkyl Phenol, EDTA
Sodium Salt

Fuel tank (inside building)	no	
Wood stove or [✓ fireplace]	yes - upstairs	
New furniture / upholstery	no	
New carpeting / flooring	not in basement ↳ upstairs - 1 mth old.	
Hobbies - glues, paints, etc.	spray starch, adhesive	=> Quilting.

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall, good condition. Floor material: tile, carpet, slab good condition other than below. Cracks? Epoxy or waterproof paint sealants? Craft room in basement ↳ plywood covering area 2x2 => owner opened, clay underneath! Spills or stains? No, Utility Conduits? sanitary stack
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A

Residence F

Floor Drains	✓(yes) __ (no) furnace room.
Fireplace, furnace or fans present?	furnace.
Is the room attached to a garage?	✓(yes) __ (no) ___(car) chemicals, lawnmower ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: ______(m) 8'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	painting upstairs.
Does anyone smoke in the facility or just outside any of the doors or windows?	previous owners
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	driveway, concrete, grass, hardscaping.
Is there a septic system on site?	__(yes) ✓(no)

XCG

XCG Consultants Ltd.

Indoor Air Sampling - Preliminary Assessment:

Address:	Residence G
Time/Date:	6^{15}pm Dec6/16
Name of Person:	

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	"	
Kerosene storage cans	"	
Paints / thinners / strippers	Low VOC acrylic	
Cleaning solvents	no.	
Oven cleaners	upstairs	
Carpet / upholstery cleaners	no.	
Other house cleaning products	basics under sink in bathroom - bleach powder	
Moth balls	no.	
Polishes / waxes	no.	
Insecticides	no.	
Furniture / floor polish	no. polished floors 2x/mth upstairs. *	
Nail polish / polish remover	no.	
Hairspray	occassionally	
Cologne / perfume	not much basement	
Air fresheners	"	

"Damp Tramp" in washroom

* Bona, Stone, Tile, + Laminate Floor Cleaner.

Fuel tank (inside building)	no	
Wood stove or [✓ fireplace]	not hooked up	
New furniture / upholstery	no	
New carpeting / flooring	no	
Hobbies - glues, paints, etc.	Spray starch, adhesive (quilting).	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. good condition Floor material: Carpet, slab (concrete) good condition. Cracks? Epoxy or waterproof paint sealants? none visible Spills or stains? no Utility Conduits? yes - sanitary
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no) N/A.

Floor Drains	✓(yes) __ (no) furnace room.
Fireplace, furnace or fans present?	fireplace.
Is the room attached to a garage?	__(yes) __ (no) ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: ______(m) 8'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	painted upstairs bath ↳ 2 yrs ago.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	garden, grass, hardscaping, driveway
Is there a septic system on site?	__(yes) ✓(no)

Residence H

XCG
XCG Consultants Ltd.

Indoor Air Sampling - Preliminary Assessment:

Address:	Dec 6 6^{30}.
Time/Date:	
Name of Person:	

[redacted] Mon/Tues. 2^{30}pm.

Potential Sources	**Location(s)**	**Removed before Sampling? (Yes/ No/ N/A)**
Gasoline storage cans	no	
Gas-powered equipment	no.	
Kerosene storage cans	no	
Paints / thinners / strippers	no.	
Cleaning solvents	no.	
Oven cleaners	no.	
Carpet / upholstery cleaners	no.	
Other house cleaning products	no.	
Moth balls	no.	
Polishes / waxes	"	
Insecticides	"	
Furniture / floor polish	"	
Nail polish / polish remover	no.	
Hairspray	"	
Cologne / perfume	"	
Air fresheners	"	

Fuel tank (inside building)	no.	
Wood stove or [✓ fireplace]	yes - gas	
New furniture / upholstery	no.	
New carpeting / flooring	no. (laminate - 3 yrs old)	
Hobbies - glues, paints, etc.	no.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: Concrete, insulation/studs. Floor material: Concrete good condition. Cracks? Epoxy or waterproof paint sealants? minor crack one area. Spills or stains? no. Utility Conduits? sanitery.
Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump: __(yes) __ (no) N/A.

Residence H

Floor Drains	✓(yes) __ (no)
Fireplace, furnace or fans present?	Furnace.
Is the room attached to a garage? → not room. but attached garage.	✓(yes) __ (no) ___(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: ______(m) 8'
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, hardscaping, paving
Is there a septic system on site?	__(yes) ✓(no)

Residence I

Preliminary Assessment:

Potential Sources	Location(s)	Removed before Sampling? (Yes/No/NA)
Gasoline storage cans	no.	
Gas-powered equipment	no.	
Kerosene storage cans	no.	
Paints / thinners / strippers	under basement stairs ↳ not opened in 4 yrs. latex/acrylic water based	not removed.
Cleaning solvents	no.	
Oven cleaners	no.	
Carpet / upholstery cleaners	no.	
Other house cleaning products	yes - bathroom in basement	
Moth balls	no.	
Polishes / waxes	pledge Goo Gone	no - under kitchen sink.
Insecticides	no.	
Furniture / floor polish	see above.	
Nail polish / polish remover	no.	
Hairspray	no	
Cologne / perfume	no.	

Residence I

Air fresheners	Febreze Sometimes.	
Fuel tank (inside building)	no.	
Wood stove or fireplace	gas fireplaces	
New furniture / upholstery	no.	
New carpeting / flooring	no.	
Hobbies - glues, paints, etc.	no.	

Additional notes about material and condition of the floor and/or foundation and/or walls (ie. cracks, spills, stains, utility conduits):	Wall material: drywall. Floor material: Concrete but carpet Cracks? Epoxy or waterproof paint sealants? 1 minor crack in furnace room. Remainder covered. Spills or stains? none visible. Utility Conduits? in furnace room, through slab.

Residence I

Sumps	Sump: __(yes) ✓(no) Sump Pump: __(yes) ✓(no) Water in sump:__(yes) __ (no)
Floor Drains	✓(yes) __ (no) in furnace, laundry area.
Fireplace, furnace or fans present?	yes - gas.
Is the room attached to a garage?	✓(yes) __ (no) => not directly => upstairs. ✓(car) ___(gas powered equipment or fuel stored in garage)
Number of floors above grade:	1
Are basements or crawlspaces present?	___(No) ✓YES. Approx. Depth: 2 (m)
Maintenance and repairs- has any painting or staining been done in the past 6 months?	no.
Does anyone smoke in the facility or just outside any of the doors or windows?	no.
Has there ever been a fire in the facility?	__(yes) ✓(no)
Ground cover surrounding building:	grass, esphalt.
Is there a septic system on site?	__(yes) ✓(no)

Residence I

Commercial or Industrial Facility- where are the uniforms laundered? Type of cleaner?	N/A
Commercial or Industrial Facility- do any of the tools or equipment require sterilization? What process or chemical is used?	N/A.
Other:	—

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence A

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.6.	Indoor Barometric Pressure:	105.4
Outdoor Temperature:	7°C (-12°c WC)	Indoor Temperature:	16°C
Relative Humidity of Sampling Environment:	35%.	Wind Direction & Speed:	S 11 Km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.2	Indoor Barometric Pressure:	105.3
Outdoor Temperature:	2°C (no WC)	Indoor Temperature:	17°C
Relative Humidity of Sampling Environment:	39%.	Wind Direction & Speed:	22 km/hr SE

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

no changes to PSI (Dec/16)

Lab Identifier:	Residence A				
Canister Number(s):	2758		Regulator Number:	661	
Starting PID readings- 5 in 1 minute:	2	1	2	2	1
Start Time:	15:52		Starting Canister Vacuum:	-26.0	
Ending PID readings- 5 in 1 minute:	1	1	1	2	1
End Time:	15:45		Ending Canister Vacuum:	-6.0	

Sample Height:	~1.1m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	in room w/ FD off main room, adjacent to furnace room
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	doors all open in basement. Minimal in/out to exterior of house.

CH_4 0.0

O_2 21.0

CO_2 0.1

%LEL 0.

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence B

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.6	Indoor Barometric Pressure:	105.5
Outdoor Temperature:	-5°C (-8 WC)	Indoor Temperature:	16°C.
Relative Humidity of Sampling Environment:	45%	Wind Direction & Speed:	ESE 7 km/hr.

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.0	Indoor Barometric Pressure:	105.3
Outdoor Temperature:	2°C (no WC)	Indoor Temperature:	17°C
Relative Humidity of Sampling Environment:	45%.	Wind Direction & Speed:	SE 26 km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

CH_4 0.0
CO_2 0.1
O_2 21.5
% LEL 0

Lab Identifier:	Residence B				
Canister Number(s):	T21636		Regulator Number:	1309	
Starting PID readings- 5 in 1 minute:	1	1	1	1	0
Start Time:	17:27		Starting Canister Vacuum:	-25.0	
Ending PID readings- 5 in 1 minute:	1	1	1	0	1
End Time:	17:30		Ending Canister Vacuum:	-6.5	

Sample Height:	~1.2m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	furnace room, off laundry room.
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	pretty isolated from any direct exterior air influences.

Washing machine / dryer going @ sample drop-off.

Cleaning products removed to another area in basement, door closed.

↳ no other changes to PSI conducted Dec /16.

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 + Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence C

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.6	Indoor Barometric Pressure:	105.7
Outdoor Temperature:	7°C (-12°C WC)	Indoor Temperature:	18°C
Relative Humidity of Sampling Environment:	38%	Wind Direction & Speed:	S 11 Km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.2	Indoor Barometric Pressure:	105.4
Outdoor Temperature:	2°C (no WC)	Indoor Temperature:	18°C
Relative Humidity of Sampling Environment:	42%	Wind Direction & Speed:	22 km/hr SE

Trip Blank Canister Number: *	—		
Location of Duplicate Sample:	immediately beside other		
Canister Number(s):	2580	Regulator Number:	1407.

no changes since PSI Dec/16.

* Trip Blank: same canister used for both SV + IA canisters. All kept ~~?~~ together during shipping and when not in use.

Lab Identifier:	Residence C "XCG-300"				
Canister Number(s):	14258		Regulator Number:	1368	
Starting PID readings- 5 in 1 minute:	1	1	1	0	1
Start Time:	15:32		Starting Canister Vacuum:	-26.0/-27.0	
Ending PID readings- 5 in 1 minute:	1	1	1	1	1
End Time:	3:29		Ending Canister Vacuum:	-6.0/-9.0	

Sample Height:	1.2m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	basement, under stairs near FD.
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	no door to 1st flr. minimal traffic in + out front door.

basement all open, incl. furnace, hot water heater, etc.

CH_4	0.0
O_2	21.3
CO_2	0.1
%LEL	0

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17.
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence D

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	102.1	Indoor Barometric Pressure:	105.7 KPa
Outdoor Temperature:	-15°C (-23°C WC)	Indoor Temperature:	20°C
Relative Humidity of Sampling Environment:	42%	Wind Direction & Speed:	S 16km/hr.

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	101.8	Indoor Barometric Pressure:	105.6
Outdoor Temperature:	-8 (-10 WC)	Indoor Temperature:	19°C
Relative Humidity of Sampling Environment:	45%	Wind Direction & Speed:	N 3km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

no changes since PSI Dec/16.

on stool in basement, ~1.2m off floor near furnace, utility conduits through floor.

1/2

Lab Identifier:	Residence D				
Canister Number(s):	18232		Regulator Number:	766.	
Starting PID readings- 5 in 1 minute:	2	1	1	2	1
Start Time:	9:50		Starting Canister Vacuum:	-32.0	
Ending PID readings- 5 in 1 minute:	1	1	2	2	2
End Time:	9:55		Ending Canister Vacuum:	-11	

Sample Height:	~1.2m.
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	on stool in basement
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	minimal. Door to basement closed from rest of house to keep cat upstairs.

CO_2 0.1%

CH_4 0.0%

O_2 20.9%

% LEL 0

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17.
Technician:	MCL
Project Number:	~~3~~- 4-2332-04-03
Site Address:	Residence E

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	102.1	Indoor Barometric Pressure:	105.6
Outdoor Temperature:	-15°C (-23°C)	Indoor Temperature:	18°C
Relative Humidity of Sampling Environment:	45%	Wind Direction & Speed:	S 16km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	101.8	Indoor Barometric Pressure:	105.4
Outdoor Temperature:	-8 (-10WC)	Indoor Temperature:	16°C
Relative Humidity of Sampling Environment:	40%	Wind Direction & Speed:	N 3km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

9:32 -29.0.

in furnace room, which is also connected to crawl space. 1.5m off floor on step-ladder.

no changes since PSI Dec/16.

Lab Identifier:	Residence E				
Canister Number(s):	129		Regulator Number:	757	
Starting PID readings- 5 in 1 minute:	2	3	2	2	2
Start Time:	9:32		Starting Canister Vacuum:	-29.0	
Ending PID readings- 5 in 1 minute:	3	2	2	3	2
End Time:	9:40		Ending Canister Vacuum:	-9.0	

Sample Height:	~1.5m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	in furnace room. Connected to crawl space.
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	no direct pathway to exterior. 3 people living in house- moderate door traffic.

CH_4 0.0
CO_2 0.1
O_2 20.8

1 person lives in basement, bedroom connected to furnace room. Crawlspace used to store xmas decorations, etc.

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence F

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.9	Indoor Barometric Pressure:	106.0.
Outdoor Temperature:	-12°C (-19°C windchill)	Indoor Temperature:	15°C
Relative Humidity of Sampling Environment:	48%	Wind Direction & Speed:	SSE 18km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.5	Indoor Barometric Pressure:	105.8
Outdoor Temperature:	2°C (no wc)	Indoor Temperature:	18°C
Relative Humidity of Sampling Environment:	45%	Wind Direction & Speed:	SE 17km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

low VOC paint, new door/ door-frame in past few weeks before sampling. Photograph of paint can included w/ site photos. No detectable odour noted. No other changes since RSI (Dec/16)

Lab Identifier:	Residence F				
Canister Number(s):	14918		Regulator Number:	458	
Starting PID readings- 5 in 1 minute:	1	0	0	1	1
Start Time:	12:38		Starting Canister Vacuum:	-26.0	
Ending PID readings- 5 in 1 minute:	1	1	1	0	0
End Time:	12:30		Ending Canister Vacuum:	-7.0	

Sample Height:	1.2m on stepladder
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	in furnace room ↳ FD w/ door open.
HVAC conditions during sampling:	Type: Forced Air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	windows closed. Door to furnace room open to rest of house. Door to exterior opened a few times only during sample.

new door, painting in past few weeks.

↳ Minwax photos on camera.

O_2 21.2%

CH4 0.0%

CO_2 0.1%

0 % LEL 0

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence G

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.9	Indoor Barometric Pressure:	105.9
Outdoor Temperature:	-12°C (-17 WC)	Indoor Temperature:	16°C
Relative Humidity of Sampling Environment:	34%	Wind Direction & Speed:	SSE 10km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.5	Indoor Barometric Pressure:	105.7
Outdoor Temperature:	2°C (no WC)	Indoor Temperature:	17°C
Relative Humidity of Sampling Environment:	36%	Wind Direction & Speed:	SE 17km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

no changes to Preliminary
Site Inspection (Dec 2016)

Lab Identifier:	Residence G				
Canister Number(s):	14531		Regulator Number:	1376	
Starting PID readings- 5 in 1 minute:	1	0	0	1	0
Start Time:	12:52		Starting Canister Vacuum:	-260	
Ending PID readings- 5 in 1 minute:	0	0	1	2	1
End Time:	12:50.		Ending Canister Vacuum:	-5,5	

Sample Height:	~1m off floor
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	in furnace room, doors open, on step stool
HVAC conditions during sampling:	Type: forced air ✓(On)___(Off) ↳ set to lower temp than normal b/c residents away.
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	minimal. Residents are away, therefore gave access to XCG. All windows closed.

GEM readings @ pick-up:

O_2 20.9 %

PID 2ppm

CO_2 0.1 %

CH_4 0.1 %

% LEL = 0

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence H

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.6	Indoor Barometric Pressure:	105.7
Outdoor Temperature:	-5°C (-8°C wc)	Indoor Temperature:	16°C.
Relative Humidity of Sampling Environment:	~~50~~ 40 %.	Wind Direction & Speed:	ESE 7km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.0	Indoor Barometric Pressure:	105.5
Outdoor Temperature:	2°C (no wc)	Indoor Temperature:	16°C
Relative Humidity of Sampling Environment:	40%.	Wind Direction & Speed:	SE 26km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

no changes since PSI Dec/16.

Lab Identifier:	Residence H				
Canister Number(s):	18260.		Regulator Number:	1354	
Starting PID readings- 5 in 1 minute:	1	1	0	0	1
Start Time:	18.03 pm		Starting Canister Vacuum:	-26.0	
Ending PID readings- 5 in 1 minute:	0	0	1	0	1
End Time:	18:15		Ending Canister Vacuum:	-5.5	

Sample Height:	~1.m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	middle of basement on stepladder
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	minimal. windows closed.

Basement completely open -> no barriers/walls.

CH_4 0.0
CO_2 0.1
O_2 21.6
%LEL 0

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence I

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.8	Indoor Barometric Pressure:	105.5
Outdoor Temperature:	-13°C (-21WC)	Indoor Temperature:	20°C
Relative Humidity of Sampling Environment:	42%	Wind Direction & Speed:	18Km/hr South

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.7	Indoor Barometric Pressure:	105.4
Outdoor Temperature:	1°C	Indoor Temperature:	21°C
Relative Humidity of Sampling Environment:	45%	Wind Direction & Speed:	12Km/hr SSE

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

PSI conducted Mar 9/17 -
no changes.

1m off ground in middle of
laundry, furnace room. Door to
rest of basement/house open.

13

Lab Identifier:	Residence I				
Canister Number(s):	14530		Regulator Number:	972	
Starting PID readings- 5 in 1 minute:	2	1	1	2	1
Start Time:	10:34		Starting Canister Vacuum:	-29.0	
Ending PID readings- 5 in 1 minute:	1	1	1	2	1
End Time:	10 50		Ending Canister Vacuum:	- 8.0	

Sample Height:	~1m on chair
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	in middle of laundry/ furnace room
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	minimal. Residents away overnight.

CH_4 0.0

CO_2 0.1

O_2 20.5

%LEL 0.

Indoor Air Quality- Summa Canister Sampling

Date:	Mar 13/17 - Mar 14/17
Technician:	MCL
Project Number:	4-2352-04-03
Site Address:	Residence J

Starting Meteorological Parameters:

Outdoor Barometric Pressure:	101.8	Indoor Barometric Pressure:	105.4.
Outdoor Temperature:	-13°C (-21° wc)	Indoor Temperature:	22°C
Relative Humidity of Sampling Environment:	40%.	Wind Direction & Speed:	South 18Km/hr

Ending Meteorological Parameters:

Outdoor Barometric Pressure:	100.7	Indoor Barometric Pressure:	105.4
Outdoor Temperature:	1°C	Indoor Temperature:	21°C
Relative Humidity of Sampling Environment:	42%	Wind Direction & Speed:	SSE 12Km/hr

Trip Blank Canister Number:	—		
Location of Duplicate Sample:	—		
Canister Number(s):	—	Regulator Number:	—

on ironing board in middle of room, ~1.5m above floor in furnace/laundry room.

Ambient sample 2595 reg 955 #4

11am north of

Lab Identifier:	Residence J				
Canister Number(s):	2813		Regulator Number:	166.	
Starting PID readings- 5 in 1 minute:	1	1	2	1	0
Start Time:	10:49		Starting Canister Vacuum:	-28.0	
Ending PID readings- 5 in 1 minute:	1	1	2	2	2
End Time:	11:00		Ending Canister Vacuum:	-9.0	

Sample Height:	on ironing board ~ 1.5m
Description of Sample Location (ie. room, position within a building, exit number, building number, etc):	middle of laundry / furnace room (basement)
HVAC conditions during sampling:	Type: forced air ✓(On)____(Off)
Description of doors and windows and their usage (open, closed, high traffic through the doors, ie. how many times opened and closed in an hour)	minimal.

CH_4 0.0

O_2 20.9

CO_2 0.1

% LEL 0

no change since PSI conducted March 9/17.

APPENDIX F

SOIL VAPOUR SAMPLING FIELD NOTES

XCG
XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Mar 14/17 TECHNICIAN: MCL / SB

PROBE ID: XCG-2 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-2(MW) 9.31 ~~btoc~~ bgs	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
1	/	1.7	18.5	0.0	/	/	/	100.2
3		1.6	18.6	0.0				"
5		1.6	18.6	0.0				"
8		1.6	18.7	0.0				"

screen depth:

3.0mbgs

PROBE ID: XCG-1 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-1(MW) 8.01mbgs	Pump Flow Rate: 1L/min.

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
1	/	2.8	18.6	0.0	/	/	/	100.2
3		2.7	18.6	0.0				"
6		2.6	18.8	0.0				"
9		2.6	18.8	0.0				"

screen depth

4.0mbgs.

Weather:	partially sunny, cloudy
Wind Direction:	SE
Wind Speed:	22km/hr
Temperature:	2°C
Relative Humidity:	

*probes purged within previous 72hrs. (at least 3 volumes).

Equipment Used:

LandtecGEM2000
+ Dwyer Manometer

XCG
XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Mar 14/17 TECHNICIAN: MCL/SB

PROBE ID: XCG-4 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-4 (MW): 3:96	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kPa)
1	/	0.0	21.2	0.0	/	/	/	100.2
6		1.0	19.3	0.5				"
9		1.1	19.5	0.4				"
10		1.4	18.8	0.7				"

Screen depth 1.0

PROBE ID: XCG-5 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-5 (MW): 3.79	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kPa)
1	/	0.3	21.1	0.0	/	/	/	100.2
3		0.3	21.0	0.0				"
8		0.3	21.0	0.0				"
10		0.3	21.0	0.0				"

Screen depth 2.0

Weather:	Sunny
Wind Direction:	SE
Wind Speed:	22km/hr
Temperature:	2°C
Relative Humidity:	

Equipment Used:

XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Nov14/17 TECHNICIAN: MCL / SB

PROBE ID: XCG-6 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-6(MW) : 3.57	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kPa)
12		16.9	1.5	1.0				101.9
15		17.1	1.4	1.0				"
18		17.0	1.4	1.0				"
21		17.4	1.1	1.0				"
24		17.4	1.1	1.0				"

Screen depth 1.7

PROBE ID: XCG-12 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @XCG-12(MW) : 7.62	Pump Flow Rate: 1L/min.

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kPa)
1		0.1	20.3	0.0				102.1
6		0.1	20.6	0.0				"
8		0.1	20.4	0.0				"
10		0.1	20.5	0.0				"

Screen depth ~~17~~ 2.0

Weather:	Sun w/ clouds.
Wind Direction:	north in am, SSE by pm.
Wind Speed:	3 -> 17 km/hr.
Temperature:	2°C
Relative Humidity:	

Equipment Used:

XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Mar14/17 TECHNICIAN: MA/SB

PROBE ID: VW01

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @MW-01: 7.45mbgs	Pump Flow Rate: 1L/min.

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
1		0.8	20.7	0.0				100.0
3		1.0	20.6	0.0				"
5		1.3	20.3	0.0				"
7		1.9	19.8	0.0				"
9		2.4	19.4	0.0				"
11		2.9	19.0	0.0				"
13		3.6	18.3	0.0				"

Screen depth: 6.1

PROBE ID:

Initial Pressure/Vacuum in Probe:	Water Level:	Pump Flow Rate:

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
15		4.2	17.8	0.0				"
17		4.3	17.7	0.0				"
19		4.3	17.7	0.0				"

Weather:	partial sun/cloud
Wind Direction:	SE
Wind Speed:	SE 20km/hr
Temperature:	2°C
Relative Humidity:	

Equipment Used:

XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Mar13/17 TECHNICIAN: MCA/SB

PROBE ID: VW02

Initial Pressure/Vacuum in Probe: N/A*	Water Level: @MW-07) 4.47	Pump Flow Rate: 1L/min.

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
3	/	2.8	19.4	4.8	/	/	/	101.6
9	/	1.9	20.5	2.4				"

*no cap - open pipe.

Did not stabilize.

7.6mbgs.

LIKELY BLINDED.

PROBE ID: XCG-10(SUP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @MW-02 2.40.	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
0.5	/	3.6	11.1	0.0	/	/	/	101.6
3		3.3	11.6	0.0				"
6		2.7	13.5	0.0				"
9		2.4	14.3	0.0				"

Screen depth 1.5m

Weather:	Sunny
Wind Direction:	ESE
Wind Speed:	7Km/hr
Temperature:	-5°C
Relative Humidity:	

Equipment Used:

XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

PROBE ID: VW03

DATE: Mar 13/17 TECHNICIAN: MCL/SB

Initial Pressure/Vacuum in Probe: 0.0	Water Level: (@MW-07) 4.47	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
0		6.1	13.2	0.0				101.6
3		6.4	12.6	0.0				"
6		6.5	12.3	0.0				"
9		6.5	12.4	0.0				"

screen depth: 3.0

PROBE ID: XCG-13 (SVP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: (@XCG-13 (MW)) 3.77	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
0		0.1	21.8	0.0				101.6
3		3.4	16.6	0.7				"
6		3.3	16.7	0.7				"
9		3.3	16.7	0.7				"

screen depth: 2.0

Weather:	Sunny
Wind Direction:	ESE
Wind Speed:	7 km/hr
Temperature:	-5°C
Relative Humidity:	

Equipment Used:

XCG Consultants Ltd.

SOIL GAS SAMPLING FIELD FORM

DATE: Mar 14/17 TECHNICIAN: MCL/SB

PROBE ID: XCG-9 (SRP)

Initial Pressure/Vacuum in Probe: 0.0	Water Level: @MW-01: 7.45mbgs	Pump Flow Rate: 1L/min.

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
1		0.3	21.6	0.0				100.2
3		0.5	20.8	0.0				"
6		0.5	20.8	0.0				"
9		0.5	20.8	0.0				"

Screen depth: 1.5

PROBE ID: VW-05

Initial Pressure/Vacuum in Probe: 0.0	Water Level: could not locate VW-05	Pump Flow Rate: 1L/min

Elapsed Time (min)	Vacuum (in-H2O)	CO2	O2	CH4	H2S	CO (ppm)	FID (ppm)	Atmospheric Pressure (kpa)
1		1.6	16.6	0.1				100.2
3		3.1	18.5	0.0				"
5		2.7	19.0	0.0				"
9		2.6	19.0	0.0				"

Screen depth: 4.4

Weather:	partialy sunny, cloudy.
Wind Direction:	SE
Wind Speed:	22 km/hr
Temperature:	2°C
Relative Humidity:	

Equipment Used:
Landtec GEM 2000, Dwyer Manometer

historic WL:
879.974 TOP.
877.229 WL
= ~2.75mbtop.

Chain of Custody Form - Summa^{TM} Canister

30585

Maxxam
A Bureau Veritas Group Company

6740 Campobello Rd
Mississauga Ontario, L5N 2L8
www.maxxam.ca

Toll Free: 1-800-668-0639
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CAM FCD-01302 /1

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INVOICE INFORMATION

Company Name: XCG Consulting
Contact Name: V. Schiaholtz
Address:
E-mail:
Ph:
Sampled by: MCL

REPORT INFORMATION

Company Name: XCG
Project Manager: E Mance
Address:
E-mail: elisabeth.mance@xcg.com
Ph: marycatherineL@xcg.com

ANALYSIS REQUESTED

Field Sample ID	Canister Serial #	Flow Regulator Serial #	Collection Date	*START VACUUM (inches of Hg)*	*END VACUUM (inches of Hg)*	SOIL VAPOUR	AMBIENT/INDOOR AIR	AMBIENT/COMMERCIAL/INDUSTRIAL	SUB-SLAB GAS	FULL LIST OF VOCs (reference TO15A)	Aromatic/Aliphatic Hydrocarbon Fractions	F1 (C6-C10) and F2 (C10-C16)	Selected VOC's - please specify	Other	O2, CO2, CO, CH4, Nitrogen			CANISTERS NOT USED
XCG-5 (SVP)	1380	1485	03/14/17	-26	-5½							✓	✓		✓			
XCG-4 (SVP)	1281	561	"	-25	-5							✓	✓		✓			
XCG-12 (SVP)	2462	258	"	-24½	-5							✓	✓		✓			
XCG-6 (SVP)	2383	694	03/12/17	-24½	-4							✓	✓		✓			
XCG-2 (SVP)	243	552	03/11/17	-25½	-7							✓	✓		✓			
VW-05	1800	592	"	-26	-4							✓	✓		✓			
XCG-100	3017	592	"	-26	-4							✓	✓		✓			
XCG-1 (SVP)	1470	284	03/11/17	-25½								✓	✓		✓			
XCG-13 (SVP)	354	926	03/12/17	-26	-4½							✓	✓		✓			
XCG-10 (SVP)	1041	677	"	-26	-2½							✓	✓		✓			
VW-01	332	379	03/10/17	-26								✓	✓		✓			
XCG-9 (SVP)	333	603	03/11/17	-25	-5							✓	✓		✓			

TAT Requirement

STD 10 Business day ☑
Rush 5 Business day * ☐
Rush 2 Business day * ☐
Rush Other * ☐
202
* need approval from Maxxam

PROJECT INFORMATION

Project #: 4-2352-04-02
Name:
PO #:
Maxxam Quote #:
Maxxam Contact:
Task Order/Line Item

REPORTING REQUIREMENTS

2-58
EDD ☐
Regulations ON 153 ☐
ON 419 ☐
BC CSR ☐
Other

Notes

1) please indicate on chain of custody if your samples are soil vapour or ambient air
2) please list all canisters on the chain of custody even if unused

PROJECT SPECIFIC COMMENTS

VOC list will be sent via email.

Client Signature:
Date/Time: Mar 15/17.

Received by:
Date/Time:

PLEASE RETURN ALL UNUSED EQUIPMENT

Chain of Custody Form - Summa^{TM} Canister

30581

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6740 Campobello Rd
Mississauga Ontario, L5N 2L8
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CAM FCD-01302 /1

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INVOICE INFORMATION

Company Name: XCG Consulting
Contact Name:
Address:
E-mail:
Ph:
Sampled by:

REPORT INFORMATION

Company Name:
Project Manager:
Address:
E-mail:
Ph:

ANALYSIS REQUESTED

Field Sample ID	Canister Serial #	Flow Regulator Serial #	Collection Date	START VACUUM (inches of Hg)	END VACUUM (inches of Hg)	SOIL VAPOUR	AMBIENT/INDOOR AIR	AMBIENT/COMMERCIAL/INDUSTRIAL	SUB-SLAB GAS	FULL LIST OF VOCs (reference TO15A)	Aromatic/Aliphatic Hydrocarbon Fractions	F1 (C6-C10) and F2 (C10-C16)	Selected VOC's - please specify	Other	O2, CO, CO2, CH4, Nitrogen			CANISTERS NOT USED
VW-03	1280	931	03/12/1									✓	✓		✓			
Trip Blank	215	N/A	N/A									✓	✓		✓			
	2019																	✓
	2500																	✓

TAT Requirement

STD 10 Business day ☐
Rush 5 Business day * ☐
Rush 2 Business day * ☐
Rush Other * ☐

* need approval from Maxxam

PROJECT INFORMATION

Project #: 4-2250-04-03
Name:
PO #:
Maxxam Quote #:
Maxxam Contact:
Task Order/Line Item

REPORTING REQUIREMENTS

EDD ☐
Regulations ON 153 ☐
ON 419 ☐
BC CSR ☐
Other

Notes

1) please indicate on chain of custody if your samples are soil vapour or ambient air
2) please list all canisters on the chain of custody even if unused

PROJECT SPECIFIC COMMENTS

Client Signature:
Date/Time: Mar 15/17

Received by:
Date/Time:

PLEASE RETURN ALL UNUSED EQUIPMENT

APPENDIX G

HISTORICAL GROUNDWATER MONITORING RESULTS

Table G1 Summary of Historical Groundwater Elevations

Location	Date	Ground Surface Elevation (mASL)	Top of Casing Elevation (mASL)	Top of Pipe Elevation (mASL)	Top of Casing - Top of Pipe (m)	Top of Pipe - Ground Surface (m)	Water Depth from Top of Pipe (m)	Water Depth from Top of Casing (m)	Water Table Elevation (mASL)
MW-01	07-Aug-13	880.579	880.565	880.505	0.060	--	--	--	877.39
	10-Mar-17						--	7.45	873.12
	01-Jun-17						--	7.44	873.13
	24-Sep-17						--	7.40	873.17
	16-Dec-17						7.340	--	873.17
MW-02	07-Aug-13	879.006	Not Surveyed	--	0.110	--	--	--	877.31
	01-Mar-17						--	2.37	--
	01-Jun-17						--	2.03	--
	24-Sep-17						--	2.38	--
	16-Dec-17						2.500	--	--
MW-03	07-Aug-13	879.393	879.396	879.346	0.050	--	--	--	874.65
	10-Mar-17						--	2.86	876.536
	01-Jun-17						--	2.53	876.87
	24-Sep-17						--	2.54	876.86
	17-Dec-17						2.670	--	876.68
MW-04	07-Aug-13	879.589	Not Surveyed	--	0.020	--	--	--	873.26
	01-Mar-17						--	--	--
	01-Jun-17						--	2.67	--
	24-Sep-17						--	2.64	--
	17-Dec-17						2.910	--	--
MW-05	07-Aug-13	--	--	--	--	--	--	--	877.23
	01-Mar-17						--	--	--
	01-Jun-17						--	5.61	--
	24-Sep-17						--	5.55	--
	17-Dec-17						5.670	--	--
MW-06	07-Aug-13	879.108	879.941	879.881	0.060	--	--	--	876.61
	01-Mar-17						3.30	--	876.58
	01-Jun-17						3.30	--	876.58
	24-Sep-17						3.09	--	876.79
	17-Dec-17						3.30	--	876.58
MW-07	07-Aug-13	879.575	880.626	880.530	--	0.955	--	--	877.33
	01-Mar-17						4.48	--	876.05
	01-Jun-17						4.39	--	876.14
	24-Sep-17						4.61	--	875.92
	16-Dec-17						4.63	--	875.90
XCG-1 (MW)	01-Mar-17	881.206	881.186	881.146	0.040	--	--	8.01	873.18
	01-Jun-17						--	8.05	873.14
	24-Sep-17						--	7.98	873.21
	17-Dec-17						7.940	--	873.21
XCG-2 (MW)	01-Mar-17	881.102	882.329	882.219	0.110	--	9.32	--	872.90
	01-Jun-17						9.43	--	872.79
	24-Sep-17						9.46	--	872.76
	17-Dec-17						9.37	--	872.85
XCG-4 (MW)	01-Mar-17	879.220	880.342	880.282	0.060	--	3.65	--	876.63
	01-Jun-17						3.19	--	877.09
	24-Sep-17						3.32	--	876.96
	17-Dec-17						3.70	--	876.58
XCG-5 (MW)	01-Mar-17	880.271	880.289	880.189	0.100	--	--	3.76	876.53
	01-Jun-17						--	3.53	876.76
	24-Sep-17						--	3.44	876.85
	17-Dec-17						3.560	--	876.63
XCG-6 (MW)	01-Mar-17	879.971	879.987	879.897	0.090	--	--	3.45	876.54
	01-Jun-17						--	3.32	876.67
	24-Sep-17						--	3.10	876.89
	17-Dec-17						3.250	--	876.65
XCG-12 (MW)	10-Mar-17	880.827	880.847	880.757	0.090	--	--	7.63	873.22
	01-Jun-17						--	7.67	873.18
	24-Sep-17						--	Dry	--
	17-Dec-17						Dry	--	--
XCG-13 (MW)	02-Mar-17	879.672	879.702	879.612	0.090	--	--	3.73	875.97
	01-Jun-17						--	3.63	876.07
	24-Sep-17						--	3.89	875.81
	17-Dec-17						3.850	--	875.76
XCG-14 (MW)	01-Mar-17	880.719	880.704	880.674	0.030	--	--	7.31	873.39
	01-Jun-17						--	7.29	873.41
	24-Sep-17						--	7.25	873.45
	17-Dec-17						7.240	--	873.43

Notes:
-- no data
Benchmark: ASCM 283036, property line nail at 5794702.76, 12182.95 as determined by Bemco Land Surveying Ltd, December 15, 2016.

Table G2 Summary of Historical Field Parameters in Groundwater

Location	Date	Temperature (°C)	pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Total Dissolved Solid (mg/L)	Redox (mV)
March Sampling Event							
MW-01	8-Aug-13	9.60	7.12	632	1.58	578.50	31.7
	12-Mar-17	7.45	6.56	828	9.05	--	184.2
MW-02	7-Aug-13	9.80	7.08	919	2.57	838.50	44.3
	13-Mar-17	4.16	7.32	1247	2.95	--	-31.0
MW-03	8-Aug-13	9.80	6.76	1292	1.16	1189.50	49.8
	13-Mar-17	4.31	6.90	1766	0.86	--	-23.6
MW-04	8-Aug-13	11.30	7.00	1971	2.13	1729.00	45.5
MW-05	8-Aug-13	8.50	6.79	1353	1.50	1287.00	40.8
MW-06	8-Aug-13	9.00	6.65	1944	0.86	1820.00	-93.8
	14-Mar-17	5.05	6.06	2847	4.54	--	16.3
MW-07	7-Aug-13	8.10	6.67	1320	2.50	1261.00	-103.5
	14-Mar-17	6.33	6.11	2370	0.99	--	-15.6
XCG-1 (MW)	11-Mar-17	6.80	7.17	676	6.82	--	72.2
XCG-2 (MW)	11-Mar-17	6.04	7.25	822	5.10	--	118.6
XCG-4 (MW)	13-Mar-17	1.59	8.38	1110	3.21	--	-137.2
XCG-5 (MW)	13-Mar-17	4.59	10.29	747	8.36	--	-186.6
XCG-6 (MW)	13-Mar-17	4.36	6.20	1842	3.76	--	210.7
XCG-12 (MW)	14-Mar-17	3.25	6.47	1017	4.54	--	16.3
XCG-13 (MW)	14-Mar-17	3.82	6.19	2025	1.13	--	11.3
XCG-14 (MW)	11-Mar-17	6.16	7.26	1022	4.53	--	58.8

Notes:

-- No Value/Data

Table G3 Summary of Historical Analytical Results for VOCs in Groundwater

Sample ID	MW-01		MW-02		MW-03		MW-04	MW-05	MW-06		MW-07		XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG 5 (MW)	XCG 6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)
	08-Aug-13	12-Mar-17	07-Aug-13	13-Mar-17	08-Aug-13	13-Mar-17	08-Aug-13	08-Aug-13	08-Aug-13	14-Mar-17	07-Aug-13	14-Mar-17	10-Mar-17	11-Mar-17	11-Mar-17	14-Mar-17	13-Mar-17	13-Mar-17	12-Mar-17	14-Mar-17	11-Mar-17
Total Trihalomethanes	ND	<1.3	ND	<1.3	ND	<1.3	ND	ND	ND	<1.3	ND	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
Bromodichloromethane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bromoform	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Bromomethane	ND	<2.0	ND	<2.0	ND	<2.0	ND	ND	ND	<2.0	ND	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon tetrachloride	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chlorobenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chlorodibromomethane	ND	<1.0	ND	<1.0	ND	<1.0	ND	ND	ND	<1.0	ND	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	ND	<1.0	ND	<1.0	ND	<1.0	ND	1.5	ND	<1.0	ND	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ND	<0.50	ND	<0.50	ND	<0.50	1.6	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Chloromethane	ND	<2.0	ND	<2.0	ND	<2.0	ND	ND	ND	<2.0	ND	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2-dibromoethane	ND	<0.20	ND	<0.20	ND	<0.20	ND	ND	ND	0.30	ND	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
1,2-dichlorobenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	0.52	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,3-dichlorobenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,4-dichlorobenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	2.3	1.2	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-dichloroethane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2-dichloroethane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1-dichloroethene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,2-dichloroethene	ND	<0.50	ND	<0.50	4.5	20	ND	21	2.6	18	130.00	120	<0.50	<0.50	<0.50	<0.50	<0.50	1.2	<0.50	130	<0.50
trans-1,2-dichloroethene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.9	<0.50
Dichloromethane	ND	<2.0	ND	<2.0	ND	<2.0	ND	ND	ND	<2.0	ND	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2-dichloropropane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
cis-1,3-dichloropropene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
trans-1,3-dichloropropene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl methacrylate	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Methyl-tert-butylether (MTBE)	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Styrene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	0.75	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,1,2-tetrachloroethane	ND	<1.0	ND	<1.0	ND	<1.0	ND	ND	ND	<1.0	ND	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-tetrachloroethane	ND	<2.0	ND	<2.0	ND	<2.0	ND	ND	ND	<2.0	ND	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Tetrachloroethene	ND	<0.50	1.4	<0.50	ND	<0.50	50	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2,3-trichlorobenzene	ND	<1.0	ND	<1.0	ND	<1.0	ND	ND	ND	<1.0	ND	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-trichlorobenzene	ND	<1.0	ND	<1.0	ND	<1.0	ND	ND	ND	<1.0	ND	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3,5-trichlorobenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	0.73	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,1-trichloroethane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,1,2-trichloroethane	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	0.56	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Trichloroethene	ND	<0.50	1.6	<0.50	ND	<0.50	1	ND	ND	<0.50	6.8	7.4	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.68	<0.50
Trichlorofluoromethane	ND	<0.50	ND	<0.50	ND	<0.50	1	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,2,4-trimethylbenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	39	14	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
1,3,5-trimethylbenzene	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	9	3.8	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vinyl chloride	ND	<0.50	ND	<0.50	10	16	ND	24	15	8.4	26	39	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	21	<0.50

Notes:

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< or ND

All units in µg/L, unless otherwise specified.

Table G4 Summary of Historical Analytical Results for Routine Parametres and Nutrients in Groundwater

Sample ID	Units	MW-01		MW-02		MW-03		MW-04	MW-05	MW-06		MW-07		XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG-5 (MW)	XCG-6 (MW)	XCG-12	XCG-13 (MW)	XCG-14 (MW)
		08-Aug-13	12-Mar-17	07-Aug-13	13-Mar-17	08-Aug-13	13-Mar-17	08-Aug-13	08-Aug-13	08-Aug-13	14-Mar-17	07-Aug-13	14-Mar-17	10-Mar-17	11-Mar-17	11-Mar-17	14-Mar-17	13-Mar-17	13-Mar-17	12-Mar-17	14-Mar-17	11-Mar-17
Calculated Parameters				--																		
Anion Sum	meq/L	--	9.3	--	13	--	20	--	--	--	32		25	7.1	8.8	8.8	12	8.1	18	12	24	12
Cation Sum	meq/L	--	8.9	--	13	--	20	--	--	--	30	--	26	7.1	8.8	8.9	12	8.0	18	12	23	12
Hardness (CaCO3)	mg/L	--	420	--	520	--	920	--	--	--	970	--	1100	340	320	320	480	390	870	550	1000	560
Ion Balance (% Difference)	N/A	--	2.0	--	1.3	--	0.29	--	--	--	3.5	--	0.66	0.43	0.13	0.50	0.87	0.31	0.89	1.5	2.3	0.77
Dissolved Nitrate (NO3)	mg/L	--	0.21	--	6.2	--	1.7	--	--	--	0.14	--	0.20	0.10	0.063	0.077	<0.044	2.7	250	0.17	<0.044	0.056
Nitrate plus Nitrite (N)	mg/L	--	0.047	--	1.4	--	0.38	--	--	--	0.031	--	0.044	0.024	0.014	0.017	<0.010	0.61	56	0.037	<0.010	0.013
Dissolved Nitrite (NO2)	mg/L	--	<0.033	--	<0.033	--	<0.033	--	--	--	<0.033	--	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	0.20	<0.033	<0.033	<0.033
Calculated Total Dissolved Solids	mg/L	--	450	--	660	--	990	--	--	--	1500	--	1300	350	460	460	580	380	1000	580	1100	570
Miscellaneous Inorganics																						
Conductivity	uS/cm	940	830	1400	1200	1900	1800	2400	2000	2700	2800	2100	2400	660	820	830	1000	700	1700	1000	2100	1000
pH	pH	7.59	7.37	7.40	7.57	7.09	7.31	7.31	7.20	6.83	7.10	7.04	7.12	7.73	7.30	7.29	7.74	7.76	7.32	7.59	7.15	7.34
Anions																						
Alkalinity (PP as CaCO3)	mg/L	--	<0.50	--	<0.50	--	<0.50	--	--	--	<0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Alkalinity (Total as CaCO3)	mg/L	430	410	470	360	1000	960	650	890	1400	1500	820	890	310	340	340	550	390	600	530	920	490
Bicarbonate (HCO3)	mg/L	520	500	570	430	1300	1200	790	1100	1700	1800	1000	1100	380	420	420	670	470	730	640	1100	590
Carbonate (CO3)	mg/L	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Hydroxide (OH)	mg/L	ND	<0.50	ND	<0.50	ND	<0.50	ND	ND	ND	<0.50	ND	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Sulphate (SO4)	mg/L	50	37	69	53	39	36	510	44	5	<1.0	18	7.2	29	57	58	9.3	10	82	42	6.8	56
Dissolved Chloride (Cl)	mg/L	21.0	12	110.0	160	16.0	13	130.0	160.0	100.0	83	240.0	260	10	27	27	17	2.0	11	22	200	21
Nutrients																						
Dissolved Nitrite (N)	mg/L	ND	<0.010	0.013	<0.010	0.01	<0.010	0.026	ND	ND	<0.010	ND	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.060	<0.033	<0.010	<0.010
Dissolved Nitrate (N)	mg/L	0.04	0.047	10.00	1.4	0.49	0.38	20.00	0.00	ND	0.031	0.02	0.044	0.024	0.014	0.017	<0.010	0.61	56	0.58	<0.010	0.013
Total Ammonia (N)	mg/L	0.074	0.19	0.27	<0.050	0.11	0.13	0.06	0.25	96	69	2.4	0.87	0.38	0.23	0.23	0.17	<0.050	0.093	0.54	0.18	0.30
Total Nitrogen (N)	mg/L	0.59	1.3	11.00	1.8	1.30	1.0	22.00	1.10	100.00	96	88.00	1.9	2.5	0.45	0.55	0.64	0.82	57	3.6	0.93	1.4
Total Phosphorus (P)	mg/L	0.4400	0.70	3.4000	0.0061	0.1100	0.0097	0.0880	0.7200	14.0000	1.1	53.0000	0.030	2.5	0.19	0.10	0.11	0.0085	0.0046	1.2	0.020	2.6
Total Kjeldahl Nitrogen	mg/L	0.55	1.2	0.84	0.34	0.82	0.63	1.30	1.10	100.00	96	88.00	1.9	2.5	0.44	0.53	0.64	0.21	1.0	3.4	0.93	1.4
Demand Parameters																						
Biochemical Oxygen Demand	mg/L	ND	<2.0	ND	<2.0	3.5	6.9	ND	5.2	130	22	25	7.8	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	8.3	3.1	<2.0
Total Chemical Oxygen Demand	mg/L	77	<5.0	22	15	69	65	54	140	1800	330	1600	64	71	37	36	41	<5.0	20	110	41	85
Misc. Inorganics																						
Total Organic Carbon (C)	mg/L	5.8	4.3	8.8	8.8	16.0	8.1	13.0	16.0	71.0	72.0	18.0	19	<2.5	3.3	4.2	4.3	3.7	12.0	16	15	<5.0
Organic Acids																						
Formic Acid	mg/L	ND	<0.50	--	<0.50	--	<0.50	ND	--	ND	<0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Acetic Acid	mg/L	ND	<0.50	--	<0.50	--	<0.50	ND	--	ND	<0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Propionic Acid	mg/L	ND	<0.50	--	<0.50	--	<0.50	ND	--	ND	<0.50	--	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Butyric Acid	mg/L	--	<10	--	<10	--	<10	--	--	--	<10	--	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Misc. Organics																						
Adsorbable Organic Halogen	mg/L	0.09	0.02	--	0.07	--	<0.01	0.14	--	0.05	0.14	--	0.06	0.02	0.03	0.02	0.03	0.01	0.03	0.02	0.6	0.02

Notes:

RDL	boratory Reportable Detection Limit

1. Alberta Tier 1 groundwater remediation guidelines for residential/parkland land use, coarse grained soil (February 2016).

--	no data
< or ND	Less than the RDL

Table G5 Summary of Historical Analytical Results for Dissolved Metals in Groundwater

Sample ID	Units	MW-01		MW-02		MW-03		MW-04	MW-05	MW-06		MW-07		XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG-5 (MW)	XCG-6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)
		08-Aug-13	12-Mar-17	07-Aug-13	13-Mar-17	08-Aug-13	13-Mar-17	08-Aug-13	08-Aug-13	08-Aug-13	14-Mar-17	07-Aug-13	14-Mar-17	10-Mar-17	11-Mar-17	11-Mar-17	14-Mar-17	13-Mar-17	13-Mar-17	12-Mar-17	14-Mar-17	11-Mar-17
Dissolved Cadmium (Cd)	ug/L	0.033	0.29	--	0.044	--	0.044	0.040	--	ND	<0.020	--	0.022	0.053	0.15	0.13	0.29	0.042	0.060	0.023	0.088	0.064
Dissolved Aluminum (Al)	mg/L	0.003	0.0039	--	<0.0030	--	<0.0030	ND	--	ND	0.0057	--	<0.0030	0.0056	0.0031	0.0038	0.0044	<0.0030	<0.0030	0.0054	0.0042	0.0031
Dissolved Antimony (Sb)	mg/L	ND	<0.00060	--	<0.00060	--	<0.00060	ND	--	ND	<0.00060	--	<0.00060	<0.00060	0.00065	<0.00060	<0.00060	0.00075	<0.00060	<0.00060	<0.00060	<0.00060
Dissolved Arsenic (As)	mg/L	0.00059	0.00029	--	<0.00020	--	0.00041	0.00051	--	0.01500	0.0092	--	0.0073	0.0011	0.0013	0.0013	0.00044	0.00033	0.00046	**0.019**	0.0014	0.0011
Dissolved Barium (Ba)	mg/L	0.92	0.71	--	0.64	--	0.89	0.17	--	0.86	0.99	--	1.1	0.51	0.090	0.093	0.22	0.22	0.46	**1.2**	0.94	0.52
Dissolved Beryllium (Be)	mg/L	ND	<0.0010	--	<0.0010	--	<0.0010	ND	--	ND	<0.0010	--	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Boron (B)	mg/L	0.064	0.042	--	0.025	--	0.17	0.081	--	0.480	0.23	--	0.066	0.038	0.090	0.090	0.038	0.024	0.049	0.054	0.050	0.046
Dissolved Calcium (Ca)	mg/L	130	110	--	130	--	220	390	--	250	230	--	230	77	84	83	130	86	250	130	190	120
Dissolved Chromium (Cr)	mg/L	ND	<0.0010	--	<0.0010	--	<0.0010	ND	--	ND	0.0019	--	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Cobalt (Co)	mg/L	0.00049	<0.00030	--	0.0011	--	0.0016	ND	--	0.012	0.014	--	0.012	0.00097	0.0024	0.0023	0.00099	<0.00030	0.00050	0.00080	0.0068	0.00043
Dissolved Copper (Cu)	mg/L	0.00230	0.00085	--	0.0010	--	0.0013	0.00330	--	0.00190	<0.00020	--	<0.00020	0.0032	0.0011	0.0010	0.0019	0.00071	0.0022	0.00047	0.00089	0.00071
Dissolved Iron (Fe)	mg/L	ND	<0.060	--	0.065	--	0.13	ND	--	9.2	29	--	12	<0.060	<0.060	<0.060	<0.060	<0.060	0.086	<0.060	0.066	<0.060
Dissolved Lead (Pb)	mg/L	ND	<0.00020	--	<0.00020	--	<0.00020	ND	--	ND	<0.00020	--	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Lithium (Li)	mg/L	0.033	0.027	--	0.022	--	0.064	0.025	--	ND	<0.020	--	0.038	0.020	0.037	0.038	<0.020	<0.020	<0.020	0.031	0.051	0.047
Dissolved Magnesium (Mg)	mg/L	44	37	--	51	--	88	100	--	110	97	--	130	35	28	27	38	42	62	56	140	61
Dissolved Manganese (Mn)	mg/L	0.25	0.089	--	<0.0040	--	0.49	0.03	--	0.54	0.49	--	1.8	0.28	0.50	0.49	0.29	<0.0040	0.15	0.61	0.71	0.26
Dissolved Molybdenum (Mo)	mg/L	0.00280	0.0027	--	0.00040	--	0.00069	0.00058	--	0.00440	0.00074	--	0.0024	0.0040	0.0043	0.0046	0.00081	0.00088	0.00044	0.0034	0.00055	0.0020
Dissolved Nickel (Ni)	mg/L	0.0025	0.00092	--	0.0029	--	0.0072	0.0041	--	0.0180	0.012	--	0.016	0.0032	0.0073	0.0069	0.0081	0.0012	0.0049	0.0021	0.015	0.0013
Dissolved Phosphorus (P)	mg/L	ND	0.11	--	<0.10	--	<0.10	ND	--	ND	<0.10	--	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Potassium (K)	mg/L	5.0	3.9	--	2.5	--	6.3	6.9	--	41.0	33	--	3.7	3.3	3.7	3.7	25	2.0	6.5	7.7	3.2	2.5
Dissolved Selenium (Se)	mg/L	0.00083	0.00023	--	<0.00020	--	<0.00020	0.00220	--	ND	0.00050	--	0.00026	0.00030	0.00061	0.00058	<0.00020	0.00021	0.00034	<0.00020	0.00027	<0.00020
Dissolved Silicon (Si)	mg/L	6	6.1	--	7.7	--	7.8	8	--	15	15	--	11	6.2	6.5	6.6	7.6	11	8.1	7.6	9.4	6.8
Dissolved Silver (Ag)	mg/L	ND	<0.00010	--	<0.00010	--	<0.00010	ND	--	ND	<0.00010	--	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Sodium (Na)	mg/L	9.4	9.8	--	48	--	39	47.0	--	110.0	88	--	73	6.8	51	54	29	4.8	17	11	54	10
Dissolved Strontium (Sr)	mg/L	0.75	0.71	--	0.41	--	1.3	0.68	--	1.20	1.2	--	1.7	0.55	0.81	0.82	0.38	0.28	0.65	0.72	1.9	1.1
Dissolved Sulphur (S)	mg/L	19.0	10	--	15	--	9.0	170.0	--	2.4	2.3	--	3.4	8.3	16	17	3.1	2.8	21	12	2.7	15
Dissolved Thallium (Tl)	mg/L	ND	<0.00020	--	<0.00020	--	<0.00020	ND	--	ND	<0.00020	--	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Tin (Sn)	mg/L	ND	<0.0010	--	<0.0010	--	<0.0010	ND	--	ND	0.0018	--	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010
Dissolved Titanium (Ti)	mg/L	ND	<0.0010	--	<0.0010	--	<0.0010	ND	--	ND	0.0022	--	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Uranium (U)	mg/L	0.0130	0.0098	--	0.0026	--	0.0095	0.0046	--	ND	0.00060	--	0.010	0.0037	0.013	0.014	0.0028	0.0016	0.0025	0.0013	0.011	0.015
Dissolved Vanadium (V)	mg/L	ND	<0.0010	--	<0.0010	--	<0.0010	ND	--	ND	<0.0010	--	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Zinc (Zn)	mg/L	0.0085	0.0036	--	<0.0030	--	<0.0030	0.026	--	ND	0.013	--	<0.0030	0.0032	<0.0030	<0.0030	0.0073	<0.0030	<0.0030	<0.0030	0.0034	<0.0030

Notes:

--	no data
< / ND	Less than the RDL

Table G6   Summary of Historical Analytical Results for Total Metals in Groundwater

Sample ID	Units	MW-01		MW-02		MW-03		MW-04	MW-05	MW-06		MW-07		XCG-1 (MW)	XCG-2 (MW)		XCG-4 (MW)	XCG-5 (MW)	XCG-6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)
		41494.00	12-Mar-17	07-Aug-13	13-Mar-17	08-Aug-13	13-Mar-17	08-Aug-13	08-Aug-13	08-Aug-13	14-Mar-17	07-Aug-13	14-Mar-17	10-Mar-17	11-Mar-17	11-Mar-17	14-Mar-17	13-Mar-17	13-Mar-17	12-Mar-17	14-Mar-17	11-Mar-17
Total Cadmium (Cd)	ug/L	0.4	1.9	0.9	0.34	0.25	0.089	0.130	0.930	33.000	0.77	5.40	0.25	4.2	1.1	0.76	12	0.12	0.19	1.8	0.17	1.7
Total Aluminum (Al)	mg/L	7.6	6.6	16.0	0.18	0.21	0.53	1.1	13	360.00	11	110	0.39	27	2.8	2.5	3.3	0.087	0.067	12	0.18	16
Total Antimony (Sb)	mg/L	ND	0.00063	0.00120	<0.00060	ND	<0.00060	ND	0.00085	0.013	0.00096	ND	<0.00060	0.00090	0.00093	0.00075	<0.00060	0.00082	<0.00060	0.00077	<0.00060	0.00085
Total Arsenic (As)	mg/L	0.011	0.0086	0.0200	0.00036	0.00130	0.00094	0.00260	0.02100	0.57000	0.023	0.095	0.015	0.056	0.0043	0.0037	0.0030	0.00057	0.00047	0.062	0.0018	0.021
Total Barium (Ba)	mg/L	1.2	0.85	1.10	0.68 (1)	1.00	0.91	0.19	1.20	27.00	1.5	49.0	1.2	1.5	0.14	0.13	0.27	0.23	0.47	1.4	0.91	1.2
Total Beryllium (Be)	mg/L	ND	<0.0010	0.0013	<0.0010	ND	<0.0010	ND	0.0013	0.024	<0.0010	ND	<0.0010	0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	0.0016
Total Boron (B)	mg/L	0.054	0.042	0.064	0.030	0.110	0.20	0.085	0.100	0.54	0.25	ND	0.064	0.047	0.11	0.098	0.039	0.029	0.057	0.055	0.050	0.065
Total Calcium (Ca)	mg/L	160	130	390	130	260	240	410	300	9300	280	22000	240	250	93	83	140	88	260	170	190	240
Total Chromium (Cr)	mg/L	0.022	0.011	0.037	<0.0010	0.0013	0.0018	0.0035	0.0290	1.2000	0.019	0.220	<0.0010	0.048	0.0036	0.0026	0.0060	<0.0010	<0.0010	0.021	<0.0010	0.029
Total Cobalt (Co)	mg/L	0.01	0.0081	0.0190	0.0015	0.0038	0.0019	0.0014	0.02	0.6000	0.024	0.140	0.014	0.035	0.0047	0.0044	0.0035	<0.00030	0.00060	0.015	0.0070	0.022
Total Copper (Cu)	mg/L	0.026	0.019	0.052	0.0018	0.0044	0.0025	0.00700	0.03900	1.7000	0.032	0.340	0.0017	0.091	0.0063	0.0057	0.0095	0.0012	0.0023	0.034	0.0012	0.056
Total Iron (Fe)	mg/L	21	14	43	0.46 (1)	1.00	1.2	3.1	42	1,800.0	69	3300	19	75	4.6	3.7	5.6	0.30	0.26	28	0.52	41
Total Lead (Pb)	mg/L	0.011	0.0084	0.0260	0.00023	0.00190	0.00082	0.0018	0.021	1.10000	0.021	0.180	0.00084	0.036	0.0045	0.0038	0.010	<0.00020	<0.00020	0.016	0.00024	0.024
Total Lithium (Li)	mg/L	0.046	0.032	0.055	0.025	0.072	0.072	0.026	0.077	0.960	0.026	2.000	0.036	0.061	0.041	0.037	<0.020	<0.020	<0.020	0.038	0.047	0.068
Total Magnesium (Mg)	mg/L	53	46	130	54	100	97	110	130	2800	120	6400	130	83	31	27	41	43	66	60	140	92
Total Manganese (Mn)	mg/L	0.64	0.87	1.10	0.0061	0.8300	0.55	0.087	1.6	41.00	0.79	110.00	1.8	1.6	0.60	0.54	0.37	0.0054	0.19	0.97	0.71	1.0
Total Molybdenum (Mo)	mg/L	0.0034	0.0036	0.0018	0.00049	0.00079	0.00087	0.00630	0.00160	0.05200	0.0018	0.0058	0.0025	0.0058	0.0049	0.0046	0.0014	0.00088	0.00053	0.0041	0.00061	0.0031
Total Nickel (Ni)	mg/L	0.032	0.022	0.067	0.0046	0.1100	0.0088	0.0080	0.0610	1.9000	0.039	0.440	0.018	0.089	0.014	0.013	0.019	0.0015	0.0054	0.044	0.015	0.059
Total Phosphorus (P)	mg/L	0.57	0.48	2.20	<0.10 (1)	ND	<0.10	0.14	1.1	71	1.1	120.0	<0.10	2.1	0.19	0.15	0.10	<0.10	<0.10	0.75	<0.10	1.2
Total Potassium (K)	mg/L	6.7	5.1	6.6	2.7 (1)	7.6	7.3	7.3	8.2	130.0	38	130	3.7	8.0	4.5	4.0	26	2.1	7.1	8.3	3.3	6.0
Total Selenium (Se)	mg/L	0.0009	0.00060	0.00081	<0.00020	ND	0.00021	0.00160	0.00065	0.01900	0.00076	ND	0.00021	0.0024	0.00089	0.00081	0.00029	0.00023	0.00037	0.00064	0.00025	0.0029
Total Silicon (Si)	mg/L	23	20	39	8.8 (1)	10.0	11	10	39	740	36	1200	12	50	16	14	17	12	9.2	30	10	43
Total Silver (Ag)	mg/L	0.0002	0.00013	0.00030	<0.00010	ND	<0.00010	ND	0.00041	0.011	0.00023	ND	<0.00010	0.00064	<0.00010	<0.00010	0.00011	<0.00010	<0.00010	0.00033	<0.00010	0.00029
Total Sodium (Na)	mg/L	9.5	8.0	51.0	51	48	42	50.0	60.0	110	95	69	76	7.3	56	51	35	4.6	19	9.7	56	10
Total Strontium (Sr)	mg/L	0.8	0.66	0.68	0.44 (1)	1.30	1.3	0.69	2.20	10.0	1.3	25.0	1.6	0.80	0.86	0.77	0.38	0.28	0.65	0.67	1.7	1.2
Total Sulphur (S)	mg/L	17	9.3	24.0	17	13	11	200.0	13.0	21	3.0	28.0	3.8	9.1	17	16	4.5	3.0	27	11	2.8	17
Total Thallium (Tl)	mg/L	ND	<0.00020	0.0002	<0.00020	ND	<0.00020	ND	ND	0.0066	<0.00020	ND	<0.00020	0.00072	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00031	<0.00020	0.00040
Total Tin (Sn)	mg/L	ND	0.0017	0.0022	<0.0010	ND	<0.0010	ND	ND	0.13	0.0065	ND	<0.0010	0.0084	0.0045	0.0037	0.0020	0.0010	<0.0010	0.0095	<0.0010	0.0019
Total Titanium (Ti)	mg/L	0.13	0.11	0.20	0.0069	0.0160	0.016	0.031	0.18	4.300	0.19	0.52	0.014	0.26	0.037	0.032	0.13	0.0022	0.0046	0.17	0.0050	0.21
Total Uranium (U)	mg/L	0.013	0.010	0.006	0.0031	0.0120	0.0091	0.0052	0.0160	0.0590	0.0016	0.0180	0.0099	0.0066	0.015	0.014	0.0035	0.0016	0.0025	0.0023	0.011	0.015
Total Vanadium (V)	mg/L	0.024	0.019	0.062	<0.0010	0.0027	0.0022	0.0055	0.047	1.8000	0.031	0.310	0.0017	0.075	0.0058	0.0053	0.010	<0.0010	<0.0010	0.036	<0.0010	0.050
Total Zinc (Zn)	mg/L	0.091	0.090	0.190	0.011	0.020	0.0074	0.039	0.21	6.1000	0.099	1.100	0.0071	0.27	0.032	0.030	0.044	0.0053	<0.0030	0.15	0.0053	0.19

Notes:

RDL	Laboratory Reportable Detection Limit
--	no data
< / ND	Less than the RDL

Table G7   Summary of Historical Analytical Results for PHCs in Groundwater

Sample ID	Units	MW-01		MW-02		MW-03		MW-04	MW-05	MW-06		MW-07		XCG-1 (MW)	XCG-2 (MW)	XCG-4 (MW)	XCG 5 (MW)	XCG 6 (MW)	XCG-12 (MW)	XCG-13 (MW)	XCG-14 (MW)
		08-Aug-13	12-Mar-17	07-Aug-13	13-Mar-17	08-Aug-13	13-Mar-17	08-Aug-13	08-Aug-13	08-Aug-13	14-Mar-17	07-Aug-13	14-Mar-17	10-Mar-17	11-Mar-17	14-Mar-17	13-Mar-17	13-Mar-17	12-Mar-17	14-Mar-17	11-Mar-17
Benzene	µg/L	ND	<0.40	ND	<0.40	ND	<0.40	ND	ND	5.9	4.8	1.7	1.7	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.86	<0.40
Toluene	µg/L	ND	<0.40	ND	<0.40	ND	<0.40	ND	ND	4.5	3.5	ND	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Ethylbenzene	µg/L	ND	<0.40	ND	<0.40	ND	<0.40	ND	ND	66	58	ND	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
m & p-Xylene	µg/L	--	<0.80	--	<0.80	--	<0.80	--	--	--	30	--	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
o-Xylene	µg/L	--	<0.40	--	<0.40	--	<0.40	--	--	--	15	--	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Xylenes (Total)	µg/L	ND	<0.80	ND	<0.80	ND	<0.80	ND	ND	66	45	ND	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
F1 (C6-C10) - BTEX	µg/L	--	<100	--	<100	--	<100	--	--	--	<100	--	<100	<100	<100	<100	<100	<100	<100	<100	<100
F1 (C6-C10)	µg/L	ND	<100	ND	<100	ND	<100	ND	ND	150	<100	ND	<100	<100	<100	<100	<100	<100	<100	<100	<100
F2 (C10-C16 Hydrocarbons)	mg/L	ND	<0.10	ND	<0.10	ND	<0.10	ND	ND	0.44	0.52	ND	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Notes:

--	no value
< / ND	Less than the RDL

APPENDIX H

CERTIFICATES OF LABORATORY ANALYSES

Your Project #: 4-2352-04-03
Your C.O.C. #: 26178

Attention:Stephanie Borgs

XCG Consulting Limited
10455 84 Avenue
Edmonton, AB
CANADA T6E2H3

Report Date: 2017/06/19
Report #: R4548274
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7B5915
Received: 2017/06/03, 10:29

Sample Matrix: AIR
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Canister Pressure (TO-15)	1	N/A	2017/06/16	BRL SOP-00304	EPA TO-15 m
Matrix Gases (1)	1	N/A	2017/06/14	CAM SOP-00225	

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) Argon interferes with Oxygen and is included in the reported Oxygen concentration. The atmosphere contains about 0.9% Argon.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Cristina (Maria) Bacchus, Project Manager
Email: CBacchus@maxxam.ca
Phone# (905)817-5763
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

Maxxam Job #: B7B5915
Report Date: 2017/06/19

XCG Consulting Limited
Client Project #: 4-2352-04-03
Sampler Initials: SB

RESULTS OF ANALYSES OF AIR

Maxxam ID		EMV462	
Sampling Date		2017/06/01	
COC Number		26178	
	UNITS	**XCG-4 (SVP) / 00212**	**QC Batch**
Volatile Organics			
Pressure on Receipt	psig	(-2.5)	5031381
QC Batch = Quality Control Batch			

COMPRESSED GAS PARAMETERS (AIR)

Maxxam ID		EMV462		
Sampling Date		2017/06/01		
COC Number		26178		
	UNITS	**XCG-4 (SVP) / 00212**	**RDL**	**QC Batch**
Fixed Gases				
Oxygen	% v/v	5.5	0.2	5028309
Methane	% v/v	<0.2	0.2	5028309
Carbon Dioxide	% v/v	9.6	0.2	5028309

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

GENERAL COMMENTS

Matrix Gas Analysis: Canister was pressurized with Helium to enable sampling. Results and DLs adjusted accordingly. Results normalized to 100% dry volume.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5028309	SB1	Method Blank	Oxygen	2017/06/15	<0.1		% v/v	
			Methane	2017/06/15	<0.1		% v/v	
			Carbon Dioxide	2017/06/15	<0.1		% v/v	
5028309	SB1	RPD	Oxygen	2017/06/14	0.34		%	20
			Carbon Dioxide	2017/06/14	5.2		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Angel Guerrero, Team Leader, VOC Air

Tom Mitchell, B.Sc, Supervisor, Compressed Gases

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

03-Jun-17 10:29
Cristina (Maria) Bacchus
B7B5915

ASR AIR-001

Form - Summa™ Canister

AIR

26178

…mpobello Rd
…uga Ontario, L5N 2L8
…xxam.ca

Toll Free: 1-800-668-0639
Phone: (905) 817-5700
Fax: (905) 817-5777

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CAM FCD-01302 /1

Page 1 of 1

INVOICE INFORMATION

Company Name: XCG Consulting
Contact Name: Stephanie Borgs
Address: 10455 84 Ave
E-mail: stephanie.borgs@xcg.com
Ph: 780-432-5770
Sampled by: SB

REPORT INFORMATION

Company Name: Same
Project Manager:
Address:
E-mail:
Ph:

ANALYSIS REQUESTED

Field Sample ID	Canister Serial #	Flow Regulator Serial #	Collection Date	START VACUUM (inches of Hg)	END VACUUM (inches of Hg)	SOIL VAPOUR	AMBIENT/INDOOR AIR	AMBIENT/COMMERCIAL/INDUSTRIAL	SUB-SLAB GAS	FULL LIST OF VOCs (reference TO15A)	Aromatic/Aliphatic Hydrocarbon Fractions	F1 (C6-C10) and F2 (C10-C16)	Selected VOC's - please specify	Other	O2/CH4/CO2 (fixed gasses)			CANISTERS NOT USED
XCG-4 (SVP)	00212	FX0667	01/06/17	-29	-5	X									X			

TAT Requirement

STD 10 Business day ✓
Rush 5 Business day * ☐
Rush 2 Business day * ☐
Rush Other * ☐

* need approval from Maxxam

PROJECT INFORMATION

Project #: 4-2352-04-03
Name: Montfort Landfill
PO #:
Maxxam Quote #:
Maxxam Contact:
Task Order/Line Item

REPORTING REQUIREMENTS

EDD ☐
Regulations ON 153 ☐
ON 419 ☐
BC CSR ☐
Other

Notes

1) please indicate on chain of custody if your samples are soil vapour or ambient air
2) please list all canisters on the chain of custody even if unused

PROJECT SPECIFIC COMMENTS

Client Signature:
Date/Time: June 1/17 @ 4:00pm

Received by: AH ALYSSA HURRI
Date/Time: 20170602 1242

Seal no

PLEASE RETURN ALL UNUSED EQUIPMENT

COC-1003 (07/16) - Summa Canister

Paramjeet PARAMJEET SINGH 2017/06/03 10:29

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-03-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359712
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B717877
Received: 2017/03/11, 08:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Formic, Acetic, Propionic & Butyric Acid (1)	1	N/A	2017/03/13	CAL SOP-00063	Dionex #031181 R07 m
Alkalinity @25C (pp, total), CO3,HCO3,OH (1)	1	N/A	2017/03/11	AB SOP-00005	SM 22 2320 B m
Organic Halogen (Adsorbable) (2)	1	2017/03/14	2017/03/14	PTC SOP-00056	Coulometric - Titr.
Biochemical Oxygen Demand (1)	1	2017/03/11	2017/03/16	AB SOP-00017	SM 22 5210B m
BTEX/F1 in Water by HS GC/MS/FID (1)	1	N/A	2017/03/13	AB SOP-00039	CCME CWS/EPA 8260c m
Cadmium - low level CCME - Dissolved (1)	1	N/A	2017/03/13	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total) (1)	1	N/A	2017/03/14	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry (1)	1	N/A	2017/03/13	AB SOP-00020	SM 22-4500-Cl G m
Chemical Oxygen Demand (1)	1	N/A	2017/03/12	AB SOP-00016	SM 22 5220D m
Conductivity @25C (1)	1	N/A	2017/03/11	AB SOP-00005	SM 22 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (1, 3)	1	2017/03/13	2017/03/13	AB SOP-00040 AB SOP-00037	CCME PHC-CWS m
Hardness (1)	1	N/A	2017/03/12	AB WI-00065	Auto Calc
Elements by ICP-Dissolved-Lab Filtered (1, 4)	1	N/A	2017/03/11	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total (1)	1	2017/03/13	2017/03/13	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICPMS-Dissolved-Lab Filtered (1, 4)	1	N/A	2017/03/12	AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total (1)	1	2017/03/13	2017/03/14	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Ion Balance (as % Difference) (1)	1	N/A	2017/03/12	AB WI-00065	Auto Calc
Sum of cations, anions (1)	1	N/A	2017/03/12	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2 (1)	1	N/A	2017/03/17	AB WI-00065	Auto Calc
Ammonia-N (Total) (1)	1	N/A	2017/03/16	AB SOP-00007	EPA 350.1 R2.0 m
Nitrate and Nitrite (1)	1	N/A	2017/03/17	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated) (1)	1	N/A	2017/03/17	AB WI-00065	Auto Calc
Nitrogen, (Nitrite, Nitrate) by IC (1, 5)	1	N/A	2017/03/11	AB SOP-00023	SM 22 4110 B m
pH @25°C (1, 6)	1	N/A	2017/03/11	AB SOP-00005	SM 22 4500-H+B m
Sulphate by Automated Colourimetry (1)	1	N/A	2017/03/13	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Calculated) (1)	1	N/A	2017/03/13	AB WI-00065	Auto Calc
Total Trihalomethanes Calculation (1)	1	N/A	2017/03/14	CAL SOP-00104	Auto Calc
Total Kjeldahl Nitrogen (1)	1	2017/03/13	2017/03/13	AB SOP-00008	EPA 351.1 R1978 m

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-03-01

Attention:STEPHANIE BORGS
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10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359712
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B717877
Received: 2017/03/11, 08:50

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Carbon (Total Organic) (1, 7)	1	N/A	2017/03/13	CAL SOP-00077	MMCW 119 1996 m
Total Phosphorus (1)	1	2017/03/13	2017/03/16	AB SOP-00024	SM 22 4500-P A,B,F m
VOCs in Water by HS GC/MS (Std List) (1)	1	N/A	2017/03/13	AB SOP-00056	EPA 5021a/8260c m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Calgary Environmental
(2) This test was performed by Maxxam Edmonton Petroleum
(3) Silica gel clean up employed.
(4) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(5) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(6) The APHA Standard Method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(7) TOC present in the sample should be considered as non-purgeable TOC.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
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CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B717877
Received: 2017/03/11, 08:50

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Robin Weaver, Environmental Project Manager
Email: RWeaver@maxxam.ca
Phone# (403)735-2258
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

AT1 BTEX AND F1-F2 IN WATER (WATER)

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	8574703
Volatiles				
Benzene	ug/L	<0.40	0.40	8575407
Toluene	ug/L	<0.40	0.40	8575407
Ethylbenzene	ug/L	<0.40	0.40	8575407
m & p-Xylene	ug/L	<0.80	0.80	8575407
o-Xylene	ug/L	<0.40	0.40	8575407
Xylenes (Total)	ug/L	<0.80	0.80	8575407
F1 (C6-C10) - BTEX	ug/L	<100	100	8575407
F1 (C6-C10)	ug/L	<100	100	8575407
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	96	N/A	8575407
4-Bromofluorobenzene (sur.)	%	102	N/A	8575407
D4-1,2-Dichloroethane (sur.)	%	92	N/A	8575407
O-TERPHENYL (sur.)	%	91	N/A	8574703

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	meq/L	7.1	N/A	8574834
Cation Sum	meq/L	7.1	N/A	8574834
Hardness (CaCO3)	mg/L	340	0.50	8574832
Ion Balance (% Difference)	N/A	0.43	0.010	8574833
Dissolved Nitrate (NO3)	mg/L	0.10	0.044	8574835
Nitrate plus Nitrite (N)	mg/L	0.024	0.010	8574836
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	8574835
Calculated Total Dissolved Solids	mg/L	350	10	8574837
Misc. Inorganics				
Conductivity	uS/cm	660	1.0	8575087
pH	pH	7.73	N/A	8575088
Low Level Elements				
Dissolved Cadmium (Cd)	ug/L	0.053	0.020	8574829
Anions				
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	8575086
Alkalinity (Total as CaCO3)	mg/L	310	0.50	8575086
Bicarbonate (HCO3)	mg/L	380	0.50	8575086
Carbonate (CO3)	mg/L	<0.50	0.50	8575086
Hydroxide (OH)	mg/L	<0.50	0.50	8575086
Dissolved Sulphate (SO4)	mg/L	29	1.0	8575691
Dissolved Chloride (Cl)	mg/L	10	1.0	8575687
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	8575100
Dissolved Nitrate (N)	mg/L	0.024	0.010	8575100
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	0.0056	0.0030	8575266
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	8575266
Dissolved Arsenic (As)	mg/L	0.0011	0.00020	8575266
Dissolved Barium (Ba)	mg/L	0.51	0.010	8575103
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	8575266
Dissolved Boron (B)	mg/L	0.038	0.020	8575103

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	77	0.30	8575103
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	8575266
Dissolved Cobalt (Co)	mg/L	0.00097	0.00030	8575266
Dissolved Copper (Cu)	mg/L	0.0032	0.00020	8575266
Dissolved Iron (Fe)	mg/L	<0.060	0.060	8575103
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	8575266
Dissolved Lithium (Li)	mg/L	0.020	0.020	8575103
Dissolved Magnesium (Mg)	mg/L	35	0.20	8575103
Dissolved Manganese (Mn)	mg/L	0.28	0.0040	8575103
Dissolved Molybdenum (Mo)	mg/L	0.0040	0.00020	8575266
Dissolved Nickel (Ni)	mg/L	0.0032	0.00050	8575266
Dissolved Phosphorus (P)	mg/L	0.13	0.10	8575103
Dissolved Potassium (K)	mg/L	3.3	0.30	8575103
Dissolved Selenium (Se)	mg/L	0.00030	0.00020	8575266
Dissolved Silicon (Si)	mg/L	6.2	0.10	8575103
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	8575266
Dissolved Sodium (Na)	mg/L	6.8	0.50	8575103
Dissolved Strontium (Sr)	mg/L	0.55	0.020	8575103
Dissolved Sulphur (S)	mg/L	8.3	0.20	8575103
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	8575266
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	8575266
Dissolved Titanium (Ti)	mg/L	0.0011	0.0010	8575266
Dissolved Uranium (U)	mg/L	0.0037	0.00010	8575266
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	8575266
Dissolved Zinc (Zn)	mg/L	0.0032	0.0030	8575266
RDL = Reportable Detection Limit				

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Low Level Elements				
Total Cadmium (Cd)	ug/L	4.2	0.020	8574818
Elements				
Total Aluminum (Al)	mg/L	27	0.0030	8574727
Total Antimony (Sb)	mg/L	0.00090	0.00060	8574727
Total Arsenic (As)	mg/L	0.056	0.00020	8574727
Total Barium (Ba)	mg/L	1.5	0.010	8574728
Total Beryllium (Be)	mg/L	0.0020	0.0010	8574727
Total Boron (B)	mg/L	0.047	0.020	8574728
Total Calcium (Ca)	mg/L	250	0.30	8574728
Total Chromium (Cr)	mg/L	0.048	0.0010	8574727
Total Cobalt (Co)	mg/L	0.035	0.00030	8574727
Total Copper (Cu)	mg/L	0.091	0.00020	8574727
Total Iron (Fe)	mg/L	75	0.060	8574728
Total Lead (Pb)	mg/L	0.036	0.00020	8574727
Total Lithium (Li)	mg/L	0.061	0.020	8574728
Total Magnesium (Mg)	mg/L	83	0.20	8574728
Total Manganese (Mn)	mg/L	1.6	0.0040	8574728
Total Molybdenum (Mo)	mg/L	0.0058	0.00020	8574727
Total Nickel (Ni)	mg/L	0.089	0.00050	8574727
Total Phosphorus (P)	mg/L	2.1	0.10	8574728
Total Potassium (K)	mg/L	8.0	0.30	8574728
Total Selenium (Se)	mg/L	0.0024	0.00020	8574727
Total Silicon (Si)	mg/L	50	0.10	8574728
Total Silver (Ag)	mg/L	0.00064	0.00010	8574727
Total Sodium (Na)	mg/L	7.3	0.50	8574728
Total Strontium (Sr)	mg/L	0.80	0.020	8574728
Total Sulphur (S)	mg/L	9.1	0.20	8574728
Total Thallium (Tl)	mg/L	0.00072	0.00020	8574727
Total Tin (Sn)	mg/L	0.0084	0.0010	8574727
Total Titanium (Ti)	mg/L	0.26	0.0010	8574727
Total Uranium (U)	mg/L	0.0066	0.00010	8574727
Total Vanadium (V)	mg/L	0.075	0.0010	8574727
RDL = Reportable Detection Limit				

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/L	0.27	0.0030	8574727

RDL = Reportable Detection Limit

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Demand Parameters				
Biochemical Oxygen Demand	mg/L	2.8	2.0	8575102
Total Chemical Oxygen Demand	mg/L	71	5.0	8575157
Misc. Inorganics				
Total Organic Carbon (C)	mg/L	<2.5 (1)	2.5	8575461
Nutrients				
Total Ammonia (N)	mg/L	0.38	0.050	8578696
Total Nitrogen (N)	mg/L	2.5	0.055	8574984
Total Phosphorus (P)	mg/L	2.5 (2)	0.075	8575370
Total Total Kjeldahl Nitrogen	mg/L	2.5 (2)	0.25	8575287
Organic Acids				
Formic Acid	mg/L	<0.50	0.50	8575570
Acetic Acid	mg/L	<0.50	0.50	8575570
Propionic Acid	mg/L	<0.50	0.50	8575570
Butyric Acid	mg/L	<10 (3)	10	8575570
Misc. Organics				
Adsorbable Organic Halogen	mg/L	0.02	0.01	8576797

RDL = Reportable Detection Limit

(1) Detection limits raised due to sample matrix.

(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

(3) Detection limits raised due to matrix interference.

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
Volatiles				
Total Trihalomethanes	ug/L	<1.3	1.3	8574985
Bromodichloromethane	ug/L	<0.50	0.50	8575411
Bromoform	ug/L	<0.50	0.50	8575411
Bromomethane	ug/L	<2.0	2.0	8575411
Carbon tetrachloride	ug/L	<0.50	0.50	8575411
Chlorobenzene	ug/L	<0.50	0.50	8575411
Chlorodibromomethane	ug/L	<1.0	1.0	8575411
Chloroethane	ug/L	<1.0	1.0	8575411
Chloroform	ug/L	<0.50	0.50	8575411
Chloromethane	ug/L	<2.0	2.0	8575411
1,2-dibromoethane	ug/L	<0.20	0.20	8575411
1,2-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,3-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,4-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,1-dichloroethane	ug/L	<0.50	0.50	8575411
1,2-dichloroethane	ug/L	<0.50	0.50	8575411
1,1-dichloroethene	ug/L	<0.50	0.50	8575411
cis-1,2-dichloroethene	ug/L	<0.50	0.50	8575411
trans-1,2-dichloroethene	ug/L	<0.50	0.50	8575411
Dichloromethane	ug/L	<2.0	2.0	8575411
1,2-dichloropropane	ug/L	<0.50	0.50	8575411
cis-1,3-dichloropropene	ug/L	<0.50	0.50	8575411
trans-1,3-dichloropropene	ug/L	<0.50	0.50	8575411
Methyl methacrylate	ug/L	<0.50	0.50	8575411
Methyl-tert-butylether (MTBE)	ug/L	<0.50	0.50	8575411
Styrene	ug/L	<0.50	0.50	8575411
1,1,1,2-tetrachloroethane	ug/L	<1.0	1.0	8575411
1,1,2,2-tetrachloroethane	ug/L	<2.0	2.0	8575411
Tetrachloroethene	ug/L	<0.50	0.50	8575411
1,2,3-trichlorobenzene	ug/L	<1.0	1.0	8575411
1,2,4-trichlorobenzene	ug/L	<1.0	1.0	8575411
1,3,5-trichlorobenzene	ug/L	<0.50	0.50	8575411
RDL = Reportable Detection Limit				

Maxxam Job #: B717877
Report Date: 2017/03/21

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR7384		
Sampling Date		2017/03/10 10:30		
COC Number		512239-03-01		
	UNITS	**XCG1**	**RDL**	**QC Batch**
1,1,1-trichloroethane	ug/L	<0.50	0.50	8575411
1,1,2-trichloroethane	ug/L	<0.50	0.50	8575411
Trichloroethene	ug/L	<0.50	0.50	8575411
Trichlorofluoromethane	ug/L	<0.50	0.50	8575411
1,2,4-trimethylbenzene	ug/L	<0.50	0.50	8575411
1,3,5-trimethylbenzene	ug/L	<0.50	0.50	8575411
Vinyl chloride	ug/L	<0.50	0.50	8575411
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	100	N/A	8575411
4-Bromofluorobenzene (sur.)	%	103	N/A	8575411
D4-1,2-Dichloroethane (sur.)	%	113	N/A	8575411

RDL = Reportable Detection Limit
N/A = Not Applicable

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.0°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8574703	O-TERPHENYL (sur.)	2017/03/13	95	60 - 130	97	60 - 130	94	%				
8575407	1,4-Difluorobenzene (sur.)	2017/03/13	98	70 - 130	89	70 - 130	86	%				
8575407	4-Bromofluorobenzene (sur.)	2017/03/13	105	70 - 130	109	70 - 130	106	%				
8575407	D4-1,2-Dichloroethane (sur.)	2017/03/13	98	70 - 130	99	70 - 130	105	%				
8575411	1,4-Difluorobenzene (sur.)	2017/03/13	107	70 - 130	100	70 - 130	99	%				
8575411	4-Bromofluorobenzene (sur.)	2017/03/13	119	70 - 130	113	70 - 130	104	%				
8575411	D4-1,2-Dichloroethane (sur.)	2017/03/13	89	70 - 130	102	70 - 130	105	%				
8574703	F2 (C10-C16 Hydrocarbons)	2017/03/13	99	60 - 130	94	70 - 130	<0.10	mg/L	NC	30		
8574727	Total Aluminum (Al)	2017/03/13	NC	80 - 120	95	80 - 120	<0.0030	mg/L	NC	20		
8574727	Total Antimony (Sb)	2017/03/13	31 (1)	80 - 120	94	80 - 120	<0.00060	mg/L	NC	20		
8574727	Total Arsenic (As)	2017/03/13	95	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20		
8574727	Total Beryllium (Be)	2017/03/13	96	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20		
8574727	Total Chromium (Cr)	2017/03/13	103	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20		
8574727	Total Cobalt (Co)	2017/03/13	95	80 - 120	101	80 - 120	<0.00030	mg/L	NC	20		
8574727	Total Copper (Cu)	2017/03/13	94	80 - 120	100	80 - 120	<0.00020	mg/L	2.6	20		
8574727	Total Lead (Pb)	2017/03/13	94	80 - 120	99	80 - 120	<0.00020	mg/L	19	20		
8574727	Total Molybdenum (Mo)	2017/03/13	85	80 - 120	98	80 - 120	<0.00020	mg/L	NC	20		
8574727	Total Nickel (Ni)	2017/03/13	101	80 - 120	100	80 - 120	<0.00050	mg/L	NC	20		
8574727	Total Selenium (Se)	2017/03/13	97	80 - 120	101	80 - 120	<0.00020	mg/L	NC	20		
8574727	Total Silver (Ag)	2017/03/13	95	80 - 120	98	80 - 120	<0.00010	mg/L	NC	20		
8574727	Total Thallium (Tl)	2017/03/13	91	80 - 120	100	80 - 120	<0.00020	mg/L	NC	20		
8574727	Total Tin (Sn)	2017/03/13	79 (1)	80 - 120	96	80 - 120	<0.0010	mg/L	NC	20		
8574727	Total Titanium (Ti)	2017/03/13	NC	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
8574727	Total Uranium (U)	2017/03/13	85	80 - 120	90	80 - 120	<0.00010	mg/L	NC	20		
8574727	Total Vanadium (V)	2017/03/13	103	80 - 120	102	80 - 120	<0.0010	mg/L	NC	20		
8574727	Total Zinc (Zn)	2017/03/13	NC	80 - 120	97	80 - 120	<0.0030	mg/L	1.7	20		
8574728	Total Barium (Ba)	2017/03/13	100	80 - 120	97	80 - 120	<0.010	mg/L	NC	20		
8574728	Total Boron (B)	2017/03/13	97	80 - 120	97	80 - 120	<0.020	mg/L	0.28	20		
8574728	Total Calcium (Ca)	2017/03/13	NC	80 - 120	105	80 - 120	<0.30	mg/L	NC	20		
8574728	Total Iron (Fe)	2017/03/13	NC	80 - 120	113	80 - 120	<0.060	mg/L	NC	20		
8574728	Total Lithium (Li)	2017/03/13	101	80 - 120	98	80 - 120	<0.020	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8574728	Total Magnesium (Mg)	2017/03/13	NC	80 - 120	98	80 - 120	<0.20	mg/L	NC	20		
8574728	Total Manganese (Mn)	2017/03/13	NC	80 - 120	103	80 - 120	<0.0040	mg/L	NC	20		
8574728	Total Phosphorus (P)	2017/03/13	103	80 - 120	101	80 - 120	<0.10	mg/L	NC	20		
8574728	Total Potassium (K)	2017/03/13	105	80 - 120	95	80 - 120	<0.30	mg/L	NC	20		
8574728	Total Silicon (Si)	2017/03/13	NC	80 - 120	99	80 - 120	<0.10	mg/L	0.17	20		
8574728	Total Sodium (Na)	2017/03/13	98	80 - 120	98	80 - 120	<0.50	mg/L	1.7	20		
8574728	Total Strontium (Sr)	2017/03/13	102	80 - 120	99	80 - 120	<0.020	mg/L	NC	20		
8574728	Total Sulphur (S)	2017/03/13					<0.20	mg/L	5.2	20		
8575086	Alkalinity (PP as CaCO3)	2017/03/11					<0.50	mg/L	NC	20		
8575086	Alkalinity (Total as CaCO3)	2017/03/11			96	80 - 120	<0.50	mg/L	2.9	20		
8575086	Bicarbonate (HCO3)	2017/03/11					<0.50	mg/L	2.9	20		
8575086	Carbonate (CO3)	2017/03/11					<0.50	mg/L	NC	20		
8575086	Hydroxide (OH)	2017/03/11					<0.50	mg/L	NC	20		
8575087	Conductivity	2017/03/11			101	90 - 110	<1.0	uS/cm	0.80	10		
8575088	pH	2017/03/11			100	97 - 103			2.3	N/A		
8575100	Dissolved Nitrate (N)	2017/03/12	NC	80 - 120	101	80 - 120	<0.010	mg/L	0.86	20		
8575100	Dissolved Nitrite (N)	2017/03/11	100	80 - 120	99	80 - 120	<0.010	mg/L				
8575102	Biochemical Oxygen Demand	2017/03/16			99	85 - 115	<2.0	mg/L	5.2	20		
8575103	Dissolved Barium (Ba)	2017/03/11	106	80 - 120	97	80 - 120	<0.010	mg/L				
8575103	Dissolved Boron (B)	2017/03/11	101	80 - 120	92	80 - 120	<0.020	mg/L				
8575103	Dissolved Calcium (Ca)	2017/03/11	99	80 - 120	96	80 - 120	<0.30	mg/L	0.73	20		
8575103	Dissolved Iron (Fe)	2017/03/11	108	80 - 120	99	80 - 120	<0.060	mg/L	NC	20		
8575103	Dissolved Lithium (Li)	2017/03/11	105	80 - 120	94	80 - 120	<0.020	mg/L				
8575103	Dissolved Magnesium (Mg)	2017/03/11	101	80 - 120	95	80 - 120	<0.20	mg/L	1.4	20		
8575103	Dissolved Manganese (Mn)	2017/03/11	106	80 - 120	100	80 - 120	<0.0040	mg/L	1.2	20		
8575103	Dissolved Phosphorus (P)	2017/03/11	115	80 - 120	101	80 - 120	<0.10	mg/L				
8575103	Dissolved Potassium (K)	2017/03/11	103	80 - 120	91	80 - 120	<0.30	mg/L	NC	20		
8575103	Dissolved Silicon (Si)	2017/03/11	88	80 - 120	82	80 - 120	<0.10	mg/L				
8575103	Dissolved Sodium (Na)	2017/03/11	106	80 - 120	95	80 - 120	<0.50	mg/L	0.83	20		
8575103	Dissolved Strontium (Sr)	2017/03/11	105	80 - 120	96	80 - 120	<0.020	mg/L				
8575103	Dissolved Sulphur (S)	2017/03/11					<0.20	mg/L				

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8575157	Total Chemical Oxygen Demand	2017/03/12	102	80 - 120	99	80 - 120	<5.0	mg/L	8.0	20		
8575266	Dissolved Aluminum (Al)	2017/03/13	96	80 - 120	119	80 - 120	<0.0030	mg/L	NC	20		
8575266	Dissolved Antimony (Sb)	2017/03/13	86	80 - 120	85	80 - 120	<0.00060	mg/L	NC	20		
8575266	Dissolved Arsenic (As)	2017/03/13	92	80 - 120	91	80 - 120	<0.00020	mg/L	8.6	20		
8575266	Dissolved Beryllium (Be)	2017/03/13	96	80 - 120	89	80 - 120	<0.0010	mg/L	NC	20		
8575266	Dissolved Chromium (Cr)	2017/03/13	90	80 - 120	90	80 - 120	<0.0010	mg/L	NC	20		
8575266	Dissolved Cobalt (Co)	2017/03/13	88	80 - 120	89	80 - 120	<0.00030	mg/L	0.27	20		
8575266	Dissolved Copper (Cu)	2017/03/13	86	80 - 120	94	80 - 120	<0.00020	mg/L	NC	20		
8575266	Dissolved Lead (Pb)	2017/03/13	88	80 - 120	92	80 - 120	<0.00020	mg/L	NC	20		
8575266	Dissolved Molybdenum (Mo)	2017/03/13	96	80 - 120	89	80 - 120	<0.00020	mg/L	1.4	20		
8575266	Dissolved Nickel (Ni)	2017/03/13	87	80 - 120	92	80 - 120	<0.00050	mg/L	5.5	20		
8575266	Dissolved Selenium (Se)	2017/03/13	104	80 - 120	92	80 - 120	<0.00020	mg/L	0.84	20		
8575266	Dissolved Silver (Ag)	2017/03/13	80	80 - 120	84	80 - 120	<0.00010	mg/L	NC	20		
8575266	Dissolved Thallium (Tl)	2017/03/13	92	80 - 120	93	80 - 120	<0.00020	mg/L	NC	20		
8575266	Dissolved Tin (Sn)	2017/03/13	95	80 - 120	90	80 - 120	<0.0010	mg/L	1.6	20		
8575266	Dissolved Titanium (Ti)	2017/03/13	88	80 - 120	93	80 - 120	<0.0010	mg/L	NC	20		
8575266	Dissolved Uranium (U)	2017/03/13	93	80 - 120	89	80 - 120	<0.00010	mg/L	1.2	20		
8575266	Dissolved Vanadium (V)	2017/03/13	93	80 - 120	93	80 - 120	<0.0010	mg/L	6.8	20		
8575266	Dissolved Zinc (Zn)	2017/03/13	93	80 - 120	92	80 - 120	<0.0030	mg/L	NC	20		
8575287	Total Total Kjeldahl Nitrogen	2017/03/13	NC	80 - 120	96	80 - 120	<0.050	mg/L	6.4	20	100	80 - 120
8575370	Total Phosphorus (P)	2017/03/16	97	80 - 120	93	80 - 120	<0.0030	mg/L	10	20	92	N/A
8575407	Benzene	2017/03/13	95	70 - 130	120	70 - 130	<0.40	ug/L	NC	30		
8575407	Ethylbenzene	2017/03/13	98	70 - 130	117	70 - 130	<0.40	ug/L	NC	30		
8575407	F1 (C6-C10) - BTEX	2017/03/13					<100	ug/L	NC	30		
8575407	F1 (C6-C10)	2017/03/13	106	70 - 130	103	70 - 130	<100	ug/L	NC	30		
8575407	m & p-Xylene	2017/03/13	97	70 - 130	117	70 - 130	<0.80	ug/L	NC	30		
8575407	o-Xylene	2017/03/13	99	70 - 130	121	70 - 130	<0.40	ug/L	NC	30		
8575407	Toluene	2017/03/13	95	70 - 130	116	70 - 130	<0.40	ug/L	NC	30		
8575407	Xylenes (Total)	2017/03/13					<0.80	ug/L	NC	30		
8575411	1,1,1,2-tetrachloroethane	2017/03/13	111	70 - 130	97	70 - 130	<1.0	ug/L	NC	40		
8575411	1,1,1-trichloroethane	2017/03/13	107	70 - 130	84	70 - 130	<0.50	ug/L	NC	40		

Maxxam Job #: B717877
Report Date: 2017/03/21

QUALITY ASSURANCE REPORT(CONT'D)

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8575411	1,1,2,2-tetrachloroethane	2017/03/13	115	70 - 130	130	70 - 130	<2.0	ug/L	NC	40		
8575411	1,1,2-trichloroethane	2017/03/13	120	70 - 130	119	70 - 130	<0.50	ug/L	NC	40		
8575411	1,1-dichloroethane	2017/03/13	111	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,1-dichloroethene	2017/03/13	99	70 - 130	77	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2,3-trichlorobenzene	2017/03/13	127	70 - 130	111	70 - 130	<1.0	ug/L	NC	40		
8575411	1,2,4-trichlorobenzene	2017/03/13	121	70 - 130	108	70 - 130	<1.0	ug/L	NC	40		
8575411	1,2,4-trimethylbenzene	2017/03/13	121	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dibromoethane	2017/03/13	113	70 - 130	117	70 - 130	<0.20	ug/L	NC	40		
8575411	1,2-dichlorobenzene	2017/03/13	122	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dichloroethane	2017/03/13	109	70 - 130	110	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dichloropropane	2017/03/13	119	70 - 130	113	70 - 130	<0.50	ug/L	NC	40		
8575411	1,3,5-trichlorobenzene	2017/03/13	112	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8575411	1,3,5-trimethylbenzene	2017/03/13	119	70 - 130	94	70 - 130	<0.50	ug/L	NC	40		
8575411	1,3-dichlorobenzene	2017/03/13	113	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,4-dichlorobenzene	2017/03/13	115	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromodichloromethane	2017/03/13	116	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromoform	2017/03/13	117	70 - 130	119	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromomethane	2017/03/13	102	70 - 130	87	70 - 130	<2.0	ug/L	NC	40		
8575411	Carbon tetrachloride	2017/03/13	108	70 - 130	79	70 - 130	<0.50	ug/L	NC	40		
8575411	Chlorobenzene	2017/03/13	111	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8575411	Chlorodibromomethane	2017/03/13	119	70 - 130	113	70 - 130	<1.0	ug/L	NC	40		
8575411	Chloroethane	2017/03/13	97	70 - 130	79	70 - 130	<1.0	ug/L	NC	40		
8575411	Chloroform	2017/03/13	110	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	Chloromethane	2017/03/13	122	70 - 130	91	70 - 130	<2.0	ug/L	NC	40		
8575411	cis-1,2-dichloroethene	2017/03/13	109	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8575411	cis-1,3-dichloropropene	2017/03/13	110	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	Dichloromethane	2017/03/13	103	70 - 130	101	70 - 130	<2.0	ug/L	NC	40		
8575411	Methyl methacrylate	2017/03/13	117	70 - 130	129	70 - 130	<0.50	ug/L	NC	40		
8575411	Methyl-tert-butylether (MTBE)	2017/03/13	122	70 - 130	107	70 - 130	<0.50	ug/L	NC	40		
8575411	Styrene	2017/03/13	114	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8575411	Tetrachloroethene	2017/03/13	112	70 - 130	86	70 - 130	<0.50	ug/L	NC	40		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8575411	trans-1,2-dichloroethene	2017/03/13	104	70 - 130	83	70 - 130	<0.50	ug/L	NC	40		
8575411	trans-1,3-dichloropropene	2017/03/13	117	70 - 130	127	70 - 130	<0.50	ug/L	NC	40		
8575411	Trichloroethene	2017/03/13	110	70 - 130	93	70 - 130	<0.50	ug/L	NC	40		
8575411	Trichlorofluoromethane	2017/03/13	101	70 - 130	72	70 - 130	<0.50	ug/L	NC	40		
8575411	Vinyl chloride	2017/03/13	93	70 - 130	69 (1)	70 - 130	<0.50	ug/L	NC	40		
8575461	Total Organic Carbon (C)	2017/03/13	NC	80 - 120	105	80 - 120	<0.50	mg/L	3.1	20		
8575570	Acetic Acid	2017/03/13	94	80 - 120	95	80 - 120	<0.50	mg/L	NC	20		
8575570	Butyric Acid	2017/03/13	97	80 - 120	96	80 - 120	<0.50	mg/L	NC	20		
8575570	Formic Acid	2017/03/13	103	80 - 120	88	80 - 120	<0.50	mg/L	NC	20		
8575570	Propionic Acid	2017/03/13	90	80 - 120	106	80 - 120	<0.50	mg/L	NC	20		
8575687	Dissolved Chloride (Cl)	2017/03/13	105	80 - 120	104	80 - 120	<1.0	mg/L	19	20		
8575691	Dissolved Sulphate (SO4)	2017/03/13	NC	80 - 120	101	80 - 120	<1.0	mg/L	1.7	20		
8576797	Adsorbable Organic Halogen	2017/03/14					<0.5	mg/L			104	84 - 111
8578696	Total Ammonia (N)	2017/03/16	96	80 - 120	95	80 - 120	<0.050	mg/L	1.2	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Dennis Ngondu, B.Sc., P.Chem., QP, Supervisor, Organics

Gayle Simpson, Analyst II

Junzhi Gao

Janet Gao, B.Sc., QP, Supervisor, Organics

Peng Liang

Harry (Peng) Liang, Senior Analyst

Veronica Falk

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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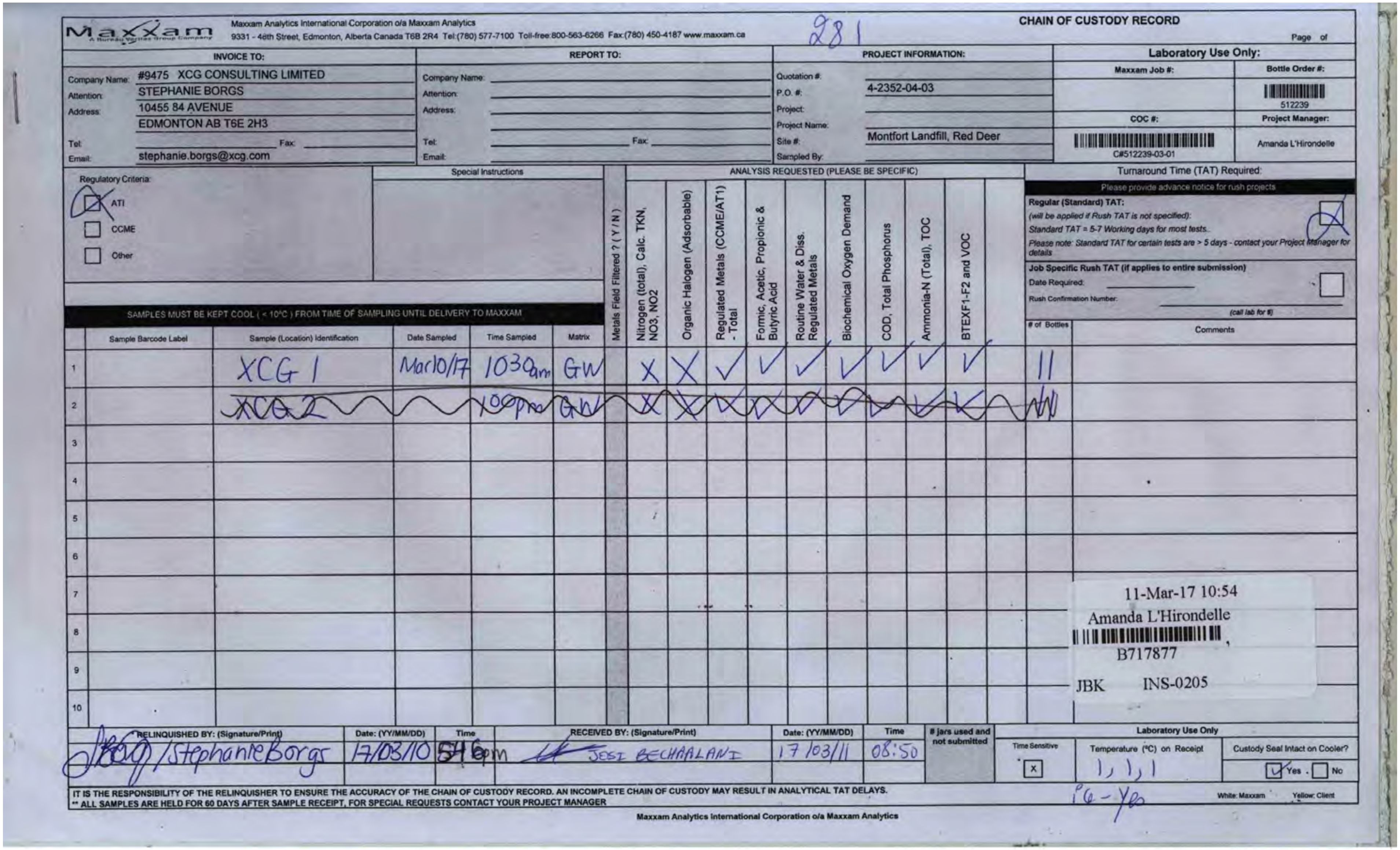
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



Maxxam Analytics International Corporation o/a Maxxam Analytics
9331 - 48th Street, Edmonton, Alberta Canada T6B 2R4 Tel:(780) 577-7100 Toll-free:800-563-6266 Fax:(780) 450-4187 www.maxxam.ca

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CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:

Company Name: #9475 XCG CONSULTING LIMITED
Attention: STEPHANIE BORGS
Address: 10455 84 AVENUE
EDMONTON AB T6E 2H3
Tel: Fax:
Email: stephanie.borgs@xcg.com

REPORT TO:

Company Name:
Attention:
Address:
Tel: Fax:
Email:

PROJECT INFORMATION:

Quotation #:
P.O. #: 4-2352-04-03
Project:
Project Name:
Site #: Montfort Landfill, Red Deer
Sampled By:

Laboratory Use Only:

Maxxam Job #:
Bottle Order #: 512239
COC #: C#512239-03-01
Project Manager: Amanda L'Hirondelle

Regulatory Criteria:
☒ ATI
☐ CCME
☐ Other

Special Instructions

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details
Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: *(call lab for #)*

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Nitrogen (total), Calc. TKN, NO3, NO2	Organic Halogen (Adsorbable)	Regulated Metals (CCME/AT1) - Total	Formic, Acetic, Propionic & Butyric Acid	Routine Water & Diss. Regulated Metals	Biochemical Oxygen Demand	COD, Total Phosphorus	Ammonia-N (Total), TOC	BTEXF1-F2 and VOC		# of Bottles	Comments
1		XCG 1	Mar10/17	1030am	GW		X	X	✓	✓	✓	✓	✓	✓	✓		11	
2		~~XCG 2~~		~~100pm~~	~~GW~~		~~X~~	~~X~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~	~~✓~~		~~11~~	
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

11-Mar-17 10:54
Amanda L'Hirondelle
B717877
JBK INS-0205

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
/Stephanie Borgs	17/03/10	546pm	JESI BECHAALANI	17/03/11	08:50	

Laboratory Use Only
Time Sensitive: ☒
Temperature (°C) on Receipt: 1, 1, 1
Custody Seal Intact on Cooler? ☑ Yes ☐ No
ic - Yes

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

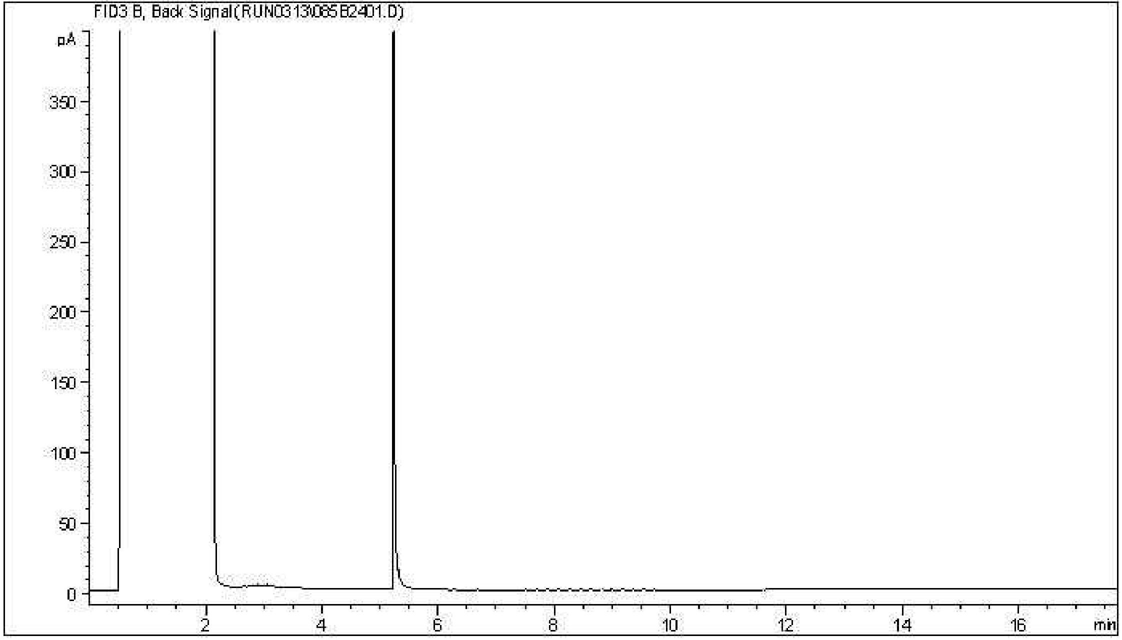
Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam Job #: B717877
Report Date: 2017/03/21
Maxxam Sample: QR7384

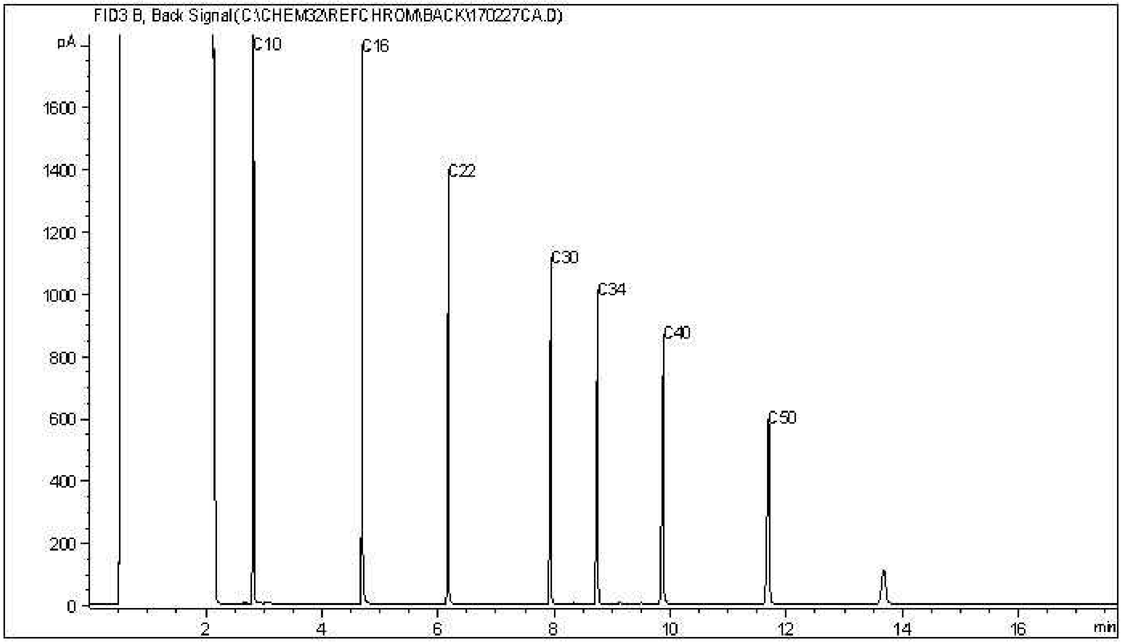
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: XCG1

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: C#512239-02-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359779
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718037
Received: 2017/03/13, 08:30

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Formic, Acetic, Propionic & Butyric Acid	5	N/A	2017/03/13	CAL SOP-00063	Dionex #031181 R07 m
Alkalinity @25C (pp, total), CO3,HCO3,OH	5	N/A	2017/03/14	AB SOP-00005	SM 22 2320 B m
Organic Halogen (Adsorbable) (1)	5	2017/03/14	2017/03/14	PTC SOP-00056	Coulometric - Titr.
Biochemical Oxygen Demand	6	2017/03/13	2017/03/18	AB SOP-00017	SM 22 5210B m
BTEX/F1 in Water by HS GC/MS/FID	6	N/A	2017/03/13	AB SOP-00039	CCME CWS/EPA 8260c m
Cadmium - low level CCME - Dissolved	5	N/A	2017/03/15	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	3	N/A	2017/03/15	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	2	N/A	2017/03/16	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	1	N/A	2017/03/17	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry	1	N/A	2017/03/14	AB SOP-00020	SM 22-4500-Cl G m
Chloride by Automated Colourimetry	4	N/A	2017/03/16	AB SOP-00020	SM 22-4500-Cl G m
Chemical Oxygen Demand	6	N/A	2017/03/15	AB SOP-00016	SM 22 5220D m
Conductivity @25C	5	N/A	2017/03/14	AB SOP-00005	SM 22 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	6	2017/03/13	2017/03/13	AB SOP-00040 AB SOP-00037	CCME PHC-CWS m
Hardness	4	N/A	2017/03/14	AB WI-00065	Auto Calc
Hardness	1	N/A	2017/03/15	AB WI-00065	Auto Calc
Elements by ICP-Dissolved-Lab Filtered (3)	4	N/A	2017/03/14	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP-Dissolved-Lab Filtered (3)	1	N/A	2017/03/15	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total	6	2017/03/14	2017/03/14	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICPMS-Dissolved-Lab Filtered (3)	5	N/A	2017/03/14	AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	3	2017/03/14	2017/03/14	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	3	2017/03/14	2017/03/15	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Ion Balance (as % Difference)	5	N/A	2017/03/14	AB WI-00065	Auto Calc
Sum of cations, anions	4	N/A	2017/03/14	AB WI-00065	Auto Calc
Sum of cations, anions	1	N/A	2017/03/15	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	6	N/A	2017/03/15	AB WI-00065	Auto Calc
Ammonia-N (Total)	6	N/A	2017/03/14	AB SOP-00007	EPA 350.1 R2.0 m

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
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CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718037
Received: 2017/03/13, 08:30

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Nitrate and Nitrite	6	N/A	2017/03/14	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	6	N/A	2017/03/14	AB WI-00065	Auto Calc
Nitrogen, (Nitrite, Nitrate) by IC (4)	5	N/A	2017/03/13	AB SOP-00023	SM 22 4110 B m
Nitrogen, (Nitrite, Nitrate) by IC (4)	1	N/A	2017/03/14	AB SOP-00023	SM 22 4110 B m
pH @25°C (5)	5	N/A	2017/03/14	AB SOP-00005	SM 22 4500-H+B m
Sulphate by Automated Colourimetry	1	N/A	2017/03/14	AB SOP-00018	SM 22 4500-SO4 E m
Sulphate by Automated Colourimetry	4	N/A	2017/03/16	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Calculated)	1	N/A	2017/03/14	AB WI-00065	Auto Calc
Total Dissolved Solids (Calculated)	4	N/A	2017/03/16	AB WI-00065	Auto Calc
Total Trihalomethanes Calculation	6	N/A	2017/03/14	CAL SOP-00104	Auto Calc
Total Kjeldahl Nitrogen	6	2017/03/14	2017/03/15	AB SOP-00008	EPA 351.1 R1978 m
Carbon (Total Organic) (6)	6	N/A	2017/03/15	CAL SOP-00077	MMCW 119 1996 m
Total Phosphorus	6	2017/03/15	2017/03/15	AB SOP-00024	SM 22 4500-P A,B,F m
VOCs in Water by HS GC/MS (Std List)	6	N/A	2017/03/13	AB SOP-00056	EPA 5021a/8260c m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: C#512239-02-01

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Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Edmonton Petroleum
(2) Silica gel clean up employed.
(3) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(4) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(5) The APHA Standard Method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(6) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Robin Weaver, Environmental Project Manager
Email: RWeaver@maxxam.ca
Phone# (403)735-2258
==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

AT1 BTEX AND F1-F2 IN WATER (WATER)

Maxxam ID		QR8538	QR8539	QR8540	QR8541	QR8542		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00	2017/03/12 12:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**XCG12**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8574703
Volatiles								
Benzene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8575407
Toluene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8575407
Ethylbenzene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8575407
m & p-Xylene	ug/L	<0.80	<0.80	<0.80	<0.80	<0.80	0.80	8575407
o-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8575407
Xylenes (Total)	ug/L	<0.80	<0.80	<0.80	<0.80	<0.80	0.80	8575407
F1 (C6-C10) - BTEX	ug/L	<100	<100	<100	<100	<100	100	8575407
F1 (C6-C10)	ug/L	<100	<100	<100	<100	<100	100	8575407
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	94	95	94	94	95	N/A	8575407
4-Bromofluorobenzene (sur.)	%	105	105	104	103	104	N/A	8575407
D4-1,2-Dichloroethane (sur.)	%	91	90	91	93	92	N/A	8575407
O-TERPHENYL (sur.)	%	92	97	90	95	94	N/A	8574703

RDL = Reportable Detection Limit
N/A = Not Applicable

AT1 BTEX AND F1-F2 IN WATER (WATER)

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	0.10	8574703
Volatiles				
Benzene	ug/L	<0.40	0.40	8575407
Toluene	ug/L	<0.40	0.40	8575407
Ethylbenzene	ug/L	<0.40	0.40	8575407
m & p-Xylene	ug/L	<0.80	0.80	8575407
o-Xylene	ug/L	<0.40	0.40	8575407
Xylenes (Total)	ug/L	<0.80	0.80	8575407
F1 (C6-C10) - BTEX	ug/L	<100	100	8575407
F1 (C6-C10)	ug/L	<100	100	8575407
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	96	N/A	8575407
4-Bromofluorobenzene (sur.)	%	105	N/A	8575407
D4-1,2-Dichloroethane (sur.)	%	94	N/A	8575407
O-TERPHENYL (sur.)	%	92	N/A	8574703

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR8538	QR8539	QR8540	QR8541		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**RDL**	**QC Batch**
Calculated Parameters							
Anion Sum	meq/L	8.8	8.8	12	9.3	N/A	8575626
Cation Sum	meq/L	8.8	8.9	12	8.9	N/A	8575626
Hardness (CaCO3)	mg/L	320	320	560	420	0.50	8575584
Ion Balance (% Difference)	N/A	0.13	0.50	0.77	2.0	0.010	8575624
Dissolved Nitrate (NO3)	mg/L	0.063	0.077	0.056	0.21	0.044	8575585
Nitrate plus Nitrite (N)	mg/L	0.014	0.017	0.013	0.047	0.010	8575586
Dissolved Nitrite (NO2)	mg/L	<0.033	<0.033	<0.033	<0.033	0.033	8575585
Calculated Total Dissolved Solids	mg/L	460	460	570	450	10	8575629
Misc. Inorganics							
Conductivity	uS/cm	820	830	1000	830	1.0	8576332
pH	pH	7.30	7.29	7.34	7.37	N/A	8576331
Low Level Elements							
Dissolved Cadmium (Cd)	ug/L	0.15	0.13	0.064	0.29	0.020	8575621
Anions							
Alkalinity (PP as CaCO3)	mg/L	<0.50	<0.50	<0.50	<0.50	0.50	8576330
Alkalinity (Total as CaCO3)	mg/L	340	340	490	410	0.50	8576330
Bicarbonate (HCO3)	mg/L	420	420	590	500	0.50	8576330
Carbonate (CO3)	mg/L	<0.50	<0.50	<0.50	<0.50	0.50	8576330
Hydroxide (OH)	mg/L	<0.50	<0.50	<0.50	<0.50	0.50	8576330
Dissolved Sulphate (SO4)	mg/L	57	58	56	37	1.0	8579000
Dissolved Chloride (Cl)	mg/L	27	27	21	12	1.0	8578994
Nutrients							
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	<0.010	<0.010	0.010	8576185
Dissolved Nitrate (N)	mg/L	0.014	0.017	0.013	0.047	0.010	8576185
Lab Filtered Elements							
Dissolved Aluminum (Al)	mg/L	0.0031	0.0038	0.0031	0.0039	0.0030	8576569
Dissolved Antimony (Sb)	mg/L	0.00065	<0.00060	<0.00060	<0.00060	0.00060	8576569
Dissolved Arsenic (As)	mg/L	0.0013	0.0013	0.0011	0.00029	0.00020	8576569
Dissolved Barium (Ba)	mg/L	0.090	0.093	0.52	0.71	0.010	8576973
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Boron (B)	mg/L	0.090	0.090	0.046	0.042	0.020	8576973

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR8538	QR8539	QR8540	QR8541		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	84	83	120	110	0.30	8576973
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Cobalt (Co)	mg/L	0.0024	0.0023	0.00043	<0.00030	0.00030	8576569
Dissolved Copper (Cu)	mg/L	0.0011	0.0010	0.00071	0.00085	0.00020	8576569
Dissolved Iron (Fe)	mg/L	<0.060	<0.060	<0.060	<0.060	0.060	8576973
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	8576569
Dissolved Lithium (Li)	mg/L	0.037	0.038	0.047	0.027	0.020	8576973
Dissolved Magnesium (Mg)	mg/L	28	27	61	37	0.20	8576973
Dissolved Manganese (Mn)	mg/L	0.50	0.49	0.26	0.089	0.0040	8576973
Dissolved Molybdenum (Mo)	mg/L	0.0043	0.0046	0.0020	0.0027	0.00020	8576569
Dissolved Nickel (Ni)	mg/L	0.0073	0.0069	0.0013	0.00092	0.00050	8576569
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.11	0.10	8576973
Dissolved Potassium (K)	mg/L	3.7	3.7	2.5	3.9	0.30	8576973
Dissolved Selenium (Se)	mg/L	0.00061	0.00058	<0.00020	0.00023	0.00020	8576569
Dissolved Silicon (Si)	mg/L	6.5	6.6	6.8	6.1	0.10	8576973
Dissolved Silver (Ag)	mg/L	<0.00010	0.00015	<0.00010	<0.00010	0.00010	8576569
Dissolved Sodium (Na)	mg/L	51	54	10	9.8	0.50	8576973
Dissolved Strontium (Sr)	mg/L	0.81	0.82	1.1	0.71	0.020	8576973
Dissolved Sulphur (S)	mg/L	16	17	15	10	0.20	8576973
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	8576569
Dissolved Tin (Sn)	mg/L	0.0011	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Uranium (U)	mg/L	0.013	0.014	0.015	0.0098	0.00010	8576569
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0036	0.0030	8576569
RDL = Reportable Detection Limit							

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	meq/L	0.0000	N/A	8575626
Cation Sum	meq/L	0.0030	N/A	8575626
Hardness (CaCO3)	mg/L	<0.50	0.50	8575584
Ion Balance (% Difference)	N/A	NC	0.010	8575624
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	8575585
Nitrate plus Nitrite (N)	mg/L	<0.010	0.010	8575586
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	8575585
Calculated Total Dissolved Solids	mg/L	<10	10	8575629
Misc. Inorganics				
Conductivity	uS/cm	1.1	1.0	8576332
pH	pH	5.57	N/A	8576331
Low Level Elements				
Dissolved Cadmium (Cd)	ug/L	<0.020	0.020	8575621
Anions				
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	8576330
Alkalinity (Total as CaCO3)	mg/L	<0.50	0.50	8576330
Bicarbonate (HCO3)	mg/L	<0.50	0.50	8576330
Carbonate (CO3)	mg/L	<0.50	0.50	8576330
Hydroxide (OH)	mg/L	<0.50	0.50	8576330
Dissolved Sulphate (SO4)	mg/L	<1.0	1.0	8576679
Dissolved Chloride (Cl)	mg/L	<1.0	1.0	8576678
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	8576185
Dissolved Nitrate (N)	mg/L	<0.010	0.010	8576185
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0030	8576569
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	8576569
Dissolved Arsenic (As)	mg/L	<0.00020	0.00020	8576569
Dissolved Barium (Ba)	mg/L	<0.010	0.010	8576973
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	8576569
Dissolved Boron (B)	mg/L	<0.020	0.020	8576973

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	<0.30	0.30	8576973
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	8576569
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	8576569
Dissolved Copper (Cu)	mg/L	<0.00020	0.00020	8576569
Dissolved Iron (Fe)	mg/L	<0.060	0.060	8576973
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	8576569
Dissolved Lithium (Li)	mg/L	<0.020	0.020	8576973
Dissolved Magnesium (Mg)	mg/L	<0.20	0.20	8576973
Dissolved Manganese (Mn)	mg/L	<0.0040	0.0040	8576973
Dissolved Molybdenum (Mo)	mg/L	<0.00020	0.00020	8576569
Dissolved Nickel (Ni)	mg/L	<0.00050	0.00050	8576569
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	8576973
Dissolved Potassium (K)	mg/L	<0.30	0.30	8576973
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	8576569
Dissolved Silicon (Si)	mg/L	<0.10	0.10	8576973
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	8576569
Dissolved Sodium (Na)	mg/L	<0.50	0.50	8576973
Dissolved Strontium (Sr)	mg/L	<0.020	0.020	8576973
Dissolved Sulphur (S)	mg/L	<0.20	0.20	8576973
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	8576569
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	8576569
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	8576569
Dissolved Uranium (U)	mg/L	<0.00010	0.00010	8576569
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	8576569
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	8576569
RDL = Reportable Detection Limit				

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR8538	QR8539	QR8540	QR8541	QR8542		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00	2017/03/12 12:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**XCG12**	**RDL**	**QC Batch**
Low Level Elements								
Total Cadmium (Cd)	ug/L	1.1	0.76	1.7	1.9	1.8	0.020	8575582
Elements								
Total Aluminum (Al)	mg/L	2.8	2.5	16	6.6	12	0.0030	8576914
Total Antimony (Sb)	mg/L	0.00093	0.00075	0.00085	0.00063	0.00077	0.00060	8576914
Total Arsenic (As)	mg/L	0.0043	0.0037	0.021	0.0086	0.062	0.00020	8576914
Total Barium (Ba)	mg/L	0.14	0.13	1.2	0.85	1.4	0.010	8576915
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0016	<0.0010	0.0010	0.0010	8576914
Total Boron (B)	mg/L	0.11	0.098	0.065	0.042	0.055	0.020	8576915
Total Calcium (Ca)	mg/L	93	83	240	130	170	0.30	8576915
Total Chromium (Cr)	mg/L	0.0036	0.0026	0.029	0.011	0.021	0.0010	8576914
Total Cobalt (Co)	mg/L	0.0047	0.0044	0.022	0.0081	0.015	0.00030	8576914
Total Copper (Cu)	mg/L	0.0063	0.0057	0.056	0.019	0.034	0.00020	8576914
Total Iron (Fe)	mg/L	4.6	3.7	41	14	28	0.060	8576915
Total Lead (Pb)	mg/L	0.0045	0.0038	0.024	0.0084	0.016	0.00020	8576914
Total Lithium (Li)	mg/L	0.041	0.037	0.068	0.032	0.038	0.020	8576915
Total Magnesium (Mg)	mg/L	31	27	92	46	60	0.20	8576915
Total Manganese (Mn)	mg/L	0.60	0.54	1.0	0.87	0.97	0.0040	8576915
Total Molybdenum (Mo)	mg/L	0.0049	0.0046	0.0031	0.0036	0.0041	0.00020	8576914
Total Nickel (Ni)	mg/L	0.014	0.013	0.059	0.022	0.044	0.00050	8576914
Total Phosphorus (P)	mg/L	0.19	0.15	1.2	0.48	0.75	0.10	8576915
Total Potassium (K)	mg/L	4.5	4.0	6.0	5.1	8.3	0.30	8576915
Total Selenium (Se)	mg/L	0.00089	0.00081	0.0029	0.00060	0.00064	0.00020	8576914
Total Silicon (Si)	mg/L	16	14	43	20	30	0.10	8576915
Total Silver (Ag)	mg/L	<0.00010	<0.00010	0.00029	0.00013	0.00033	0.00010	8576914
Total Sodium (Na)	mg/L	56	51	10	8.0	9.7	0.50	8576915
Total Strontium (Sr)	mg/L	0.86	0.77	1.2	0.66	0.67	0.020	8576915
Total Sulphur (S)	mg/L	17	16	17	9.3	11	0.20	8576915
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00040	<0.00020	0.00031	0.00020	8576914
Total Tin (Sn)	mg/L	0.0045	0.0037	0.0019	0.0017	0.0095	0.0010	8576914
Total Titanium (Ti)	mg/L	0.037	0.032	0.21	0.11	0.17	0.0010	8576914
Total Uranium (U)	mg/L	0.015	0.014	0.015	0.010	0.0023	0.00010	8576914
Total Vanadium (V)	mg/L	0.0058	0.0053	0.050	0.019	0.036	0.0010	8576914

RDL = Reportable Detection Limit

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR8538	QR8539	QR8540	QR8541	QR8542		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00	2017/03/12 12:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**XCG12**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/L	0.032	0.030	0.19	0.090	0.15	0.0030	8576914

RDL = Reportable Detection Limit

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Low Level Elements				
Total Cadmium (Cd)	ug/L	<0.020	0.020	8575582
Elements				
Total Aluminum (Al)	mg/L	<0.0030	0.0030	8576914
Total Antimony (Sb)	mg/L	<0.00060	0.00060	8576914
Total Arsenic (As)	mg/L	<0.00020	0.00020	8576914
Total Barium (Ba)	mg/L	<0.010	0.010	8576915
Total Beryllium (Be)	mg/L	<0.0010	0.0010	8576914
Total Boron (B)	mg/L	<0.020	0.020	8576915
Total Calcium (Ca)	mg/L	<0.30	0.30	8576915
Total Chromium (Cr)	mg/L	<0.0010	0.0010	8576914
Total Cobalt (Co)	mg/L	<0.00030	0.00030	8576914
Total Copper (Cu)	mg/L	<0.00020	0.00020	8576914
Total Iron (Fe)	mg/L	<0.060	0.060	8576915
Total Lead (Pb)	mg/L	<0.00020	0.00020	8576914
Total Lithium (Li)	mg/L	<0.020	0.020	8576915
Total Magnesium (Mg)	mg/L	<0.20	0.20	8576915
Total Manganese (Mn)	mg/L	<0.0040	0.0040	8576915
Total Molybdenum (Mo)	mg/L	<0.00020	0.00020	8576914
Total Nickel (Ni)	mg/L	<0.00050	0.00050	8576914
Total Phosphorus (P)	mg/L	<0.10	0.10	8576915
Total Potassium (K)	mg/L	<0.30	0.30	8576915
Total Selenium (Se)	mg/L	<0.00020	0.00020	8576914
Total Silicon (Si)	mg/L	<0.10	0.10	8576915
Total Silver (Ag)	mg/L	<0.00010	0.00010	8576914
Total Sodium (Na)	mg/L	<0.50	0.50	8576915
Total Strontium (Sr)	mg/L	<0.020	0.020	8576915
Total Sulphur (S)	mg/L	<0.20	0.20	8576915
Total Thallium (Tl)	mg/L	<0.00020	0.00020	8576914
Total Tin (Sn)	mg/L	<0.0010	0.0010	8576914
Total Titanium (Ti)	mg/L	<0.0010	0.0010	8576914
Total Uranium (U)	mg/L	<0.00010	0.00010	8576914
Total Vanadium (V)	mg/L	<0.0010	0.0010	8576914

RDL = Reportable Detection Limit

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/L	<0.0030	0.0030	8576914

RDL = Reportable Detection Limit

Maxxam Job #: B718037
Report Date: 2017/03/21

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QR8538		QR8539		QR8540		
Sampling Date		2017/03/11 15:00		2017/03/11 15:00		2017/03/11 16:00		
COC Number		C#512239-02-01		C#512239-02-01		C#512239-02-01		
	UNITS	**XCG 2**	**RDL**	**DUP1**	**RDL**	**XCG14**	**RDL**	**QC Batch**
Demand Parameters								
Biochemical Oxygen Demand	mg/L	<2.0	2.0	<2.0	2.0	<2.0	2.0	8575926
Total Chemical Oxygen Demand	mg/L	37	5.0	36	5.0	85	5.0	8577602
Misc. Inorganics								
Total Organic Carbon (C)	mg/L	3.3 (1)	1.0	4.2	0.50	<5.0 (1)	5.0	8577293
Nutrients								
Total Ammonia (N)	mg/L	0.23	0.050	0.23	0.050	0.30	0.050	8576666
Total Nitrogen (N)	mg/L	0.45	0.055	0.55	0.055	1.4	0.055	8575704
Total Phosphorus (P)	mg/L	0.19	0.0030	0.10	0.0030	2.6 (2)	0.075	8577466
Total Total Kjeldahl Nitrogen	mg/L	0.44	0.050	0.53	0.050	1.4	0.050	8576361
Organic Acids								
Formic Acid	mg/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	8575570
Acetic Acid	mg/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	8575570
Propionic Acid	mg/L	<0.50	0.50	<0.50	0.50	<0.50	0.50	8575570
Butyric Acid	mg/L	<10 (3)	10	<10 (3)	10	<10 (3)	10	8575570
Misc. Organics								
Adsorbable Organic Halogen	mg/L	0.03	0.01	0.02	0.01	0.02	0.01	8576797

RDL = Reportable Detection Limit

(1) Detection limits raised due to sample matrix.

(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

(3) Detection limits raised due to matrix interference.

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QR8541		QR8542		QR8543		
Sampling Date		2017/03/12 10:00		2017/03/12 12:00		2017/03/12 16:30		
COC Number		C#512239-02-01		C#512239-02-01		C#512239-02-01		
	UNITS	**MW-01**	**RDL**	**XCG12**	**RDL**	**FB1**	**RDL**	**QC Batch**
Calculated Parameters								
Dissolved Nitrate (NO3)	mg/L	N/A	0.044	0.58	0.044	N/A	0.044	8575585
Nitrate plus Nitrite (N)	mg/L	N/A	0.010	0.13	0.010	N/A	0.010	8575586
Dissolved Nitrite (NO2)	mg/L	N/A	0.033	<0.033	0.033	N/A	0.033	8575585
Demand Parameters								
Biochemical Oxygen Demand	mg/L	6.9	2.0	8.3	2.0	<2.0	2.0	8575926
Total Chemical Oxygen Demand	mg/L	65	5.0	110	5.0	<5.0	5.0	8577602
Misc. Inorganics								
Total Organic Carbon (C)	mg/L	8.1 (1)	2.5	16 (1)	2.5	<0.50	0.50	8577293
Nutrients								
Total Ammonia (N)	mg/L	0.19	0.050	0.54	0.050	<0.050	0.050	8576666
Total Nitrogen (N)	mg/L	1.3	0.055	3.6	0.055	<0.055	0.055	8575704
Total Phosphorus (P)	mg/L	0.70 (2)	0.015	1.2 (2)	0.015	<0.0030	0.0030	8577466
Total Total Kjeldahl Nitrogen	mg/L	1.2	0.050	3.4 (2)	0.25	<0.050	0.050	8576361
Dissolved Nitrite (N)	mg/L	N/A	N/A	<0.010	0.010	N/A	N/A	8576185
Dissolved Nitrate (N)	mg/L	N/A	N/A	0.13	0.010	N/A	N/A	8576185
Organic Acids								
Formic Acid	mg/L	<0.50	0.50	N/A	N/A	<0.50	0.50	8575570
Acetic Acid	mg/L	<0.50	0.50	N/A	N/A	<0.50	0.50	8575570
Propionic Acid	mg/L	<0.50	0.50	N/A	N/A	<0.50	0.50	8575570
Butyric Acid	mg/L	<10 (3)	10	N/A	N/A	<10 (3)	10	8575570
Misc. Organics								
Adsorbable Organic Halogen	mg/L	<0.01	0.01	N/A	N/A	0.02	0.01	8576797

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to sample matrix.
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.
(3) Detection limits raised due to matrix interference.

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR8538	QR8539	QR8540	QR8541	QR8542		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00	2017/03/12 12:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**XCG12**	**RDL**	**QC Batch**
Volatiles								
Total Trihalomethanes	ug/L	<1.3	<1.3	<1.3	<1.3	<1.3	1.3	8575705
Bromodichloromethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Bromoform	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Bromomethane	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8575411
Carbon tetrachloride	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Chlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Chlorodibromomethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8575411
Chloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8575411
Chloroform	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Chloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8575411
1,2-dibromoethane	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8575411
1,2-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,3-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,4-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,1-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,2-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,1-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
cis-1,2-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
trans-1,2-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Dichloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8575411
1,2-dichloropropane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
cis-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
trans-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Methyl methacrylate	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Methyl-tert-butylether (MTBE)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Styrene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,1,1,2-tetrachloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8575411
1,1,2,2-tetrachloroethane	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8575411
Tetrachloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,2,3-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8575411
1,2,4-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8575411
1,3,5-trichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
RDL = Reportable Detection Limit								

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR8538	QR8539	QR8540	QR8541	QR8542		
Sampling Date		2017/03/11 15:00	2017/03/11 15:00	2017/03/11 16:00	2017/03/12 10:00	2017/03/12 12:00		
COC Number		C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01	C#512239-02-01		
	UNITS	**XCG 2**	**DUP1**	**XCG14**	**MW-01**	**XCG12**	**RDL**	**QC Batch**
1,1,1-trichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,1,2-trichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Trichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Trichlorofluoromethane	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,2,4-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
1,3,5-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Vinyl chloride	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8575411
Surrogate Recovery (%)								
1,4-Difluorobenzene (sur.)	%	98	99	100	103	101	N/A	8575411
4-Bromofluorobenzene (sur.)	%	102	101	102	103	97	N/A	8575411
D4-1,2-Dichloroethane (sur.)	%	127	103	113	110	109	N/A	8575411

RDL = Reportable Detection Limit
N/A = Not Applicable

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
Volatiles				
Total Trihalomethanes	ug/L	<1.3	1.3	8575705
Bromodichloromethane	ug/L	<0.50	0.50	8575411
Bromoform	ug/L	<0.50	0.50	8575411
Bromomethane	ug/L	<2.0	2.0	8575411
Carbon tetrachloride	ug/L	<0.50	0.50	8575411
Chlorobenzene	ug/L	<0.50	0.50	8575411
Chlorodibromomethane	ug/L	<1.0	1.0	8575411
Chloroethane	ug/L	<1.0	1.0	8575411
Chloroform	ug/L	<0.50	0.50	8575411
Chloromethane	ug/L	<2.0	2.0	8575411
1,2-dibromoethane	ug/L	<0.20	0.20	8575411
1,2-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,3-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,4-dichlorobenzene	ug/L	<0.50	0.50	8575411
1,1-dichloroethane	ug/L	<0.50	0.50	8575411
1,2-dichloroethane	ug/L	<0.50	0.50	8575411
1,1-dichloroethene	ug/L	<0.50	0.50	8575411
cis-1,2-dichloroethene	ug/L	<0.50	0.50	8575411
trans-1,2-dichloroethene	ug/L	<0.50	0.50	8575411
Dichloromethane	ug/L	<2.0	2.0	8575411
1,2-dichloropropane	ug/L	<0.50	0.50	8575411
cis-1,3-dichloropropene	ug/L	<0.50	0.50	8575411
trans-1,3-dichloropropene	ug/L	<0.50	0.50	8575411
Methyl methacrylate	ug/L	<0.50	0.50	8575411
Methyl-tert-butylether (MTBE)	ug/L	<0.50	0.50	8575411
Styrene	ug/L	<0.50	0.50	8575411
1,1,1,2-tetrachloroethane	ug/L	<1.0	1.0	8575411
1,1,2,2-tetrachloroethane	ug/L	<2.0	2.0	8575411
Tetrachloroethene	ug/L	<0.50	0.50	8575411
1,2,3-trichlorobenzene	ug/L	<1.0	1.0	8575411
1,2,4-trichlorobenzene	ug/L	<1.0	1.0	8575411
1,3,5-trichlorobenzene	ug/L	<0.50	0.50	8575411
RDL = Reportable Detection Limit				

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QR8543		
Sampling Date		2017/03/12 16:30		
COC Number		C#512239-02-01		
	UNITS	**FB1**	**RDL**	**QC Batch**
1,1,1-trichloroethane	ug/L	<0.50	0.50	8575411
1,1,2-trichloroethane	ug/L	<0.50	0.50	8575411
Trichloroethene	ug/L	<0.50	0.50	8575411
Trichlorofluoromethane	ug/L	<0.50	0.50	8575411
1,2,4-trimethylbenzene	ug/L	<0.50	0.50	8575411
1,3,5-trimethylbenzene	ug/L	<0.50	0.50	8575411
Vinyl chloride	ug/L	<0.50	0.50	8575411
Surrogate Recovery (%)				
1,4-Difluorobenzene (sur.)	%	100	N/A	8575411
4-Bromofluorobenzene (sur.)	%	100	N/A	8575411
D4-1,2-Dichloroethane (sur.)	%	102	N/A	8575411

RDL = Reportable Detection Limit
N/A = Not Applicable

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Results relate only to the items tested.

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8574703	O-TERPHENYL (sur.)	2017/03/13	95	60 - 130	97	60 - 130	94	%				
8575407	1,4-Difluorobenzene (sur.)	2017/03/13	98	70 - 130	89	70 - 130	86	%				
8575407	4-Bromofluorobenzene (sur.)	2017/03/13	105	70 - 130	109	70 - 130	106	%				
8575407	D4-1,2-Dichloroethane (sur.)	2017/03/13	98	70 - 130	99	70 - 130	105	%				
8575411	1,4-Difluorobenzene (sur.)	2017/03/13	107	70 - 130	100	70 - 130	99	%				
8575411	4-Bromofluorobenzene (sur.)	2017/03/13	119	70 - 130	113	70 - 130	104	%				
8575411	D4-1,2-Dichloroethane (sur.)	2017/03/13	89	70 - 130	102	70 - 130	105	%				
8574703	F2 (C10-C16 Hydrocarbons)	2017/03/13	99	60 - 130	94	70 - 130	<0.10	mg/L	NC	30		
8575407	Benzene	2017/03/13	95	70 - 130	120	70 - 130	<0.40	ug/L	NC	30		
8575407	Ethylbenzene	2017/03/13	98	70 - 130	117	70 - 130	<0.40	ug/L	NC	30		
8575407	F1 (C6-C10) - BTEX	2017/03/13					<100	ug/L	NC	30		
8575407	F1 (C6-C10)	2017/03/13	106	70 - 130	103	70 - 130	<100	ug/L	NC	30		
8575407	m & p-Xylene	2017/03/13	97	70 - 130	117	70 - 130	<0.80	ug/L	NC	30		
8575407	o-Xylene	2017/03/13	99	70 - 130	121	70 - 130	<0.40	ug/L	NC	30		
8575407	Toluene	2017/03/13	95	70 - 130	116	70 - 130	<0.40	ug/L	NC	30		
8575407	Xylenes (Total)	2017/03/13					<0.80	ug/L	NC	30		
8575411	1,1,1,2-tetrachloroethane	2017/03/13	111	70 - 130	97	70 - 130	<1.0	ug/L	NC	40		
8575411	1,1,1-trichloroethane	2017/03/13	107	70 - 130	84	70 - 130	<0.50	ug/L	NC	40		
8575411	1,1,2,2-tetrachloroethane	2017/03/13	115	70 - 130	130	70 - 130	<2.0	ug/L	NC	40		
8575411	1,1,2-trichloroethane	2017/03/13	120	70 - 130	119	70 - 130	<0.50	ug/L	NC	40		
8575411	1,1-dichloroethane	2017/03/13	111	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,1-dichloroethene	2017/03/13	99	70 - 130	77	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2,3-trichlorobenzene	2017/03/13	127	70 - 130	111	70 - 130	<1.0	ug/L	NC	40		
8575411	1,2,4-trichlorobenzene	2017/03/13	121	70 - 130	108	70 - 130	<1.0	ug/L	NC	40		
8575411	1,2,4-trimethylbenzene	2017/03/13	121	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dibromoethane	2017/03/13	113	70 - 130	117	70 - 130	<0.20	ug/L	NC	40		
8575411	1,2-dichlorobenzene	2017/03/13	122	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dichloroethane	2017/03/13	109	70 - 130	110	70 - 130	<0.50	ug/L	NC	40		
8575411	1,2-dichloropropane	2017/03/13	119	70 - 130	113	70 - 130	<0.50	ug/L	NC	40		
8575411	1,3,5-trichlorobenzene	2017/03/13	112	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8575411	1,3,5-trimethylbenzene	2017/03/13	119	70 - 130	94	70 - 130	<0.50	ug/L	NC	40		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8575411	1,3-dichlorobenzene	2017/03/13	113	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	1,4-dichlorobenzene	2017/03/13	115	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromodichloromethane	2017/03/13	116	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromoform	2017/03/13	117	70 - 130	119	70 - 130	<0.50	ug/L	NC	40		
8575411	Bromomethane	2017/03/13	102	70 - 130	87	70 - 130	<2.0	ug/L	NC	40		
8575411	Carbon tetrachloride	2017/03/13	108	70 - 130	79	70 - 130	<0.50	ug/L	NC	40		
8575411	Chlorobenzene	2017/03/13	111	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8575411	Chlorodibromomethane	2017/03/13	119	70 - 130	113	70 - 130	<1.0	ug/L	NC	40		
8575411	Chloroethane	2017/03/13	97	70 - 130	79	70 - 130	<1.0	ug/L	NC	40		
8575411	Chloroform	2017/03/13	110	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8575411	Chloromethane	2017/03/13	122	70 - 130	91	70 - 130	<2.0	ug/L	NC	40		
8575411	cis-1,2-dichloroethene	2017/03/13	109	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8575411	cis-1,3-dichloropropene	2017/03/13	110	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8575411	Dichloromethane	2017/03/13	103	70 - 130	101	70 - 130	<2.0	ug/L	NC	40		
8575411	Methyl methacrylate	2017/03/13	117	70 - 130	129	70 - 130	<0.50	ug/L	NC	40		
8575411	Methyl-tert-butylether (MTBE)	2017/03/13	122	70 - 130	107	70 - 130	<0.50	ug/L	NC	40		
8575411	Styrene	2017/03/13	114	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8575411	Tetrachloroethene	2017/03/13	112	70 - 130	86	70 - 130	<0.50	ug/L	NC	40		
8575411	trans-1,2-dichloroethene	2017/03/13	104	70 - 130	83	70 - 130	<0.50	ug/L	NC	40		
8575411	trans-1,3-dichloropropene	2017/03/13	117	70 - 130	127	70 - 130	<0.50	ug/L	NC	40		
8575411	Trichloroethene	2017/03/13	110	70 - 130	93	70 - 130	<0.50	ug/L	NC	40		
8575411	Trichlorofluoromethane	2017/03/13	101	70 - 130	72	70 - 130	<0.50	ug/L	NC	40		
8575411	Vinyl chloride	2017/03/13	93	70 - 130	69 (1)	70 - 130	<0.50	ug/L	NC	40		
8575570	Acetic Acid	2017/03/13	94	80 - 120	95	80 - 120	<0.50	mg/L	NC	20		
8575570	Butyric Acid	2017/03/13	97	80 - 120	96	80 - 120	<0.50	mg/L	NC	20		
8575570	Formic Acid	2017/03/13	103	80 - 120	88	80 - 120	<0.50	mg/L	NC	20		
8575570	Propionic Acid	2017/03/13	90	80 - 120	106	80 - 120	<0.50	mg/L	NC	20		
8575926	Biochemical Oxygen Demand	2017/03/18			99	85 - 115	<2.0	mg/L	NC	20		
8576185	Dissolved Nitrate (N)	2017/03/14	105	80 - 120	100	80 - 120	<0.010	mg/L	NC	20		
8576185	Dissolved Nitrite (N)	2017/03/14	103	80 - 120	100	80 - 120	<0.010	mg/L	NC	20		
8576330	Alkalinity (PP as CaCO3)	2017/03/14					<0.50	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576330	Alkalinity (Total as CaCO3)	2017/03/14			104	80 - 120	<0.50	mg/L	2.5	20		
8576330	Bicarbonate (HCO3)	2017/03/14					<0.50	mg/L	2.5	20		
8576330	Carbonate (CO3)	2017/03/14					<0.50	mg/L	NC	20		
8576330	Hydroxide (OH)	2017/03/14					<0.50	mg/L	NC	20		
8576331	pH	2017/03/14			100	97 - 103			0.16	N/A		
8576332	Conductivity	2017/03/13			101	90 - 110	<1.0	uS/cm	0.45	10		
8576361	Total Total Kjeldahl Nitrogen	2017/03/15	99	80 - 120	97	80 - 120	<0.050	mg/L	NC	20	94	80 - 120
8576569	Dissolved Aluminum (Al)	2017/03/14	96	80 - 120	96	80 - 120	<0.0030	mg/L	3.7	20		
8576569	Dissolved Antimony (Sb)	2017/03/14	84	80 - 120	89	80 - 120	<0.00060	mg/L	NC	20		
8576569	Dissolved Arsenic (As)	2017/03/14	88	80 - 120	88	80 - 120	<0.00020	mg/L	7.1	20		
8576569	Dissolved Beryllium (Be)	2017/03/14	89	80 - 120	84	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Chromium (Cr)	2017/03/14	88	80 - 120	90	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Cobalt (Co)	2017/03/14	84	80 - 120	86	80 - 120	<0.00030	mg/L	NC	20		
8576569	Dissolved Copper (Cu)	2017/03/14	82	80 - 120	86	80 - 120	<0.00020	mg/L	9.6	20		
8576569	Dissolved Lead (Pb)	2017/03/14	86	80 - 120	86	80 - 120	<0.00020	mg/L	NC	20		
8576569	Dissolved Molybdenum (Mo)	2017/03/14	91	80 - 120	89	80 - 120	<0.00020	mg/L	2.0	20		
8576569	Dissolved Nickel (Ni)	2017/03/14	85	80 - 120	87	80 - 120	<0.00050	mg/L	3.0	20		
8576569	Dissolved Selenium (Se)	2017/03/14	92	80 - 120	94	80 - 120	<0.00020	mg/L	12	20		
8576569	Dissolved Silver (Ag)	2017/03/14	85	80 - 120	73 (1)	80 - 120	<0.00010	mg/L	NC	20		
8576569	Dissolved Thallium (Tl)	2017/03/14	88	80 - 120	86	80 - 120	<0.00020	mg/L	NC	20		
8576569	Dissolved Tin (Sn)	2017/03/14	89	80 - 120	92	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Titanium (Ti)	2017/03/14	88	80 - 120	91	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Uranium (U)	2017/03/14	89	80 - 120	86	80 - 120	<0.00010	mg/L	2.2	20		
8576569	Dissolved Vanadium (V)	2017/03/14	90	80 - 120	91	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Zinc (Zn)	2017/03/14	77 (1)	80 - 120	87	80 - 120	<0.0030	mg/L	18	20		
8576666	Total Ammonia (N)	2017/03/14	86	80 - 120	100	80 - 120	<0.050	mg/L	NC	20		
8576678	Dissolved Chloride (Cl)	2017/03/14	NC	80 - 120	104	80 - 120	<1.0	mg/L	0.72	20		
8576679	Dissolved Sulphate (SO4)	2017/03/14	NC	80 - 120	103	80 - 120	<1.0	mg/L	0.64	20		
8576797	Adsorbable Organic Halogen	2017/03/14					<0.5	mg/L			104	84 - 111
8576914	Total Aluminum (Al)	2017/03/14	88	80 - 120	84	80 - 120	<0.0030	mg/L	1.0	20		
8576914	Total Antimony (Sb)	2017/03/14	90	80 - 120	89	80 - 120	<0.00060	mg/L	NC	20		

Maxxam Job #: B718037
Report Date: 2017/03/21

QUALITY ASSURANCE REPORT(CONT'D)

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576914	Total Arsenic (As)	2017/03/14	90	80 - 120	90	80 - 120	<0.00020	mg/L	19	20		
8576914	Total Beryllium (Be)	2017/03/14	97	80 - 120	89	80 - 120	<0.0010	mg/L	NC	20		
8576914	Total Chromium (Cr)	2017/03/14	88	80 - 120	89	80 - 120	<0.0010	mg/L	NC	20		
8576914	Total Cobalt (Co)	2017/03/14	86	80 - 120	88	80 - 120	<0.00030	mg/L	NC	20		
8576914	Total Copper (Cu)	2017/03/14	80	80 - 120	87	80 - 120	<0.00020	mg/L				
8576914	Total Lead (Pb)	2017/03/14	85	80 - 120	88	80 - 120	<0.00020	mg/L	NC	20		
8576914	Total Molybdenum (Mo)	2017/03/14	95	80 - 120	91	80 - 120	<0.00020	mg/L	NC	20		
8576914	Total Nickel (Ni)	2017/03/14	86	80 - 120	89	80 - 120	<0.00050	mg/L	15	20		
8576914	Total Selenium (Se)	2017/03/14	43 (1)	80 - 120	92	80 - 120	<0.00020	mg/L				
8576914	Total Silver (Ag)	2017/03/14	90	80 - 120	90	80 - 120	<0.00010	mg/L	NC	20		
8576914	Total Thallium (Tl)	2017/03/14	86	80 - 120	89	80 - 120	<0.00020	mg/L	NC	20		
8576914	Total Tin (Sn)	2017/03/14	95	80 - 120	91	80 - 120	<0.0010	mg/L	16	20		
8576914	Total Titanium (Ti)	2017/03/14	88	80 - 120	90	80 - 120	<0.0010	mg/L	4.0	20		
8576914	Total Uranium (U)	2017/03/14	85	80 - 120	84	80 - 120	<0.00010	mg/L	6.8	20		
8576914	Total Vanadium (V)	2017/03/14	91	80 - 120	91	80 - 120	<0.0010	mg/L	NC	20		
8576914	Total Zinc (Zn)	2017/03/14	84	80 - 120	87	80 - 120	<0.0030	mg/L	2.0	20		
8576915	Total Barium (Ba)	2017/03/14	86	80 - 120	92	80 - 120	<0.010	mg/L	2.6	20		
8576915	Total Boron (B)	2017/03/14	90	80 - 120	91	80 - 120	<0.020	mg/L	3.3	20		
8576915	Total Calcium (Ca)	2017/03/14	NC	80 - 120	97	80 - 120	<0.30	mg/L	3.3	20		
8576915	Total Iron (Fe)	2017/03/14	NC	80 - 120	103	80 - 120	<0.060	mg/L	1.1	20		
8576915	Total Lithium (Li)	2017/03/14	91	80 - 120	91	80 - 120	<0.020	mg/L	3.2	20		
8576915	Total Magnesium (Mg)	2017/03/14	NC	80 - 120	93	80 - 120	<0.20	mg/L	3.2	20		
8576915	Total Manganese (Mn)	2017/03/14	87	80 - 120	94	80 - 120	<0.0040	mg/L	3.0	20		
8576915	Total Phosphorus (P)	2017/03/14	90	80 - 120	92	80 - 120	<0.10	mg/L	8.5	20		
8576915	Total Potassium (K)	2017/03/14	96	80 - 120	91	80 - 120	<0.30	mg/L	3.3	20		
8576915	Total Silicon (Si)	2017/03/14	95	80 - 120	95	80 - 120	<0.10	mg/L	3.4	20		
8576915	Total Sodium (Na)	2017/03/14	NC	80 - 120	94	80 - 120	<0.50	mg/L	3.2	20		
8576915	Total Strontium (Sr)	2017/03/14	NC	80 - 120	94	80 - 120	<0.020	mg/L	3.0	20		
8576915	Total Sulphur (S)	2017/03/14					<0.20	mg/L	2.5	20		
8576973	Dissolved Barium (Ba)	2017/03/14	92	80 - 120	90	80 - 120	<0.010	mg/L				
8576973	Dissolved Boron (B)	2017/03/14	94	80 - 120	92	80 - 120	<0.020	mg/L				

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576973	Dissolved Calcium (Ca)	2017/03/14	95	80 - 120	95	80 - 120	<0.30	mg/L	NC	20		
8576973	Dissolved Iron (Fe)	2017/03/14	96	80 - 120	95	80 - 120	<0.060	mg/L	NC	20		
8576973	Dissolved Lithium (Li)	2017/03/14	92	80 - 120	92	80 - 120	<0.020	mg/L				
8576973	Dissolved Magnesium (Mg)	2017/03/14	94	80 - 120	94	80 - 120	<0.20	mg/L	NC	20		
8576973	Dissolved Manganese (Mn)	2017/03/14	95	80 - 120	96	80 - 120	<0.0040	mg/L	NC	20		
8576973	Dissolved Phosphorus (P)	2017/03/14	97	80 - 120	94	80 - 120	<0.10	mg/L				
8576973	Dissolved Potassium (K)	2017/03/14	95	80 - 120	93	80 - 120	<0.30	mg/L	NC	20		
8576973	Dissolved Silicon (Si)	2017/03/14	80	80 - 120	84	80 - 120	<0.10	mg/L				
8576973	Dissolved Sodium (Na)	2017/03/14	93	80 - 120	91	80 - 120	<0.50	mg/L	NC	20		
8576973	Dissolved Strontium (Sr)	2017/03/14	90	80 - 120	91	80 - 120	<0.020	mg/L				
8576973	Dissolved Sulphur (S)	2017/03/14					<0.20	mg/L				
8577293	Total Organic Carbon (C)	2017/03/15	119	80 - 120	109	80 - 120	<0.50	mg/L	6.6	20		
8577466	Total Phosphorus (P)	2017/03/15	93	80 - 120	90	80 - 120	<0.0030	mg/L	NC	20	88	80 - 120
8577602	Total Chemical Oxygen Demand	2017/03/15	100	80 - 120	99	80 - 120	<5.0	mg/L	2.7	20		
8578994	Dissolved Chloride (Cl)	2017/03/16	105	80 - 120	108	80 - 120	<1.0	mg/L	NC	20		
8579000	Dissolved Sulphate (SO4)	2017/03/16	105	80 - 120	109	80 - 120	<1.0	mg/L	NC	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Dennis Ngondu, B.Sc., P.Chem., QP, Supervisor, Organics

Gayle Simpson, Analyst II

Junzhi Gao

Janet Gao, B.Sc., QP, Supervisor, Organics

Peng Liang

Harry (Peng) Liang, Senior Analyst

Veronica Falk

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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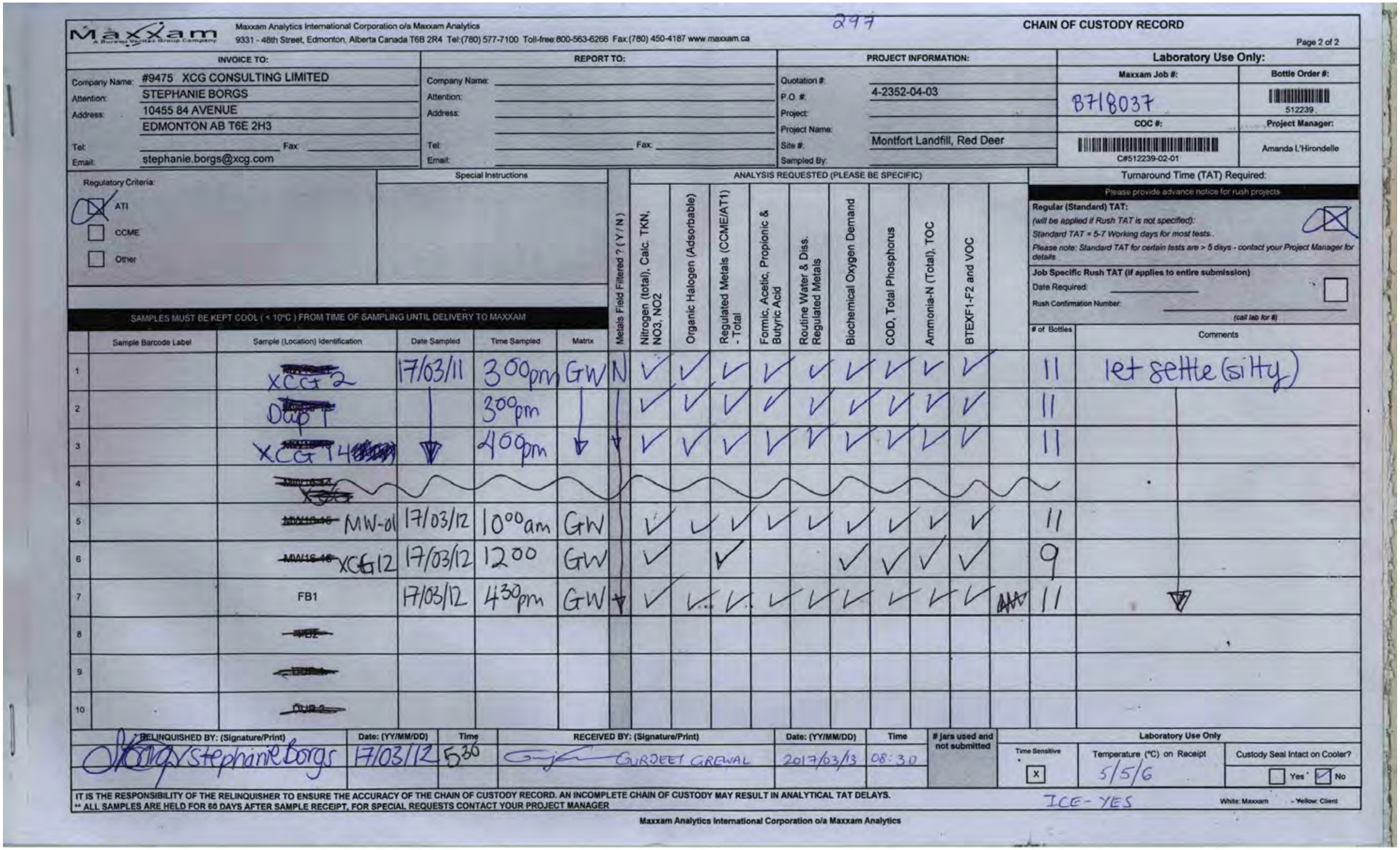
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



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CHAIN OF CUSTODY RECORD

Page 2 of 2

INVOICE TO:

Company Name: #9475 XCG CONSULTING LIMITED
Attention: STEPHANIE BORGS
Address: 10455 84 AVENUE
EDMONTON AB T6E 2H3
Tel: Fax:
Email: stephanie.borgs@xcg.com

REPORT TO:

Company Name:
Attention:
Address:
Tel: Fax:
Email:

PROJECT INFORMATION:

Quotation #:
P.O. #: 4-2352-04-03
Project:
Project Name:
Site #: Montfort Landfill, Red Deer
Sampled By:

Laboratory Use Only:

Maxxam Job #:	Bottle Order #:
B718037	512239
COC #:	Project Manager:
C#512239-02-01	Amanda L'Hirondelle

Regulatory Criteria:
☒ ATI
☐ CCME
☐ Other

Special Instructions

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: (call lab for #)

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Nitrogen (total), Calc. TKN, NO3, NO2	Organic Halogen (Adsorbable)	Regulated Metals (CCME/AT1) - Total	Formic, Acetic, Propionic & Butyric Acid	Routine Water & Diss. Regulated Metals	Biochemical Oxygen Demand	COD, Total Phosphorus	Ammonia-N (Total), TOC	BTEXF1-F2 and VOC		# of Bottles	Comments
1		~~[illegible]~~ XCG 2	17/03/11	300pm	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	let settle (silty)
2		~~[illegible]~~ Dup 1	↓	300pm	↓	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	↓
3		~~[illegible]~~ XCG 14	↓	400pm	↓	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	↓
4		~~[illegible]~~				↓												↓
5		~~[illegible]~~ MW-01	17/03/12	1000am	GW	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	↓
6		~~MW16-18~~ XCG12	17/03/12	1200	GW	↓	✓		✓			✓	✓	✓	✓		9	↓
7		FB1	17/03/12	430pm	GW	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓	[illegible]	11	↓
8		~~[illegible]~~																
9		~~[illegible]~~																
10		~~DUP 2~~																

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Stephanie Borgs	17/03/12	530	GURJEET GREWAL	2017/03/13	08:30	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
☒	5/5/6	☐ Yes ☑ No

ICE - YES

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam - Yellow: Client

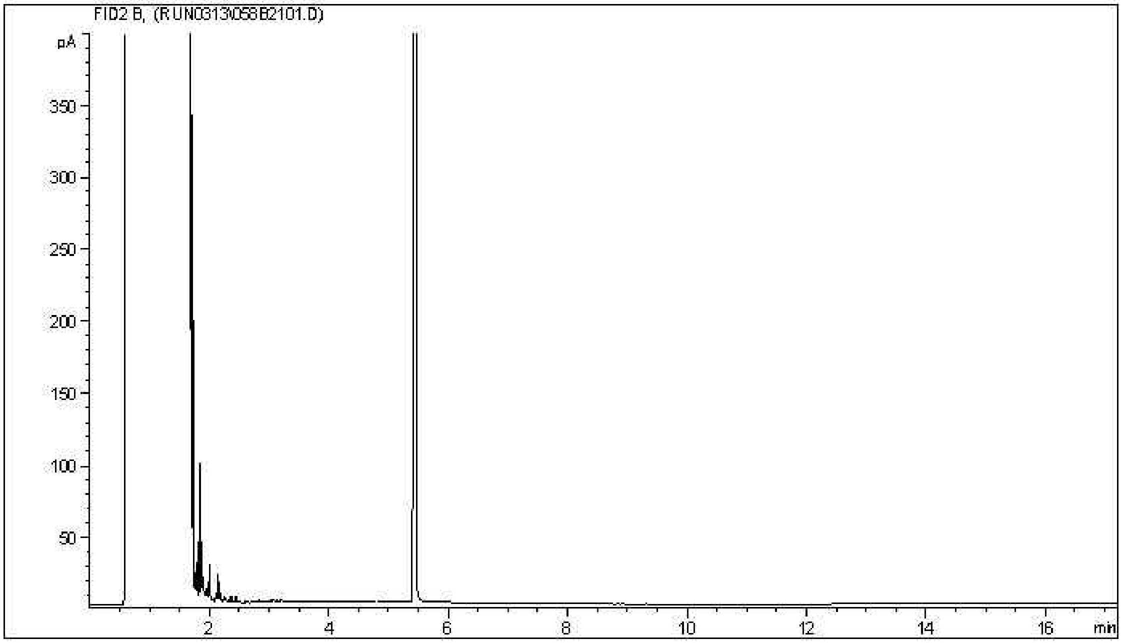
Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam Job #: B718037
Report Date: 2017/03/21
Maxxam Sample: QR8538

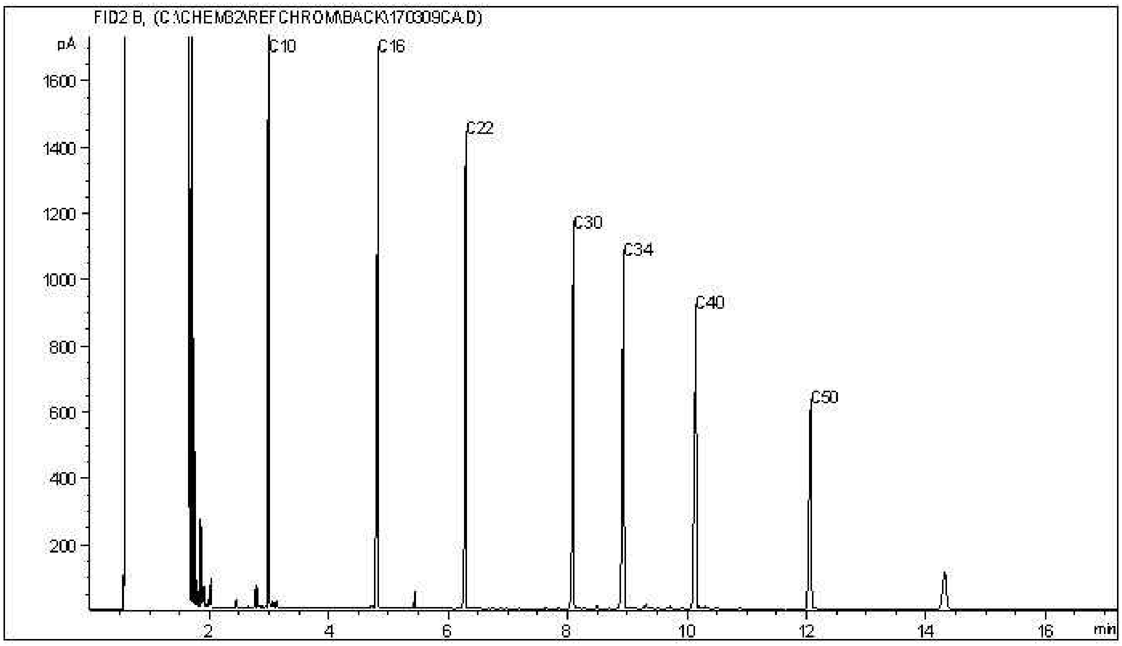
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: XCG 2

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

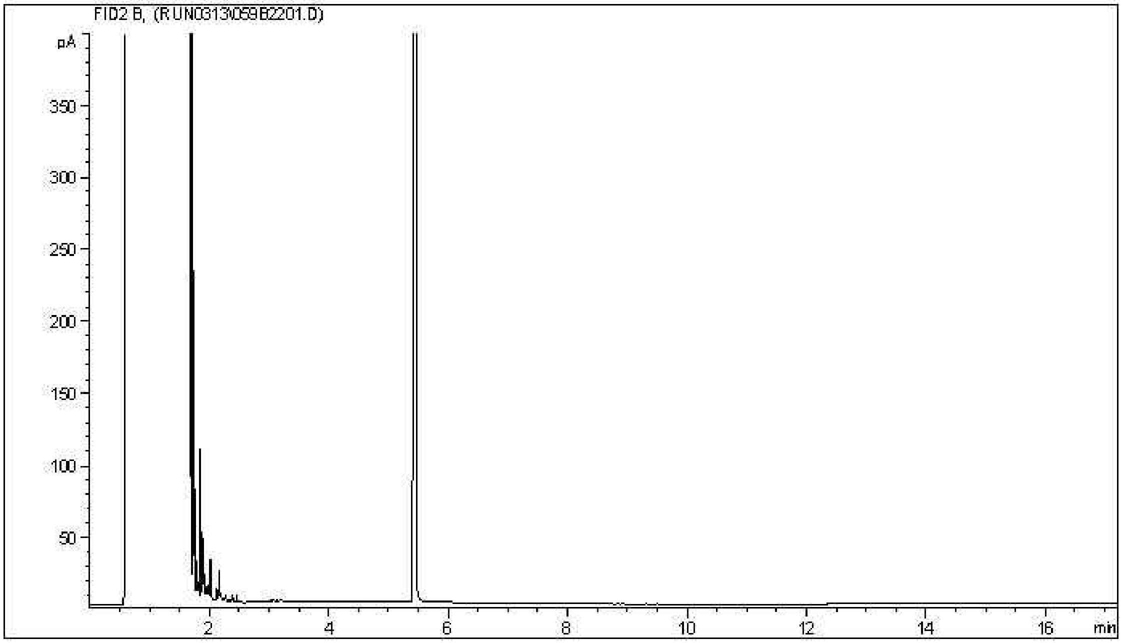
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718037
Report Date: 2017/03/21
Maxxam Sample: QR8539

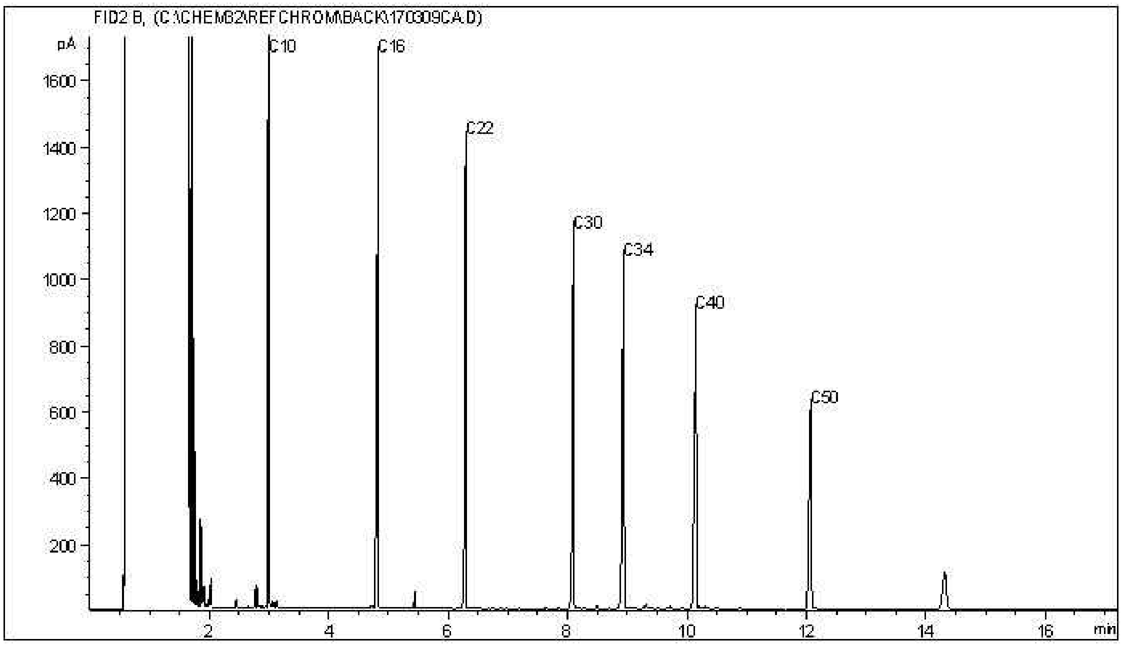
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: DUP1

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



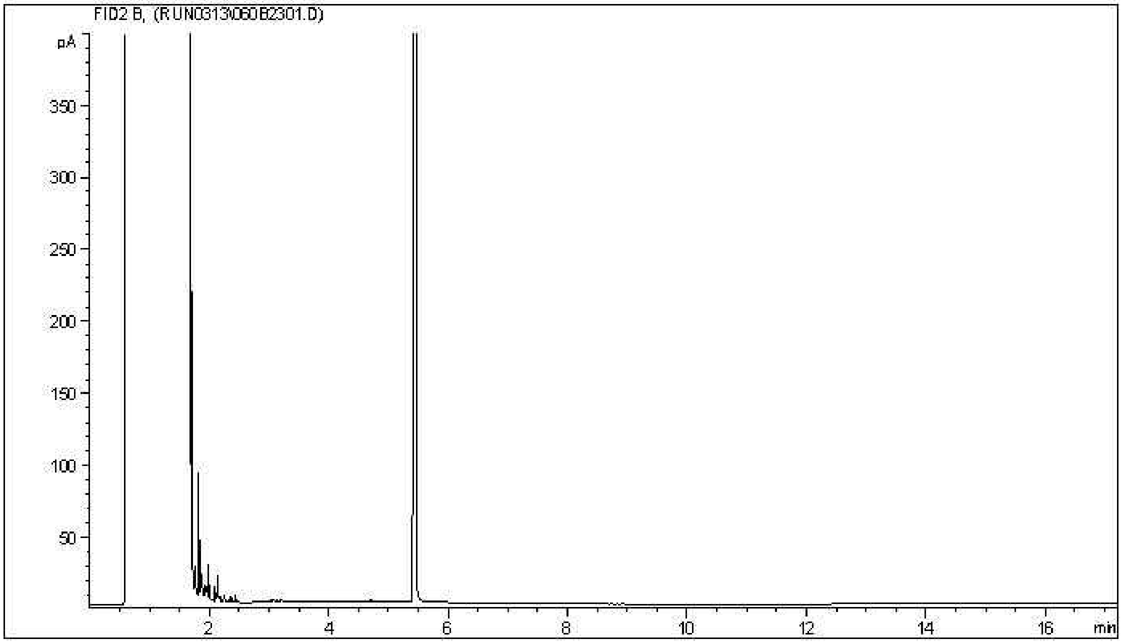
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

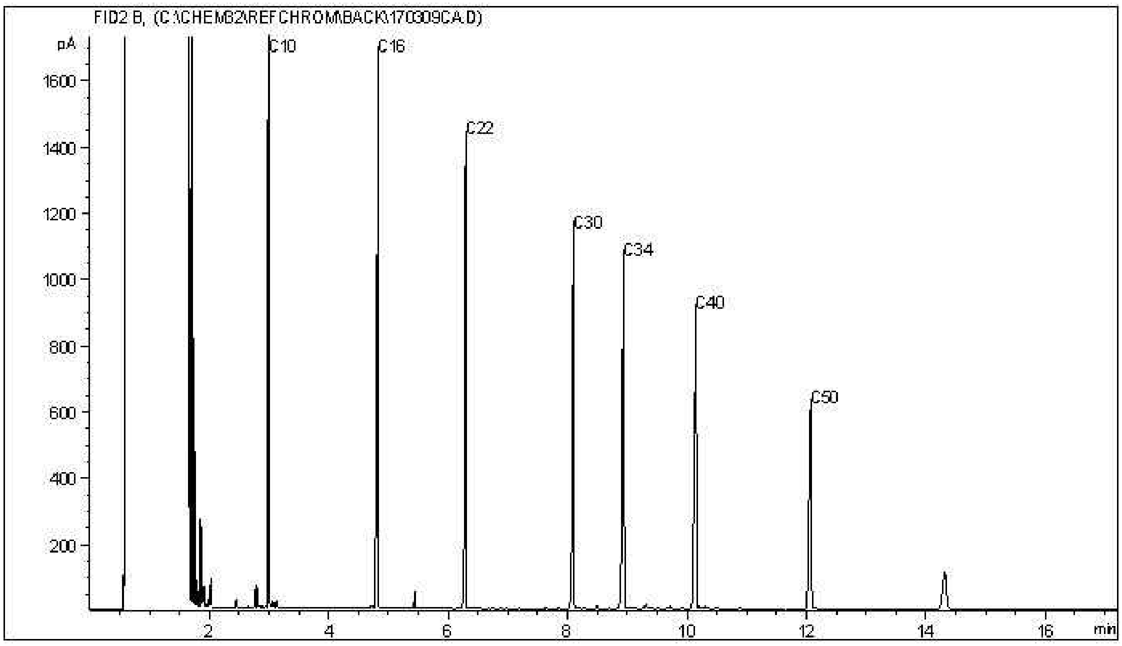
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



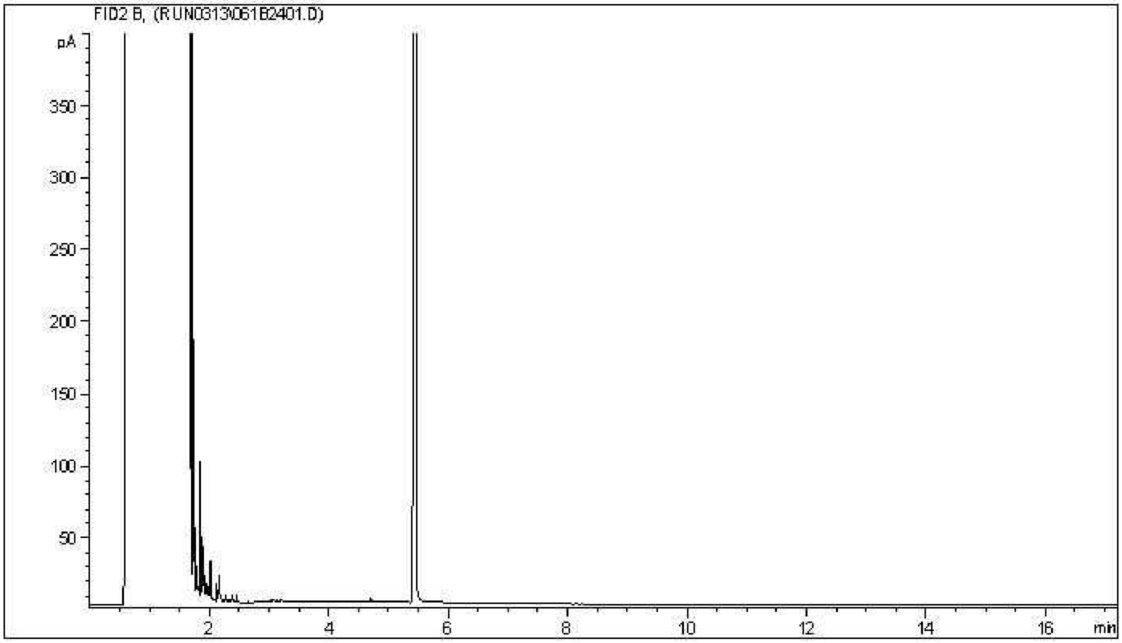
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

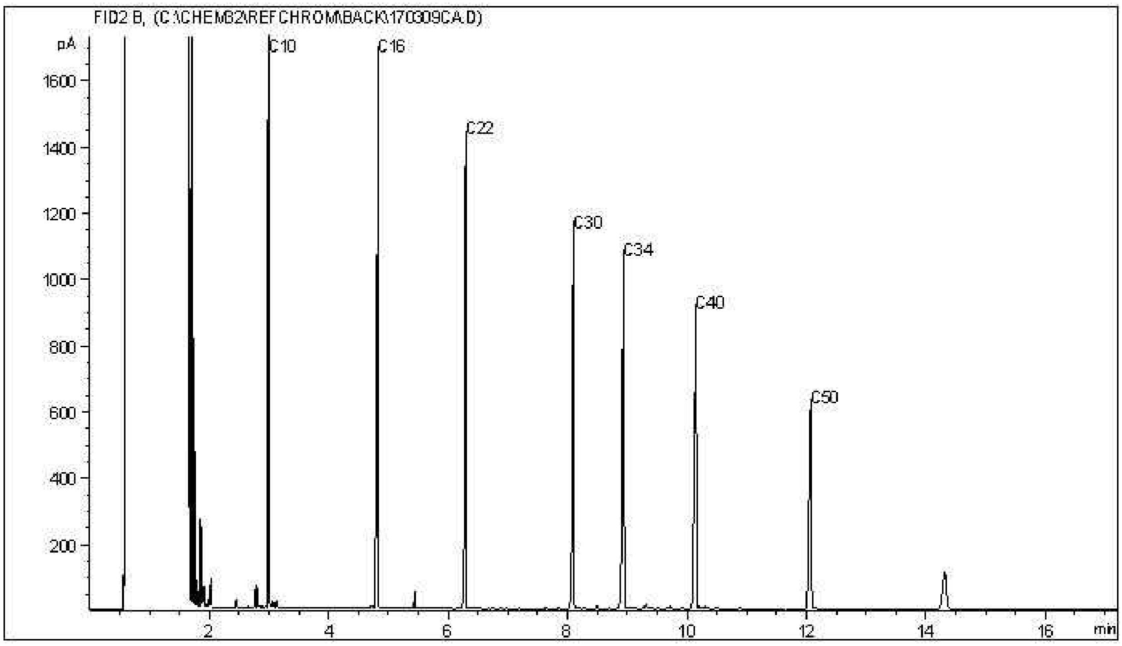
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	-	C12	Diesel:	C8	-	C22
Varsol:	C8	-	C12	Lubricating Oils:	C20	-	C40
Kerosene:	C7	-	C16	Crude Oils:	C3	-	C60+

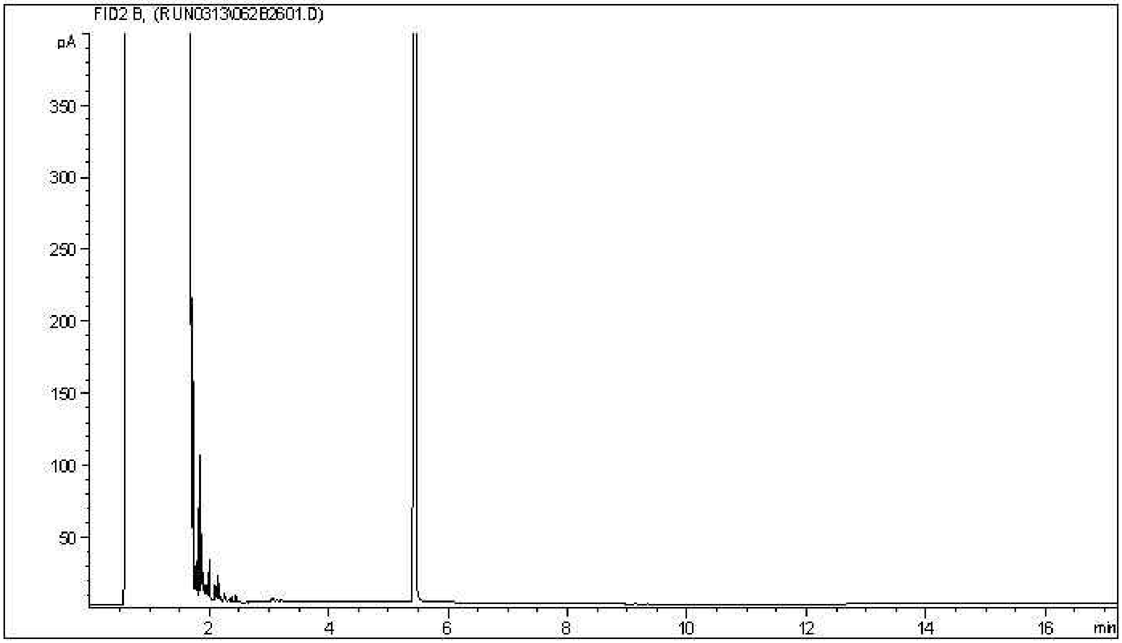
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718037
Report Date: 2017/03/21
Maxxam Sample: QR8542

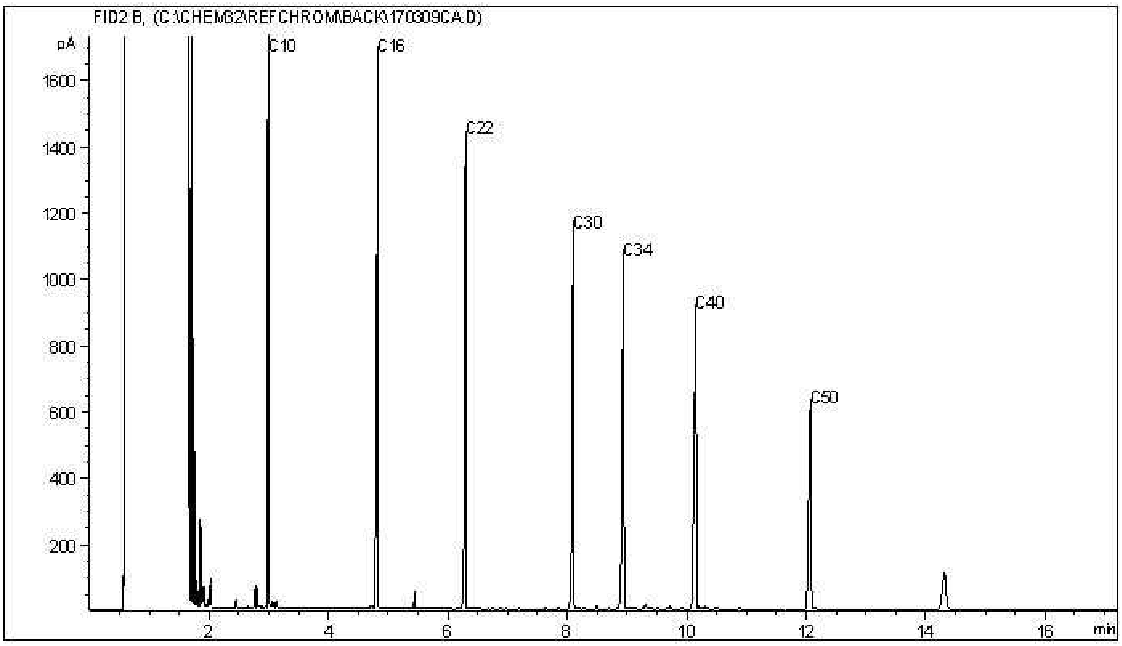
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: XCG12

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

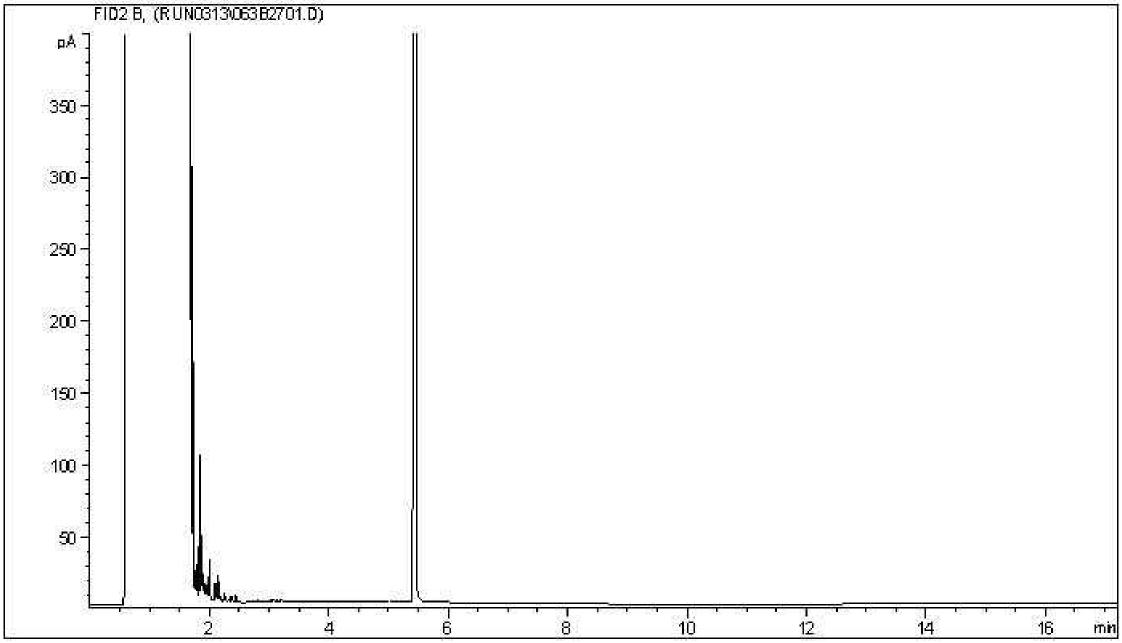
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718037
Report Date: 2017/03/21
Maxxam Sample: QR8543

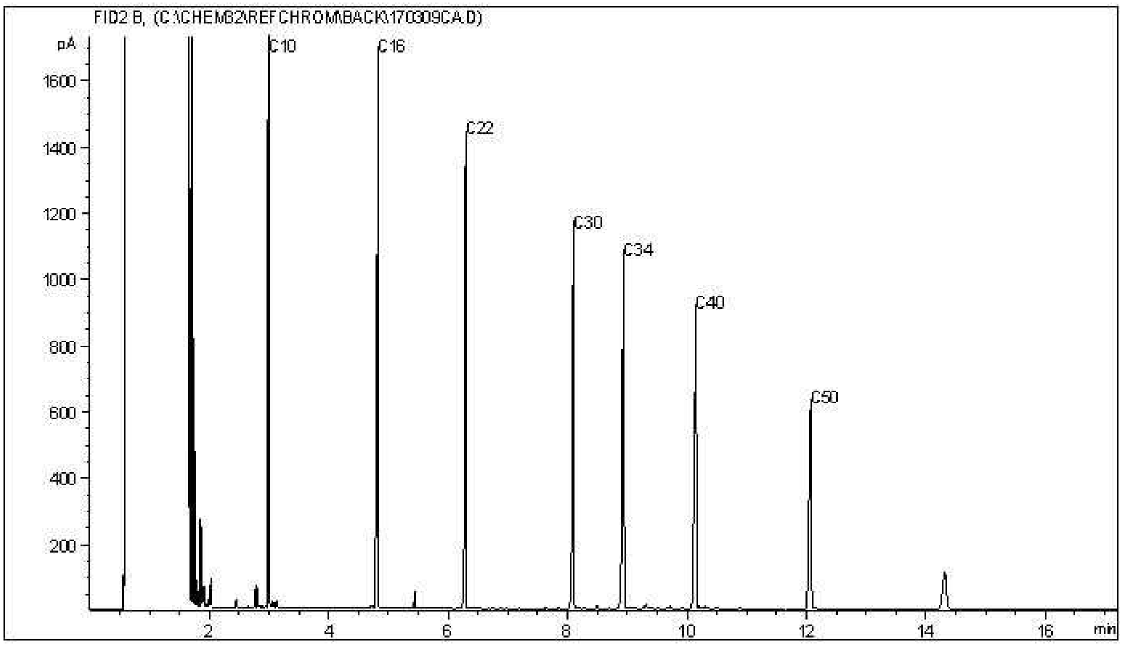
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: FB1

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC7



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-04-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359559
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718379
Received: 2017/03/14, 08:25

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Formic, Acetic, Propionic & Butyric Acid	4	N/A	2017/03/15	CAL SOP-00063	Dionex #031181 R07 m
Alkalinity @25C (pp, total), CO3,HCO3,OH	4	N/A	2017/03/14	AB SOP-00005	SM 22 2320 B m
Organic Halogen (Adsorbable) (1)	5	2017/03/16	2017/03/16	PTC SOP-00056	Coulometric - Titr.
Biochemical Oxygen Demand	4	2017/03/14	2017/03/19	AB SOP-00017	SM 22 5210B m
BTEX/F1 in Water by HS GC/MS/FID	4	N/A	2017/03/15	AB SOP-00039	CCME CWS/EPA 8260c m
Cadmium - low level CCME - Dissolved	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry	4	N/A	2017/03/16	AB SOP-00020	SM 22-4500-Cl G m
Chemical Oxygen Demand	4	N/A	2017/03/15	AB SOP-00016	SM 22 5220D m
Conductivity @25C	4	N/A	2017/03/14	AB SOP-00005	SM 22 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (2)	4	2017/03/15	2017/03/15	AB SOP-00040 AB SOP-00037	CCME PHC-CWS m
Hardness	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Elements by ICP-Dissolved-Lab Filtered (3)	4	N/A	2017/03/14	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total	3	2017/03/14	2017/03/15	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total	1	2017/03/14	2017/03/16	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICPMS-Dissolved-Lab Filtered (3)	4	N/A	2017/03/14	AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	3	2017/03/14	2017/03/14	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	1	2017/03/14	2017/03/15	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Ion Balance (as % Difference)	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Sum of cations, anions	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Ammonia-N (Total)	4	N/A	2017/03/15	AB SOP-00007	EPA 350.1 R2.0 m
Nitrate and Nitrite	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	4	N/A	2017/03/15	AB WI-00065	Auto Calc
Nitrogen, (Nitrite, Nitrate) by IC (4)	3	N/A	2017/03/14	AB SOP-00023	SM 22 4110 B m
Nitrogen, (Nitrite, Nitrate) by IC (4)	1	N/A	2017/03/15	AB SOP-00023	SM 22 4110 B m

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-04-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359559
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718379
Received: 2017/03/14, 08:25

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
pH @25°C (5)	4	N/A	2017/03/14	AB SOP-00005	SM 22 4500-H+B m
Sulphate by Automated Colourimetry	4	N/A	2017/03/16	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Calculated)	4	N/A	2017/03/16	AB WI-00065	Auto Calc
Total Trihalomethanes Calculation	4	N/A	2017/03/20	CAL SOP-00104	Auto Calc
Total Kjeldahl Nitrogen	4	2017/03/15	2017/03/15	AB SOP-00008	EPA 351.1 R1978 m
Carbon (Total Organic) (6)	4	N/A	2017/03/17	CAL SOP-00077	MMCW 119 1996 m
Total Phosphorus	4	2017/03/17	2017/03/17	AB SOP-00024	SM 22 4500-P A,B,F m
VOCs in Water by HS GC/MS (Std List)	4	N/A	2017/03/15	AB SOP-00056	EPA 5021a/8260c m

Remarks:

Maxxam Analytics’ laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam’s profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics’ liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-04-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359559
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718379
Received: 2017/03/14, 08:25

(1) This test was performed by Maxxam Edmonton Petroleum
(2) Silica gel clean up employed.
(3) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(4) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(5) The APHA Standard Method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(6) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Robin Weaver, Environmental Project Manager
Email: RWeaver@maxxam.ca
Phone# (403)735-2258
==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

AT1 BTEX AND F1-F2 IN WATER (WATER)

Maxxam ID		QS0276	QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30	2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01	512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon							
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	8576963
Volatiles							
Benzene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	8576841
Toluene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	8576841
Ethylbenzene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	8576841
m & p-Xylene	ug/L	<0.80	<0.80	<0.80	<0.80	0.80	8576841
o-Xylene	ug/L	<0.40	<0.40	<0.40	<0.40	0.40	8576841
Xylenes (Total)	ug/L	<0.80	<0.80	<0.80	<0.80	0.80	8576841
F1 (C6-C10) - BTEX	ug/L	<100	<100	<100	<100	100	8576841
F1 (C6-C10)	ug/L	<100	<100	<100	<100	100	8576841
Surrogate Recovery (%)							
1,4-Difluorobenzene (sur.)	%	95	102	96	99	N/A	8576841
4-Bromofluorobenzene (sur.)	%	95	102	94	98	N/A	8576841
D4-1,2-Dichloroethane (sur.)	%	97	101	98	99	N/A	8576841
O-TERPHENYL (sur.)	%	94	96	94	94	N/A	8576963

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS0276		QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30		2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01		512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**RDL**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Calculated Parameters								
Anion Sum	meq/L	18	N/A	8.1	20	13	N/A	8576594
Cation Sum	meq/L	18	N/A	8.0	20	13	N/A	8576594
Hardness (CaCO3)	mg/L	870	0.50	390	920	520	0.50	8576540
Ion Balance (% Difference)	N/A	0.89	0.010	0.31	0.29	1.3	0.010	8576541
Dissolved Nitrate (NO3)	mg/L	250	0.44	2.7	1.7	6.2	0.044	8576595
Nitrate plus Nitrite (N)	mg/L	56	0.10	0.61	0.38	1.4	0.010	8576596
Dissolved Nitrite (NO2)	mg/L	0.20	0.033	<0.033	<0.033	<0.033	0.033	8576595
Calculated Total Dissolved Solids	mg/L	1000	10	380	990	660	10	8576544
Misc. Inorganics								
Conductivity	uS/cm	1700	1.0	700	1800	1200	1.0	8577331
pH	pH	7.32	N/A	7.76	7.31	7.57	N/A	8577330
Low Level Elements								
Dissolved Cadmium (Cd)	ug/L	0.060	0.020	0.042	0.044	0.044	0.020	8576825
Anions								
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	<0.50	<0.50	<0.50	0.50	8577329
Alkalinity (Total as CaCO3)	mg/L	600	0.50	390	960	360	0.50	8577329
Bicarbonate (HCO3)	mg/L	730	0.50	470	1200	430	0.50	8577329
Carbonate (CO3)	mg/L	<0.50	0.50	<0.50	<0.50	<0.50	0.50	8577329
Hydroxide (OH)	mg/L	<0.50	0.50	<0.50	<0.50	<0.50	0.50	8577329
Dissolved Sulphate (SO4)	mg/L	82	1.0	10	36	53	1.0	8579016
Dissolved Chloride (Cl)	mg/L	11	1.0	2.0	13	160	1.0	8579012
Nutrients								
Dissolved Nitrite (N)	mg/L	0.060	0.010	<0.010	<0.010	<0.010	0.010	8577301
Dissolved Nitrate (N)	mg/L	56 (1)	0.10	0.61	0.38	1.4	0.010	8577301
Lab Filtered Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0030	<0.0030	<0.0030	<0.0030	0.0030	8576569
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	0.00075	<0.00060	<0.00060	0.00060	8576569
Dissolved Arsenic (As)	mg/L	0.00046	0.00020	0.00033	0.00041	<0.00020	0.00020	8576569
Dissolved Barium (Ba)	mg/L	0.46	0.010	0.22	0.89	0.64	0.010	8577123
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569

RDL = Reportable Detection Limit

N/A = Not Applicable

(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS0276		QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30		2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01		512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**RDL**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Dissolved Boron (B)	mg/L	0.049	0.020	0.024	0.17	0.025	0.020	8577123
Dissolved Calcium (Ca)	mg/L	250	0.30	86	220	130	0.30	8577123
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	0.0014	<0.0010	<0.0010	0.0010	8576569
Dissolved Cobalt (Co)	mg/L	0.00050	0.00030	<0.00030	0.0016	0.0011	0.00030	8576569
Dissolved Copper (Cu)	mg/L	0.0022	0.00020	0.00071	0.0013	0.0010	0.00020	8576569
Dissolved Iron (Fe)	mg/L	0.086	0.060	<0.060	0.13	0.065	0.060	8577123
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	<0.00020	<0.00020	<0.00020	0.00020	8576569
Dissolved Lithium (Li)	mg/L	<0.020	0.020	<0.020	0.064	0.022	0.020	8577123
Dissolved Magnesium (Mg)	mg/L	62	0.20	42	88	51	0.20	8577123
Dissolved Manganese (Mn)	mg/L	0.15	0.0040	<0.0040	0.49	<0.0040	0.0040	8577123
Dissolved Molybdenum (Mo)	mg/L	0.00044	0.00020	0.00088	0.00069	0.00040	0.00020	8576569
Dissolved Nickel (Ni)	mg/L	0.0049	0.00050	0.0012	0.0072	0.0029	0.00050	8576569
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	<0.10	<0.10	<0.10	0.10	8577123
Dissolved Potassium (K)	mg/L	6.5	0.30	2.0	6.3	2.5	0.30	8577123
Dissolved Selenium (Se)	mg/L	0.00034	0.00020	0.00021	<0.00020	<0.00020	0.00020	8576569
Dissolved Silicon (Si)	mg/L	8.1	0.10	11	7.8	7.7	0.10	8577123
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	0.00010	8576569
Dissolved Sodium (Na)	mg/L	17	0.50	4.8	39	48	0.50	8577123
Dissolved Strontium (Sr)	mg/L	0.65	0.020	0.28	1.3	0.41	0.020	8577123
Dissolved Sulphur (S)	mg/L	21	0.20	2.8	9.0	15	0.20	8577123
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	<0.00020	<0.00020	<0.00020	0.00020	8576569
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Uranium (U)	mg/L	0.0025	0.00010	0.0016	0.0095	0.0026	0.00010	8576569
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	0.0010	8576569
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	<0.0030	<0.0030	<0.0030	0.0030	8576569
RDL = Reportable Detection Limit								

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QS0276		QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30		2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01		512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**QC Batch**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Low Level Elements								
Total Cadmium (Cd)	ug/L	0.19	8576593	0.12	0.089	0.34	0.020	8576593
Elements								
Total Aluminum (Al)	mg/L	0.067	8577689	0.087	0.53	0.18	0.0030	8576918
Total Antimony (Sb)	mg/L	<0.00060	8577689	0.00082	<0.00060	<0.00060	0.00060	8576918
Total Arsenic (As)	mg/L	0.00047	8577689	0.00057	0.00094	0.00036	0.00020	8576918
Total Barium (Ba)	mg/L	0.47	8577706	0.23	0.91	0.68 (1)	0.010	8576919
Total Beryllium (Be)	mg/L	<0.0010	8577689	<0.0010	<0.0010	<0.0010	0.0010	8576918
Total Boron (B)	mg/L	0.057	8577706	0.029	0.20	0.030	0.020	8576919
Total Calcium (Ca)	mg/L	260	8577706	88	240	130	0.30	8576919
Total Chromium (Cr)	mg/L	<0.0010	8577689	<0.0010	0.0018	<0.0010	0.0010	8576918
Total Cobalt (Co)	mg/L	0.00060	8577689	<0.00030	0.0019	0.0015	0.00030	8576918
Total Copper (Cu)	mg/L	0.0023	8577689	0.0012	0.0025	0.0018	0.00020	8576918
Total Iron (Fe)	mg/L	0.26	8577706	0.30	1.2	0.46 (1)	0.060	8576919
Total Lead (Pb)	mg/L	<0.00020	8577689	<0.00020	0.00082	0.00023	0.00020	8576918
Total Lithium (Li)	mg/L	<0.020	8577706	<0.020	0.072	0.025	0.020	8576919
Total Magnesium (Mg)	mg/L	66	8577706	43	97	54	0.20	8576919
Total Manganese (Mn)	mg/L	0.19	8577706	0.0054	0.55	0.0061	0.0040	8576919
Total Molybdenum (Mo)	mg/L	0.00053	8577689	0.00088	0.00087	0.00049	0.00020	8576918
Total Nickel (Ni)	mg/L	0.0054	8577689	0.0015	0.0088	0.0046	0.00050	8576918
Total Phosphorus (P)	mg/L	<0.10	8577706	<0.10	<0.10	<0.10 (1)	0.10	8576919
Total Potassium (K)	mg/L	7.1	8577706	2.1	7.3	2.7 (1)	0.30	8576919
Total Selenium (Se)	mg/L	0.00037	8577689	0.00023	0.00021	<0.00020	0.00020	8576918
Total Silicon (Si)	mg/L	9.2	8577706	12	11	8.8 (1)	0.10	8576919
Total Silver (Ag)	mg/L	<0.00010	8577689	<0.00010	<0.00010	<0.00010	0.00010	8576918
Total Sodium (Na)	mg/L	19	8577706	4.6	42	51	0.50	8576919
Total Strontium (Sr)	mg/L	0.65	8577706	0.28	1.3	0.44 (1)	0.020	8576919
Total Sulphur (S)	mg/L	27	8577706	3.0	11	17	0.20	8576919
Total Thallium (Tl)	mg/L	<0.00020	8577689	<0.00020	<0.00020	<0.00020	0.00020	8576918
Total Tin (Sn)	mg/L	<0.0010	8577689	0.0010	<0.0010	<0.0010	0.0010	8576918
Total Titanium (Ti)	mg/L	0.0046	8577689	0.0022	0.016	0.0069	0.0010	8576918
Total Uranium (U)	mg/L	0.0025	8577689	0.0016	0.0091	0.0031	0.00010	8576918

RDL = Reportable Detection Limit

(1) Matrix Spike exceeds acceptance limits due to matrix interference. Reanalysis yields similar results.

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QS0276		QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30		2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01		512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**QC Batch**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Total Vanadium (V)	mg/L	<0.0010	8577689	<0.0010	0.0022	<0.0010	0.0010	8576918
Total Zinc (Zn)	mg/L	<0.0030	8577689	0.0053	0.0074	0.011	0.0030	8576918

RDL = Reportable Detection Limit

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QS0276	QS0277	QS0278	QS0279	QS0280		
Sampling Date		2017/03/13 11:30	2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00	2017/03/13 09:30		
COC Number		512239-04-01	512239-04-01	512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**XCG 5**	**MW-03**	**MW-02**	**XCG 12**	**RDL**	**QC Batch**
Demand Parameters								
Biochemical Oxygen Demand	mg/L	<2.0	<2.0	<2.0	<2.0	N/A	2.0	8576821
Total Chemical Oxygen Demand	mg/L	20	<5.0	15	<5.0	N/A	5.0	8577602
Misc. Inorganics								
Total Organic Carbon (C)	mg/L	12	3.7	8.8	4.3	N/A	0.50	8580072
Nutrients								
Total Ammonia (N)	mg/L	0.093	<0.050	0.13	<0.050	N/A	0.050	8577626
Total Nitrogen (N)	mg/L	57	0.82	1.0	1.8	N/A	0.055	8576542
Total Phosphorus (P)	mg/L	0.0046	0.0085	0.0097	0.0061	N/A	0.0030	8579832
Total Total Kjeldahl Nitrogen	mg/L	1.0	0.21	0.63	0.34	N/A	0.050	8577375
Organic Acids								
Formic Acid	mg/L	<0.50	<0.50	<0.50	<0.50	N/A	0.50	8575570
Acetic Acid	mg/L	<0.50	<0.50	<0.50	<0.50	N/A	0.50	8575570
Propionic Acid	mg/L	<0.50	<0.50	<0.50	<0.50	N/A	0.50	8575570
Butyric Acid	mg/L	<10 (1)	<10 (1)	<10 (1)	<10 (1)	N/A	10	8575570
Misc. Organics								
Adsorbable Organic Halogen	mg/L	0.03	0.01	0.07	0.02	0.02	0.01	8578814

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to matrix interference.

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QS0276	QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30	2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01	512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
Volatiles							
Total Trihalomethanes	ug/L	<1.3	<1.3	<1.3	<1.3	1.3	8576597
Bromodichloromethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Bromoform	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Bromomethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8576846
Carbon tetrachloride	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Chlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Chlorodibromomethane	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8576846
Chloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8576846
Chloroform	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Chloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8576846
1,2-dibromoethane	ug/L	<0.20	<0.20	<0.20	<0.20	0.20	8576846
1,2-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,3-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,4-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,1-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,2-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,1-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
cis-1,2-dichloroethene	ug/L	1.2	<0.50	20	<0.50	0.50	8576846
trans-1,2-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Dichloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8576846
1,2-dichloropropane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
cis-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
trans-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Methyl methacrylate	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Methyl-tert-butylether (MTBE)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Styrene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,1,1,2-tetrachloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8576846
1,1,2,2-tetrachloroethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8576846
Tetrachloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,2,3-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8576846
1,2,4-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8576846
1,3,5-trichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846

RDL = Reportable Detection Limit

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QS0276	QS0277	QS0278	QS0279		
Sampling Date		2017/03/13 11:30	2017/03/13 13:30	2017/03/13 16:00	2017/03/13 19:00		
COC Number		512239-04-01	512239-04-01	512239-04-01	512239-04-01		
	UNITS	**XCG 6**	**XCG 5**	**MW-03**	**MW-02**	**RDL**	**QC Batch**
1,1,1-trichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,1,2-trichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Trichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Trichlorofluoromethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,2,4-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
1,3,5-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8576846
Vinyl chloride	ug/L	<0.50	<0.50	16	<0.50	0.50	8576846
Surrogate Recovery (%)							
1,4-Difluorobenzene (sur.)	%	104	103	105	105	N/A	8576846
4-Bromofluorobenzene (sur.)	%	92	98	89	93	N/A	8576846
D4-1,2-Dichloroethane (sur.)	%	86	95	99	99	N/A	8576846

RDL = Reportable Detection Limit
N/A = Not Applicable

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.3°C

Results relate only to the items tested.

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576841	1,4-Difluorobenzene (sur.)	2017/03/14	99	70 - 130	102	70 - 130	103	%				
8576841	4-Bromofluorobenzene (sur.)	2017/03/14	107	70 - 130	101	70 - 130	100	%				
8576841	D4-1,2-Dichloroethane (sur.)	2017/03/14	101	70 - 130	97	70 - 130	101	%				
8576846	1,4-Difluorobenzene (sur.)	2017/03/15	101	70 - 130	104	70 - 130	103	%				
8576846	4-Bromofluorobenzene (sur.)	2017/03/15	105	70 - 130	102	70 - 130	94	%				
8576846	D4-1,2-Dichloroethane (sur.)	2017/03/15	99	70 - 130	105	70 - 130	95	%				
8576963	O-TERPHENYL (sur.)	2017/03/15	100	60 - 130	98	60 - 130	99	%				
8575570	Acetic Acid	2017/03/13	94	80 - 120	95	80 - 120	<0.50	mg/L	NC	20		
8575570	Butyric Acid	2017/03/13	97	80 - 120	96	80 - 120	<0.50	mg/L	NC	20		
8575570	Formic Acid	2017/03/13	103	80 - 120	88	80 - 120	<0.50	mg/L	NC	20		
8575570	Propionic Acid	2017/03/13	90	80 - 120	106	80 - 120	<0.50	mg/L	NC	20		
8576569	Dissolved Aluminum (Al)	2017/03/14	96	80 - 120	96	80 - 120	<0.0030	mg/L	3.7	20		
8576569	Dissolved Antimony (Sb)	2017/03/14	84	80 - 120	89	80 - 120	<0.00060	mg/L	NC	20		
8576569	Dissolved Arsenic (As)	2017/03/14	88	80 - 120	88	80 - 120	<0.00020	mg/L	7.1	20		
8576569	Dissolved Beryllium (Be)	2017/03/14	89	80 - 120	84	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Chromium (Cr)	2017/03/14	88	80 - 120	90	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Cobalt (Co)	2017/03/14	84	80 - 120	86	80 - 120	<0.00030	mg/L	NC	20		
8576569	Dissolved Copper (Cu)	2017/03/14	82	80 - 120	86	80 - 120	<0.00020	mg/L	9.6	20		
8576569	Dissolved Lead (Pb)	2017/03/14	86	80 - 120	86	80 - 120	<0.00020	mg/L	NC	20		
8576569	Dissolved Molybdenum (Mo)	2017/03/14	91	80 - 120	89	80 - 120	<0.00020	mg/L	2.0	20		
8576569	Dissolved Nickel (Ni)	2017/03/14	85	80 - 120	87	80 - 120	<0.00050	mg/L	3.0	20		
8576569	Dissolved Selenium (Se)	2017/03/14	92	80 - 120	94	80 - 120	<0.00020	mg/L	12	20		
8576569	Dissolved Silver (Ag)	2017/03/14	85	80 - 120	73 (1)	80 - 120	<0.00010	mg/L	NC	20		
8576569	Dissolved Thallium (Tl)	2017/03/14	88	80 - 120	86	80 - 120	<0.00020	mg/L	NC	20		
8576569	Dissolved Tin (Sn)	2017/03/14	89	80 - 120	92	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Titanium (Ti)	2017/03/14	88	80 - 120	91	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Uranium (U)	2017/03/14	89	80 - 120	86	80 - 120	<0.00010	mg/L	2.2	20		
8576569	Dissolved Vanadium (V)	2017/03/14	90	80 - 120	91	80 - 120	<0.0010	mg/L	NC	20		
8576569	Dissolved Zinc (Zn)	2017/03/14	77 (1)	80 - 120	87	80 - 120	<0.0030	mg/L	18	20		
8576821	Biochemical Oxygen Demand	2017/03/19			97	85 - 115	<2.0	mg/L	5.7	20		
8576841	Benzene	2017/03/15	89	70 - 130	82	70 - 130	<0.40	ug/L	NC	30		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576841	Ethylbenzene	2017/03/15	86	70 - 130	77	70 - 130	<0.40	ug/L	NC	30		
8576841	F1 (C6-C10) - BTEX	2017/03/15					<100	ug/L	NC	30		
8576841	F1 (C6-C10)	2017/03/15	96	70 - 130	92	70 - 130	<100	ug/L	NC	30		
8576841	m & p-Xylene	2017/03/15	83	70 - 130	84	70 - 130	<0.80	ug/L	NC	30		
8576841	o-Xylene	2017/03/15	84	70 - 130	79	70 - 130	<0.40	ug/L	NC	30		
8576841	Toluene	2017/03/15	81	70 - 130	79	70 - 130	<0.40	ug/L	NC	30		
8576841	Xylenes (Total)	2017/03/15					<0.80	ug/L	NC	30		
8576846	1,1,1,2-tetrachloroethane	2017/03/15	108	70 - 130	106	70 - 130	<1.0	ug/L	NC	40		
8576846	1,1,1-trichloroethane	2017/03/15	102	70 - 130	95	70 - 130	<0.50	ug/L	NC	40		
8576846	1,1,2,2-tetrachloroethane	2017/03/15	96	70 - 130	113	70 - 130	<2.0	ug/L	NC	40		
8576846	1,1,2-trichloroethane	2017/03/15	106	70 - 130	106	70 - 130	<0.50	ug/L	NC	40		
8576846	1,1-dichloroethane	2017/03/15	107	70 - 130	91	70 - 130	<0.50	ug/L	NC	40		
8576846	1,1-dichloroethene	2017/03/15	108	70 - 130	87	70 - 130	<0.50	ug/L	NC	40		
8576846	1,2,3-trichlorobenzene	2017/03/15	111	70 - 130	106	70 - 130	<1.0	ug/L	NC	40		
8576846	1,2,4-trichlorobenzene	2017/03/15	111	70 - 130	103	70 - 130	<1.0	ug/L	NC	40		
8576846	1,2,4-trimethylbenzene	2017/03/15	106	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8576846	1,2-dibromoethane	2017/03/15	116	70 - 130	106	70 - 130	<0.20	ug/L	NC	40		
8576846	1,2-dichlorobenzene	2017/03/15	110	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8576846	1,2-dichloroethane	2017/03/15	104	70 - 130	93	70 - 130	<0.50	ug/L	NC	40		
8576846	1,2-dichloropropane	2017/03/15	108	70 - 130	100	70 - 130	<0.50	ug/L	NC	40		
8576846	1,3,5-trichlorobenzene	2017/03/15	109	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8576846	1,3,5-trimethylbenzene	2017/03/15	115	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8576846	1,3-dichlorobenzene	2017/03/15	112	70 - 130	103	70 - 130	<0.50	ug/L	NC	40		
8576846	1,4-dichlorobenzene	2017/03/15	109	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8576846	Bromodichloromethane	2017/03/15	114	70 - 130	98	70 - 130	<0.50	ug/L	NC	40		
8576846	Bromoform	2017/03/15	110	70 - 130	112	70 - 130	<0.50	ug/L	NC	40		
8576846	Bromomethane	2017/03/15	112	70 - 130	84	70 - 130	<2.0	ug/L	NC	40		
8576846	Carbon tetrachloride	2017/03/15	99	70 - 130	94	70 - 130	<0.50	ug/L	NC	40		
8576846	Chlorobenzene	2017/03/15	107	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8576846	Chlorodibromomethane	2017/03/15	117	70 - 130	109	70 - 130	<1.0	ug/L	NC	40		
8576846	Chloroethane	2017/03/15	100	70 - 130	75	70 - 130	<1.0	ug/L	NC	40		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8576846	Chloroform	2017/03/15	111	70 - 130	100	70 - 130	<0.50	ug/L	NC	40		
8576846	Chloromethane	2017/03/15	99	70 - 130	89	70 - 130	<2.0	ug/L	NC	40		
8576846	cis-1,2-dichloroethene	2017/03/15	109	70 - 130	99	70 - 130	<0.50	ug/L	8.7	40		
8576846	cis-1,3-dichloropropene	2017/03/15	113	70 - 130	109	70 - 130	<0.50	ug/L	NC	40		
8576846	Dichloromethane	2017/03/15	121	70 - 130	93	70 - 130	<2.0	ug/L	NC	40		
8576846	Methyl methacrylate	2017/03/15	112	70 - 130	98	70 - 130	<0.50	ug/L	NC	40		
8576846	Methyl-tert-butylether (MTBE)	2017/03/15	129	70 - 130	101	70 - 130	<0.50	ug/L	NC	40		
8576846	Styrene	2017/03/15	109	70 - 130	109	70 - 130	<0.50	ug/L	NC	40		
8576846	Tetrachloroethene	2017/03/15	115	70 - 130	108	70 - 130	<0.50	ug/L	NC	40		
8576846	trans-1,2-dichloroethene	2017/03/15	124	70 - 130	91	70 - 130	<0.50	ug/L	NC	40		
8576846	trans-1,3-dichloropropene	2017/03/15	106	70 - 130	110	70 - 130	<0.50	ug/L	NC	40		
8576846	Trichloroethene	2017/03/15	105	70 - 130	103	70 - 130	<0.50	ug/L	NC	40		
8576846	Trichlorofluoromethane	2017/03/15	107	70 - 130	81	70 - 130	<0.50	ug/L	NC	40		
8576846	Vinyl chloride	2017/03/15	109	70 - 130	77	70 - 130	<0.50	ug/L	NC	40		
8576918	Total Aluminum (Al)	2017/03/14	84	80 - 120	91	80 - 120	<0.0030	mg/L				
8576918	Total Antimony (Sb)	2017/03/14	93	80 - 120	92	80 - 120	<0.00060	mg/L				
8576918	Total Arsenic (As)	2017/03/14	91	80 - 120	91	80 - 120	<0.00020	mg/L	16	20		
8576918	Total Beryllium (Be)	2017/03/14	88	80 - 120	86	80 - 120	<0.0010	mg/L				
8576918	Total Chromium (Cr)	2017/03/14	90	80 - 120	92	80 - 120	<0.0010	mg/L				
8576918	Total Cobalt (Co)	2017/03/14	90	80 - 120	91	80 - 120	<0.00030	mg/L				
8576918	Total Copper (Cu)	2017/03/14	89	80 - 120	90	80 - 120	<0.00020	mg/L				
8576918	Total Lead (Pb)	2017/03/14	89	80 - 120	89	80 - 120	<0.00020	mg/L				
8576918	Total Molybdenum (Mo)	2017/03/14	93	80 - 120	93	80 - 120	<0.00020	mg/L				
8576918	Total Nickel (Ni)	2017/03/14	89	80 - 120	91	80 - 120	<0.00050	mg/L				
8576918	Total Selenium (Se)	2017/03/14	92	80 - 120	94	80 - 120	<0.00020	mg/L				
8576918	Total Silver (Ag)	2017/03/14	90	80 - 120	89	80 - 120	<0.00010	mg/L				
8576918	Total Thallium (Tl)	2017/03/14	91	80 - 120	91	80 - 120	<0.00020	mg/L				
8576918	Total Tin (Sn)	2017/03/14	95	80 - 120	95	80 - 120	<0.0010	mg/L				
8576918	Total Titanium (Ti)	2017/03/14	89	80 - 120	92	80 - 120	<0.0010	mg/L				
8576918	Total Uranium (U)	2017/03/14	89	80 - 120	82	80 - 120	<0.00010	mg/L				
8576918	Total Vanadium (V)	2017/03/14	93	80 - 120	93	80 - 120	<0.0010	mg/L				

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8576918	Total Zinc (Zn)	2017/03/14	88	80 - 120	91	80 - 120	<0.0030	mg/L				
8576919	Total Barium (Ba)	2017/03/15	67 (1)	80 - 120	102	80 - 120	<0.010	mg/L				
8576919	Total Boron (B)	2017/03/15	117	80 - 120	100	80 - 120	<0.020	mg/L				
8576919	Total Calcium (Ca)	2017/03/15	NC	80 - 120	107	80 - 120	<0.30	mg/L				
8576919	Total Iron (Fe)	2017/03/15	865 (1)	80 - 120	108	80 - 120	<0.060	mg/L	NC	20		
8576919	Total Lithium (Li)	2017/03/15	104	80 - 120	102	80 - 120	<0.020	mg/L				
8576919	Total Magnesium (Mg)	2017/03/15	NC	80 - 120	101	80 - 120	<0.20	mg/L				
8576919	Total Manganese (Mn)	2017/03/15	112	80 - 120	103	80 - 120	<0.0040	mg/L	2.6	20		
8576919	Total Phosphorus (P)	2017/03/15	124 (1)	80 - 120	104	80 - 120	<0.10	mg/L				
8576919	Total Potassium (K)	2017/03/15	127 (1)	80 - 120	101	80 - 120	<0.30	mg/L				
8576919	Total Silicon (Si)	2017/03/15	195 (1)	80 - 120	102	80 - 120	<0.10	mg/L				
8576919	Total Sodium (Na)	2017/03/15	NC	80 - 120	102	80 - 120	<0.50	mg/L				
8576919	Total Strontium (Sr)	2017/03/15	136 (1)	80 - 120	104	80 - 120	<0.020	mg/L				
8576919	Total Sulphur (S)	2017/03/15					<0.20	mg/L				
8576963	F2 (C10-C16 Hydrocarbons)	2017/03/15	98	60 - 130	96	70 - 130	<0.10	mg/L	NC	30		
8577123	Dissolved Barium (Ba)	2017/03/14	91	80 - 120	91	80 - 120	<0.010	mg/L				
8577123	Dissolved Boron (B)	2017/03/14	92	80 - 120	93	80 - 120	<0.020	mg/L				
8577123	Dissolved Calcium (Ca)	2017/03/14	96	80 - 120	98	80 - 120	<0.30	mg/L	NC	20		
8577123	Dissolved Iron (Fe)	2017/03/14	95	80 - 120	96	80 - 120	<0.060	mg/L	NC	20		
8577123	Dissolved Lithium (Li)	2017/03/14	89	80 - 120	92	80 - 120	<0.020	mg/L				
8577123	Dissolved Magnesium (Mg)	2017/03/14	94	80 - 120	95	80 - 120	<0.20	mg/L	NC	20		
8577123	Dissolved Manganese (Mn)	2017/03/14	94	80 - 120	96	80 - 120	<0.0040	mg/L	NC	20		
8577123	Dissolved Phosphorus (P)	2017/03/14	95	80 - 120	97	80 - 120	<0.10	mg/L				
8577123	Dissolved Potassium (K)	2017/03/14	93	80 - 120	93	80 - 120	<0.30	mg/L	NC	20		
8577123	Dissolved Silicon (Si)	2017/03/14	85	80 - 120	91	80 - 120	<0.10	mg/L				
8577123	Dissolved Sodium (Na)	2017/03/14	91	80 - 120	93	80 - 120	<0.50	mg/L	NC	20		
8577123	Dissolved Strontium (Sr)	2017/03/14	92	80 - 120	92	80 - 120	<0.020	mg/L				
8577123	Dissolved Sulphur (S)	2017/03/14					<0.20	mg/L				
8577301	Dissolved Nitrate (N)	2017/03/14	103	80 - 120	101	80 - 120	<0.010	mg/L	2.0	20		
8577301	Dissolved Nitrite (N)	2017/03/14	101	80 - 120	99	80 - 120	<0.010	mg/L	1.5	20		
8577329	Alkalinity (PP as CaCO3)	2017/03/14					<0.50	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8577329	Alkalinity (Total as CaCO3)	2017/03/14			96	80 - 120	<0.50	mg/L	0.28	20		
8577329	Bicarbonate (HCO3)	2017/03/14					<0.50	mg/L	0.28	20		
8577329	Carbonate (CO3)	2017/03/14					<0.50	mg/L	NC	20		
8577329	Hydroxide (OH)	2017/03/14					<0.50	mg/L	NC	20		
8577330	pH	2017/03/14			99	97 - 103			1.8	N/A		
8577331	Conductivity	2017/03/14			100	90 - 110	<1.0	uS/cm	0.061	10		
8577375	Total Total Kjeldahl Nitrogen	2017/03/15	94	80 - 120	98	80 - 120	<0.050	mg/L	NC	20	103	80 - 120
8577602	Total Chemical Oxygen Demand	2017/03/15	100	80 - 120	99	80 - 120	<5.0	mg/L	2.7	20		
8577626	Total Ammonia (N)	2017/03/15	96	80 - 120	97	80 - 120	<0.050	mg/L	NC	20		
8577689	Total Aluminum (Al)	2017/03/15	NC	80 - 120	85	80 - 120	<0.0030	mg/L	6.8	20		
8577689	Total Antimony (Sb)	2017/03/15	88	80 - 120	88	80 - 120	<0.00060	mg/L	NC	20		
8577689	Total Arsenic (As)	2017/03/15	98	80 - 120	89	80 - 120	<0.00020	mg/L	NC	20		
8577689	Total Beryllium (Be)	2017/03/15	87	80 - 120	89	80 - 120	<0.0010	mg/L	NC	20		
8577689	Total Chromium (Cr)	2017/03/15	97	80 - 120	89	80 - 120	<0.0010	mg/L	10	20		
8577689	Total Cobalt (Co)	2017/03/15	96	80 - 120	89	80 - 120	<0.00030	mg/L	7.3	20		
8577689	Total Copper (Cu)	2017/03/15	97	80 - 120	87	80 - 120	<0.00020	mg/L	0.56	20		
8577689	Total Lead (Pb)	2017/03/15	97	80 - 120	87	80 - 120	<0.00020	mg/L	NC	20		
8577689	Total Molybdenum (Mo)	2017/03/15	100	80 - 120	89	80 - 120	<0.00020	mg/L	7.0	20		
8577689	Total Nickel (Ni)	2017/03/15	92	80 - 120	89	80 - 120	<0.00050	mg/L	9.7	20		
8577689	Total Selenium (Se)	2017/03/15	90	80 - 120	92	80 - 120	<0.00020	mg/L	19	20		
8577689	Total Silver (Ag)	2017/03/15	95	80 - 120	89	80 - 120	<0.00010	mg/L	NC	20		
8577689	Total Thallium (Tl)	2017/03/15	95	80 - 120	89	80 - 120	<0.00020	mg/L	NC	20		
8577689	Total Tin (Sn)	2017/03/15	100	80 - 120	88	80 - 120	<0.0010	mg/L	NC	20		
8577689	Total Titanium (Ti)	2017/03/15	88	80 - 120	88	80 - 120	<0.0010	mg/L	18	20		
8577689	Total Uranium (U)	2017/03/15	94	80 - 120	84	80 - 120	<0.00010	mg/L	0.85	20		
8577689	Total Vanadium (V)	2017/03/15	105	80 - 120	89	80 - 120	<0.0010	mg/L	NC	20		
8577689	Total Zinc (Zn)	2017/03/15	102	80 - 120	86	80 - 120	<0.0030	mg/L	NC	20		
8577706	Total Barium (Ba)	2017/03/15	102	80 - 120	101	80 - 120	<0.010	mg/L	0.87	20		
8577706	Total Boron (B)	2017/03/15	100	80 - 120	99	80 - 120	<0.020	mg/L	2.4	20		
8577706	Total Calcium (Ca)	2017/03/15	106	80 - 120	106	80 - 120	<0.30	mg/L	1.1	20		
8577706	Total Iron (Fe)	2017/03/15	107	80 - 120	109	80 - 120	<0.060	mg/L	4.7	20		

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8577706	Total Lithium (Li)	2017/03/15	101	80 - 120	101	80 - 120	<0.020	mg/L	1.4	20		
8577706	Total Magnesium (Mg)	2017/03/15	101	80 - 120	100	80 - 120	<0.20	mg/L	1.2	20		
8577706	Total Manganese (Mn)	2017/03/15	103	80 - 120	104	80 - 120	<0.0040	mg/L	1.2	20		
8577706	Total Phosphorus (P)	2017/03/15	105	80 - 120	105	80 - 120	<0.10	mg/L	NC	20		
8577706	Total Potassium (K)	2017/03/15	100	80 - 120	100	80 - 120	<0.30	mg/L	1.2	20		
8577706	Total Silicon (Si)	2017/03/15	103	80 - 120	101	80 - 120	<0.10	mg/L	1.5	20		
8577706	Total Sodium (Na)	2017/03/15	95	80 - 120	101	80 - 120	<0.50	mg/L	0.26	20		
8577706	Total Strontium (Sr)	2017/03/15	103	80 - 120	103	80 - 120	<0.020	mg/L	1.1	20		
8577706	Total Sulphur (S)	2017/03/15					<0.20	mg/L	1.1	20		
8578814	Adsorbable Organic Halogen	2017/03/16					<0.5	mg/L			101	84 - 111
8579012	Dissolved Chloride (Cl)	2017/03/16	NC	80 - 120	105	80 - 120	<1.0	mg/L	0.28	20		
8579016	Dissolved Sulphate (SO4)	2017/03/16	NC	80 - 120	105	80 - 120	<1.0	mg/L	0.17	20		
8579832	Total Phosphorus (P)	2017/03/17	91	80 - 120	89	80 - 120	<0.0030	mg/L	NC	20	87	80 - 120
8580072	Total Organic Carbon (C)	2017/03/17	NC	80 - 120	115	80 - 120	<0.50	mg/L	1.8	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Dennis Ngondu, B.Sc., P.Chem., QP, Supervisor, Organics

Gayle Simpson, Analyst II

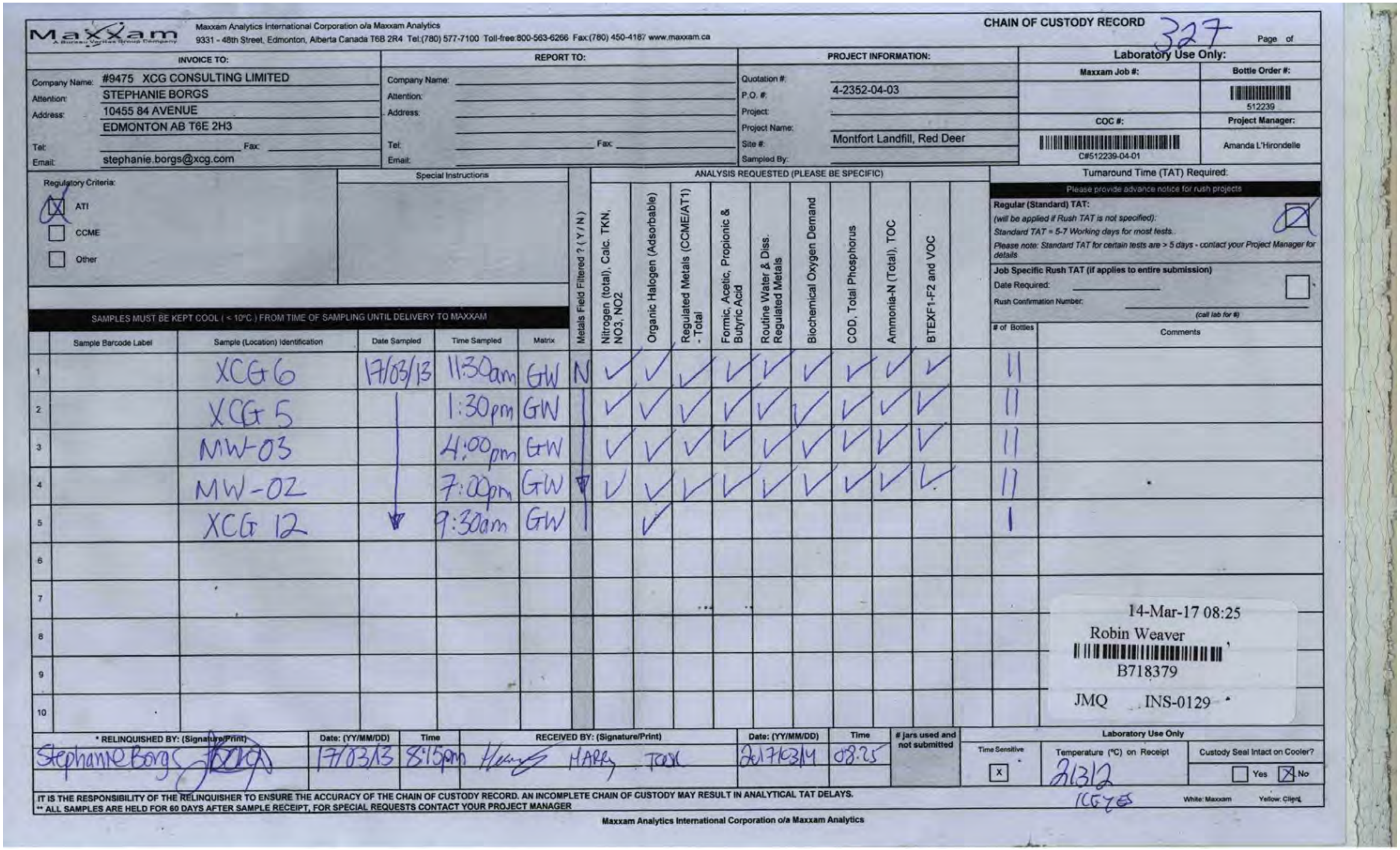
Junzhi Gao

Janet Gao, B.Sc., QP, Supervisor, Organics

Peng Liang

Harry (Peng) Liang, Senior Analyst

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



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Maxxam Analytics International Corporation o/a Maxxam Analytics
9331 - 48th Street, Edmonton, Alberta Canada T6B 2R4 Tel:(780) 577-7100 Toll-free:800-563-6266 Fax:(780) 450-4187 www.maxxam.ca

CHAIN OF CUSTODY RECORD 327

Page of

INVOICE TO:

Company Name: #9475 XCG CONSULTING LIMITED
Attention: STEPHANIE BORGS
Address: 10455 84 AVENUE
EDMONTON AB T6E 2H3
Tel: Fax:
Email: stephanie.borgs@xcg.com

REPORT TO:

Company Name:
Attention:
Address:
Tel: Fax:
Email:

PROJECT INFORMATION:

Quotation #:
P.O. #: 4-2352-04-03
Project:
Project Name:
Site #: Montfort Landfill, Red Deer
Sampled By:

Laboratory Use Only:

Maxxam Job #:	Bottle Order #:
	512239
COC #:	Project Manager:
C#512239-04-01	Amanda L'Hirondelle

Regulatory Criteria:
☒ ATI
☐ CCME
☐ Other

Special Instructions

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Nitrogen (total), Calc. TKN, NO3, NO2	Organic Halogen (Adsorbable)	Regulated Metals (CCME/AT1) - Total	Formic, Acetic, Propionic & Butyric Acid	Routine Water & Diss. Regulated Metals	Biochemical Oxygen Demand	COD, Total Phosphorus	Ammonia-N (Total), TOC	BTEXF1-F2 and VOC		# of Bottles	Comments
1		XCG6	17/03/13	11:30am	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
2		XCG 5	↓	1:30pm	GW	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
3		MW-03	↓	4:00pm	GW	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
4		MW-02	↓	7:00pm	GW	↓	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
5		XCG 12	↓	9:30am	GW			✓									1	
6																		
7																		
8																		
9																		
10																		

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number:
(call lab for #)

14-Mar-17 08:25
Robin Weaver
B718379
JMQ INS-0129

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Stephanie Borgs	17/03/13	8:15pm	HARRY TOOK	2017/03/14	08:25	

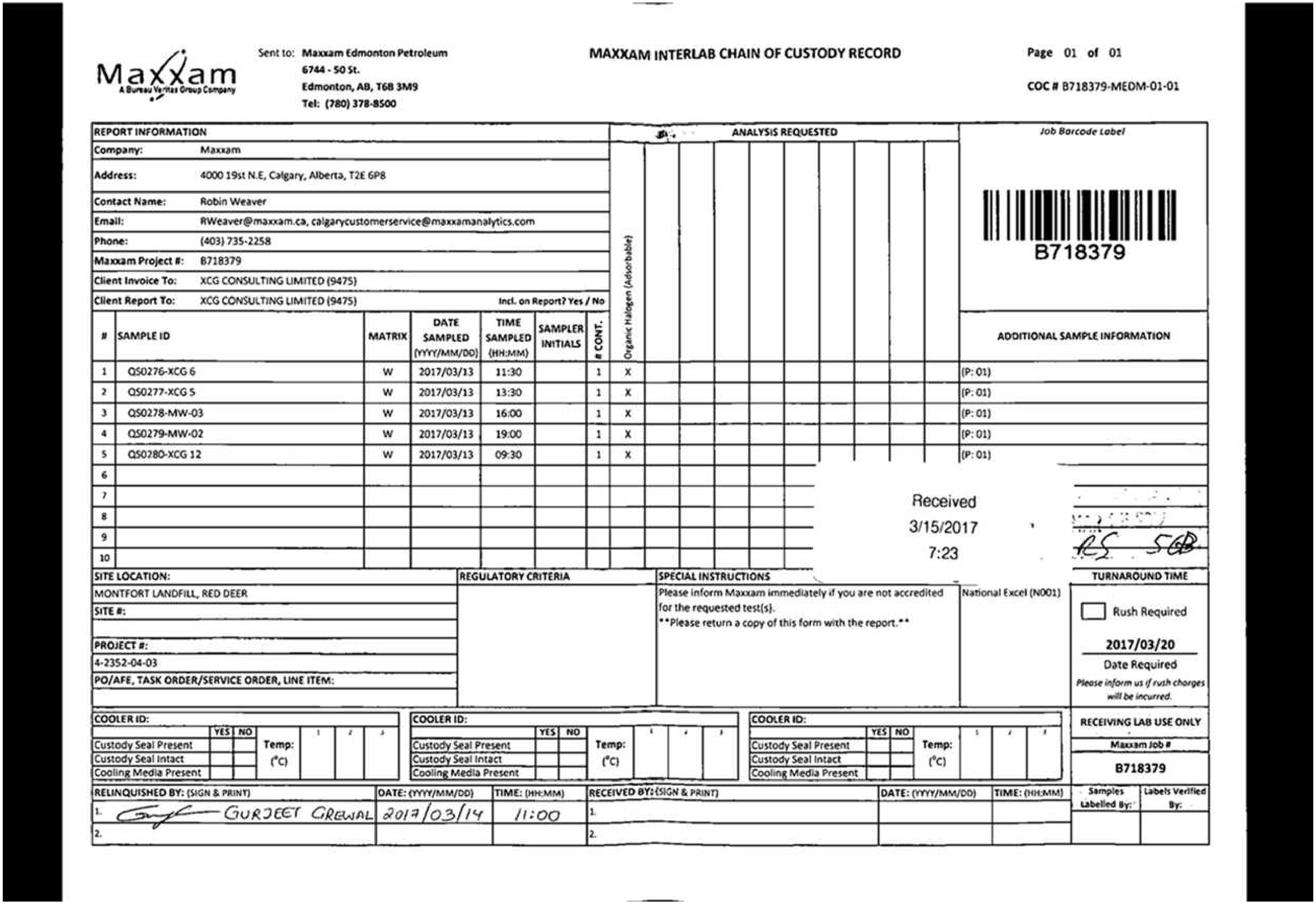
Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
☒	2/3/2 ICEYES	☐ Yes ☒ No

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

Maxxam Analytics International Corporation o/a Maxxam Analytics



Maxxam
A Bureau Veritas Group Company

Sent to: Maxxam Edmonton Petroleum
6744 - 50 St.
Edmonton, AB, T6B 3M9
Tel: (780) 378-8500

MAXXAM INTERLAB CHAIN OF CUSTODY RECORD

Page 01 of 01

COC # B718379-MEDM-01-01

REPORT INFORMATION

Company: Maxxam
Address: 4000 19st N.E, Calgary, Alberta, T2E 6P8
Contact Name: Robin Weaver
Email: RWeaver@maxxam.ca, calgarycustomerservice@maxxamanalytics.com
Phone: (403) 735-2258
Maxxam Project #: B718379
Client Invoice To: XCG CONSULTING LIMITED (9475)
Client Report To: XCG CONSULTING LIMITED (9475) Incl. on Report? Yes / No

ANALYSIS REQUESTED

Job Barcode Label

B718379

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Organic Halogen (Adsorbable)									ADDITIONAL SAMPLE INFORMATION
1	QS0276-XCG 6	W	2017/03/13	11:30		1	X									(P: 01)
2	QS0277-XCG 5	W	2017/03/13	13:30		1	X									(P: 01)
3	QS0278-MW-03	W	2017/03/13	16:00		1	X									(P: 01)
4	QS0279-MW-02	W	2017/03/13	19:00		1	X									(P: 01)
5	QS0280-XCG 12	W	2017/03/13	09:30		1	X									(P: 01)
6																
7																
8																
9																
10																

Received
3/15/2017
7:23

RS 5GB

SITE LOCATION:
MONTFORT LANDFILL, RED DEER
SITE #:
PROJECT #:
4-2352-04-03
PO/AFE, TASK ORDER/SERVICE ORDER, LINE ITEM:

REGULATORY CRITERIA

SPECIAL INSTRUCTIONS
Please inform Maxxam immediately if you are not accredited for the requested test(s).
Please return a copy of this form with the report.

National Excel (N001)

TURNAROUND TIME
☐ Rush Required
2017/03/20
Date Required
Please inform us if rush charges will be incurred.

COOLER ID:

	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:

	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:

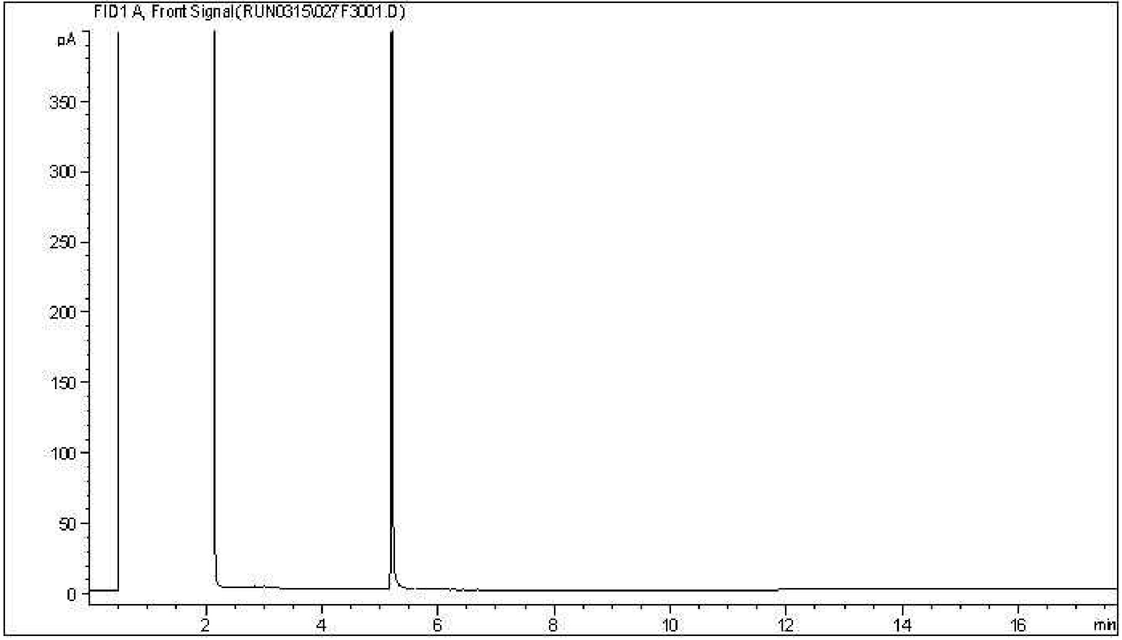
	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RECEIVING LAB USE ONLY
Maxxam Job #
B718379

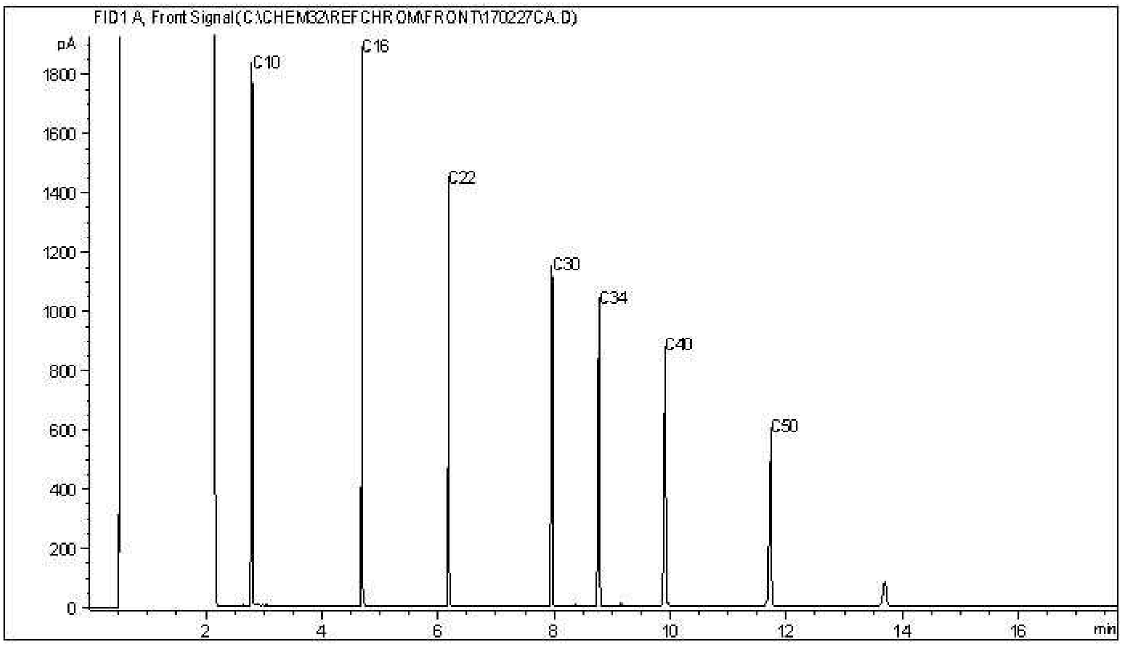
RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	Samples Labelled By:	Labels Verified By:
1. GURJEET GREWAL	2017/03/14	11:00	1.				
2.			2.				

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



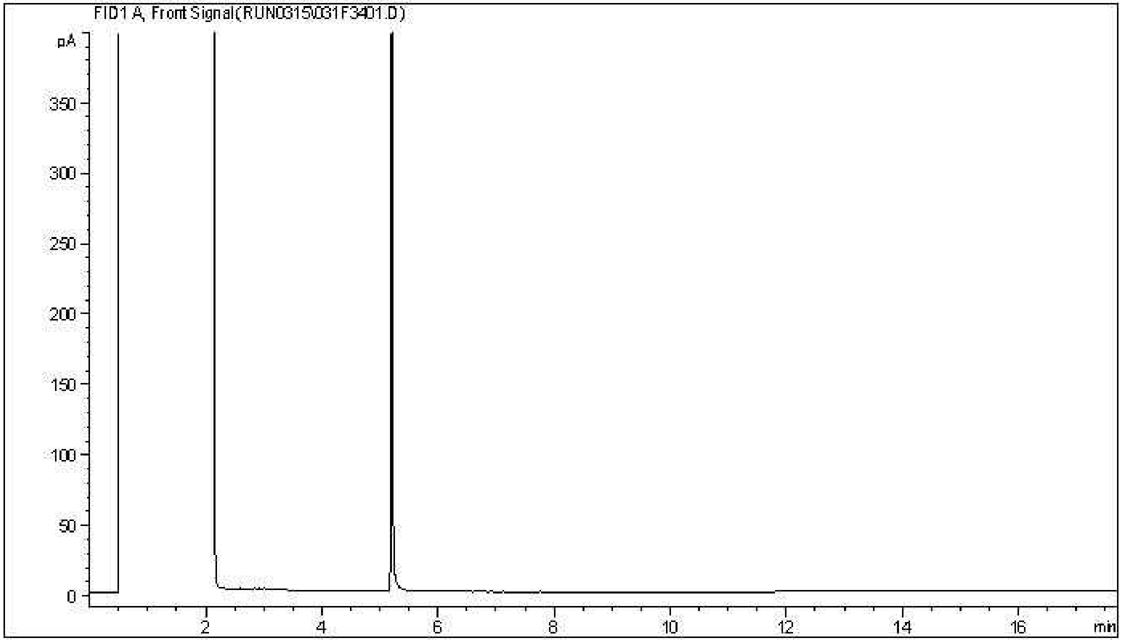
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

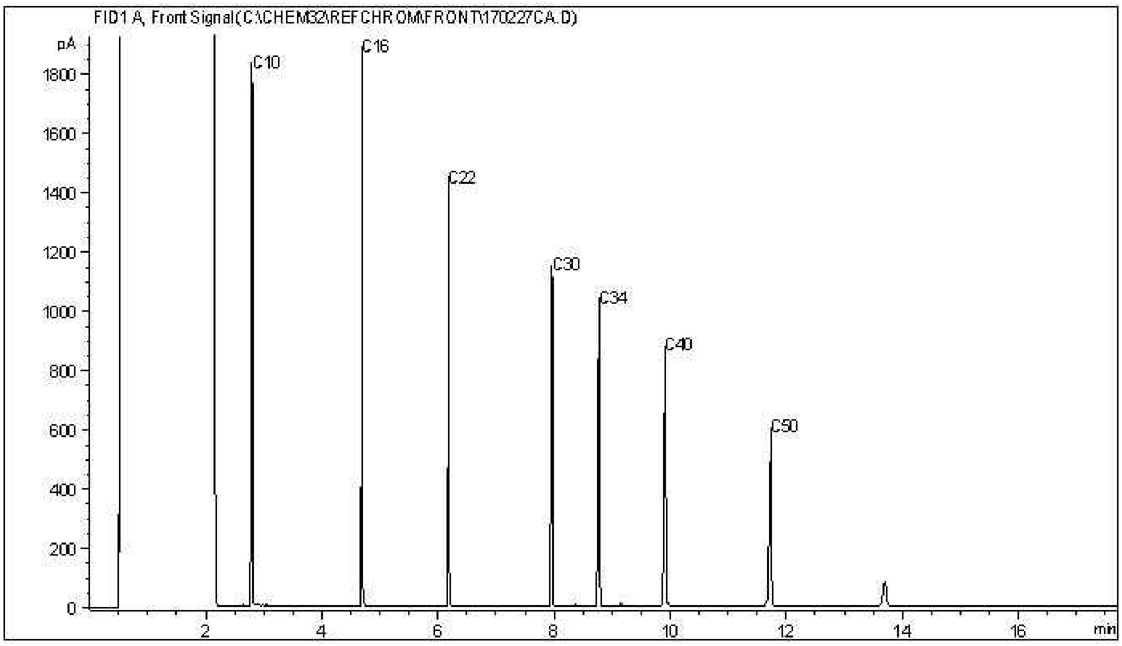
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

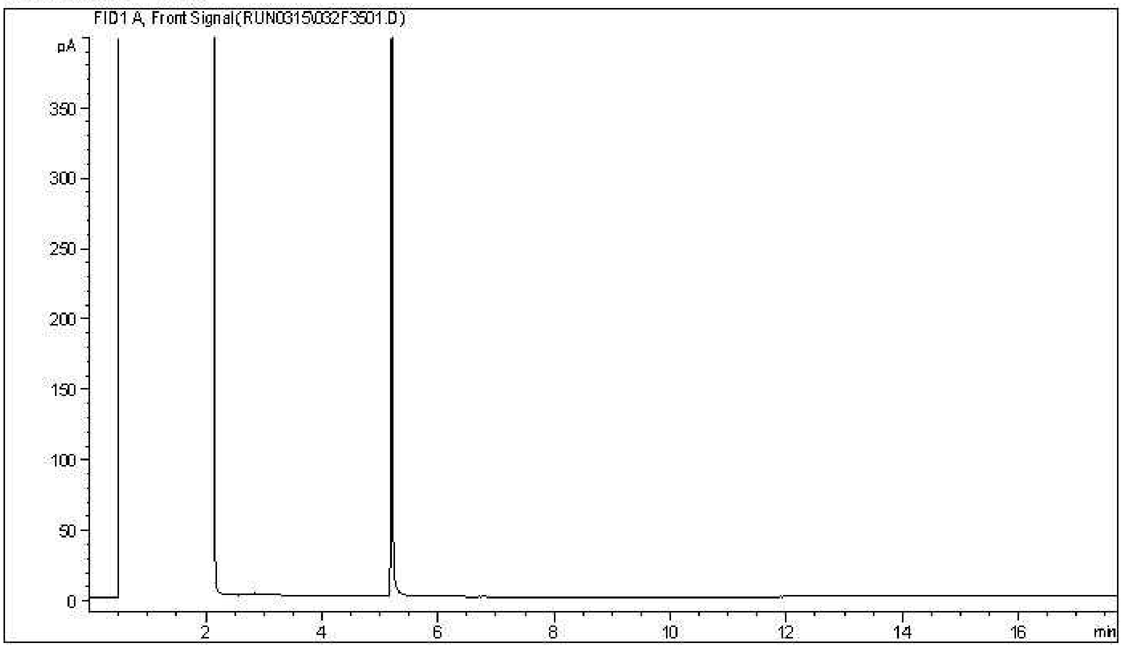
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718379
Report Date: 2017/03/21
Maxxam Sample: QS0278

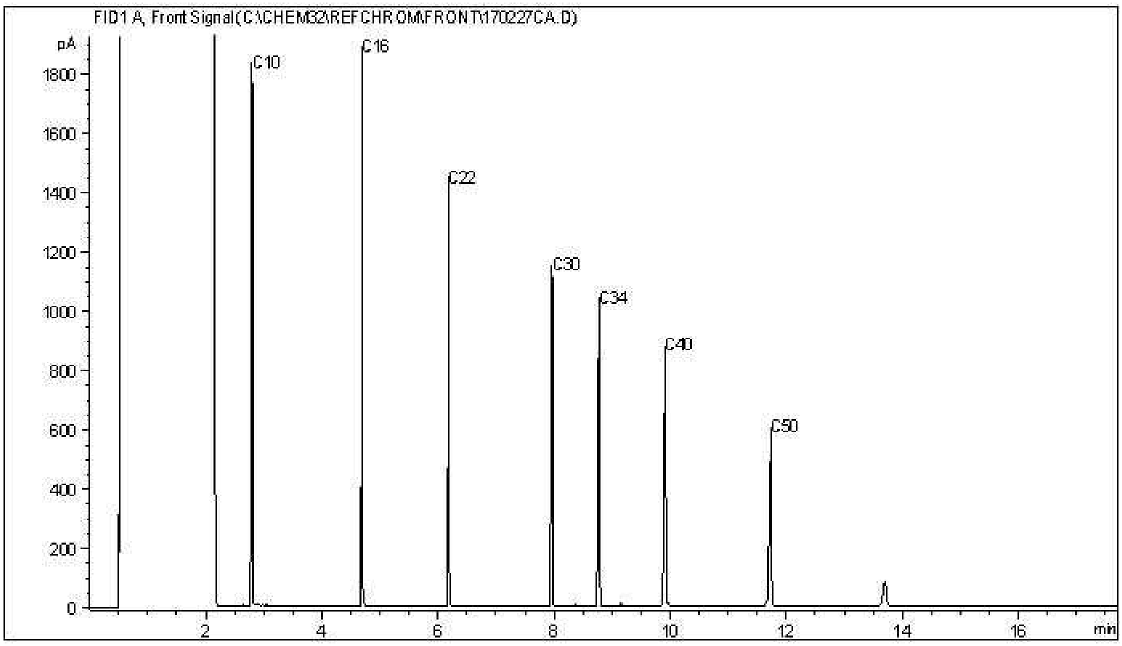
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: MW-03

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

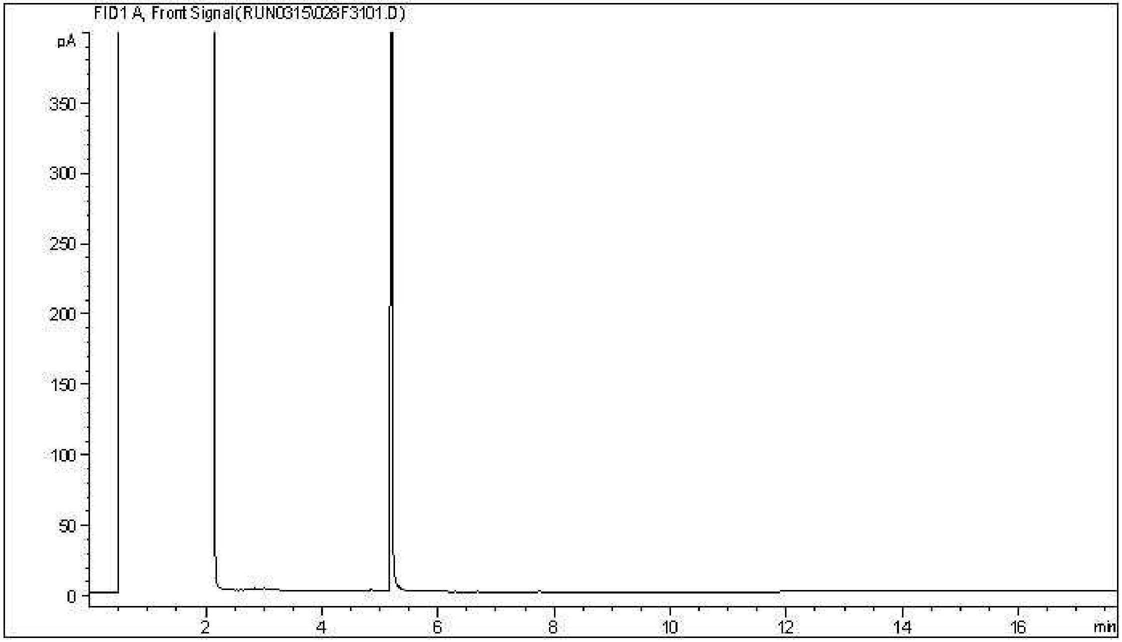
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718379
Report Date: 2017/03/21
Maxxam Sample: QS0279

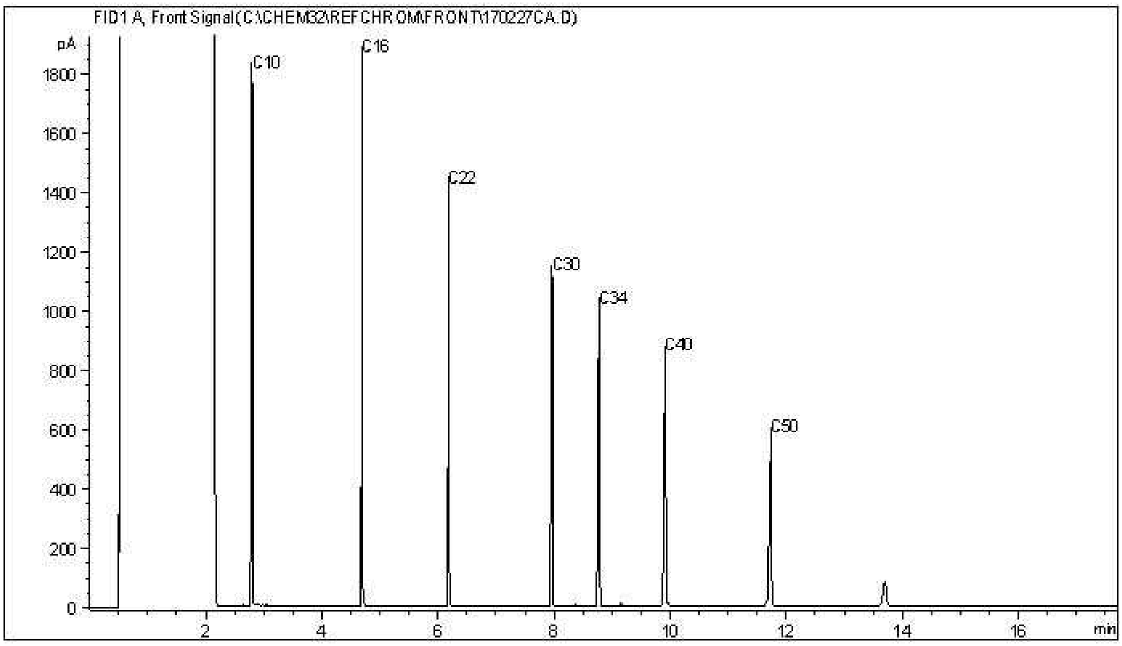
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: MW-02

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4	-	C12	Diesel:	C8	-	C22
Varsol:	C8	-	C12	Lubricating Oils:	C20	-	C40
Kerosene:	C7	-	C16	Crude Oils:	C3	-	C60+

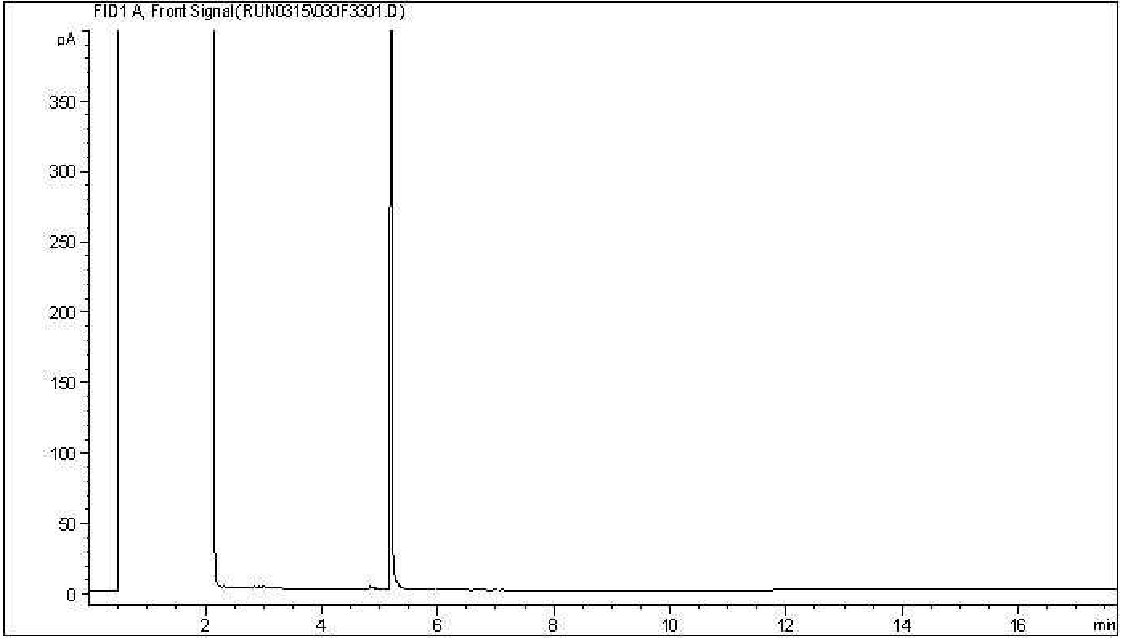
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718379
Report Date: 2017/03/21
Maxxam Sample: QS0279 Lab-Dup

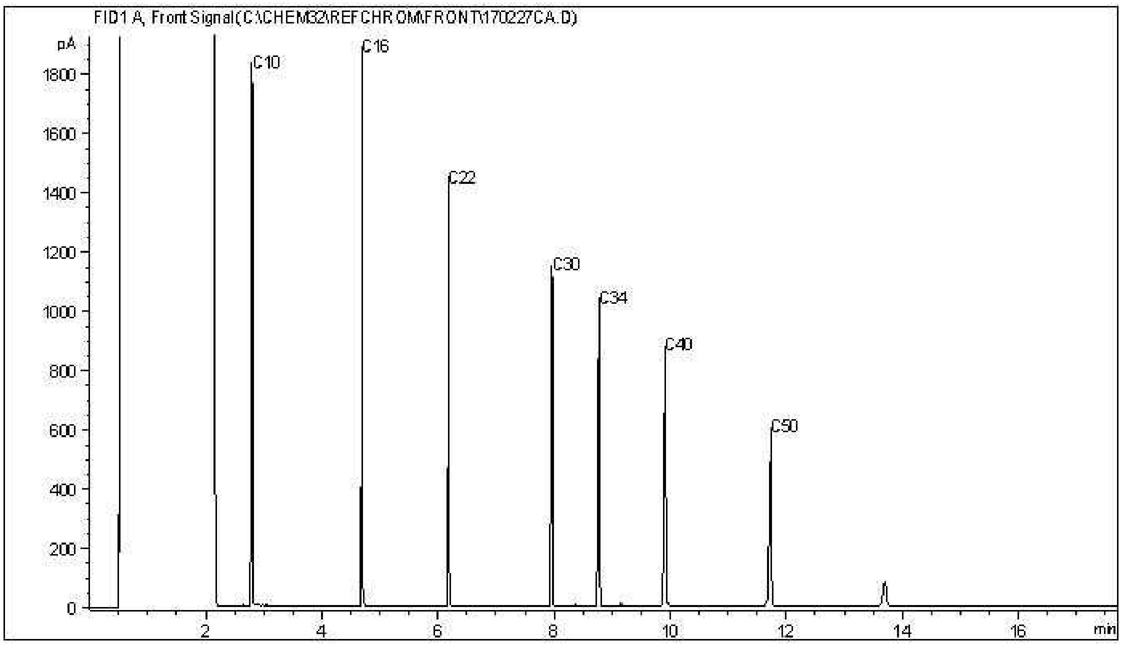
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: MW-02

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: GC15



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-01-01

Attention:STEPHANIE BORGS

XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359883
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718663
Received: 2017/03/15, 07:30

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Formic, Acetic, Propionic & Butyric Acid (1)	5	N/A	2017/03/16	CAL SOP-00063	Dionex #031181 R07 m
Alkalinity @25C (pp, total), CO3,HCO3,OH	5	N/A	2017/03/15	AB SOP-00005	SM 22 2320 B m
Organic Halogen (Adsorbable) (2)	2	2017/03/16	2017/03/16	PTC SOP-00056	Coulometric - Titr.
Organic Halogen (Adsorbable) (2)	2	2017/03/17	2017/03/17	PTC SOP-00056	Coulometric - Titr.
Biochemical Oxygen Demand	4	2017/03/15	2017/03/20	AB SOP-00017	SM 22 5210 B m
BTEX/F1 in Water by HS GC/MS/FID	4	N/A	2017/03/15	AB SOP-00039	CCME CWS/EPA 8260c m
Cadmium - low level CCME - Dissolved	5	N/A	2017/03/16	AB WI-00065	Auto Calc
Cadmium - low level CCME (Total)	4	N/A	2017/03/17	AB WI-00065	Auto Calc
Chloride by Automated Colourimetry	5	N/A	2017/03/16	AB SOP-00020	SM 22 4500-Cl G m
Chemical Oxygen Demand	4	N/A	2017/03/15	AB SOP-00016	SM 22 5220D m
Conductivity @25C	5	N/A	2017/03/15	AB SOP-00005	SM 22 2510 B m
CCME Hydrocarbons in Water (F2; C10-C16) (3)	4	2017/03/16	2017/03/16	AB SOP-00040 / AB SOP-00037	CCME PHC-CWS m
Hardness	5	N/A	2017/03/15	AB WI-00065	Auto Calc
Elements by ICP-Dissolved-Lab Filtered (4)	5	N/A	2017/03/15	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total	4	2017/03/16	2017/03/16	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICPMS-Dissolved-Lab Filtered (4)	5	N/A	2017/03/16	AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	4	2017/03/16	2017/03/16	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Ion Balance (as % Difference)	5	N/A	2017/03/15	AB WI-00065	Auto Calc
Sum of cations, anions	5	N/A	2017/03/15	AB WI-00065	Auto Calc
Nitrogen (total), Calc. TKN, NO3, NO2	4	N/A	2017/03/16	AB WI-00065	Auto Calc
Ammonia-N (Total)	4	N/A	2017/03/15	AB SOP-00007	EPA 350.1 R2.0 m
Nitrate and Nitrite	5	N/A	2017/03/16	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	5	N/A	2017/03/16	AB WI-00065	Auto Calc
Nitrogen, (Nitrite, Nitrate) by IC (5)	5	N/A	2017/03/15	AB SOP-00023	SM 22 4110 B m
pH @25°C (6)	5	N/A	2017/03/15	AB SOP-00005	SM 22 4500 H+ B m
Sulphate by Automated Colourimetry	5	N/A	2017/03/16	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Calculated)	5	N/A	2017/03/16	AB WI-00065	Auto Calc
Total Trihalomethanes Calculation	3	N/A	2017/03/20	AB SOP-00056	Auto Calc

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-01-01

Attention:STEPHANIE BORGS
XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359883
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718663
Received: 2017/03/15, 07:30

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Total Trihalomethanes Calculation	1	N/A	2017/03/21	AB SOP-00056	Auto Calc
Total Kjeldahl Nitrogen	4	2017/03/15	2017/03/16	AB SOP-00008	EPA 351.1 R 1978 m
Carbon (Total Organic) (7)	4	N/A	2017/03/15	EENVSOP-00060	MMCW 119 1996 m
Total Phosphorus	4	2017/03/16	2017/03/17	AB SOP-00024	SM 22 4500-P A,B,F m
VOCs in Water by HS GC/MS (Std List)	3	N/A	2017/03/20	AB SOP-00056	EPA 5021a/8260c m
VOCs in Water by HS GC/MS (Std List)	1	N/A	2017/03/21	AB SOP-00056	EPA 5021a/8260c m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER
Your C.O.C. #: 512239-01-01

Attention:STEPHANIE BORGS
XCG CONSULTING LIMITED
10455 84 AVENUE
EDMONTON, AB
CANADA T6E 2H3

Report Date: 2017/03/21
Report #: R2359883
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B718663
Received: 2017/03/15, 07:30

(1) This test was performed by Maxxam Calgary Environmental
(2) This test was performed by Maxxam Edmonton Petroleum
(3) Silica gel clean up employed.
(4) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: Whenever applicable, Dissolved >Total for any parameter that falls within method uncertainty for duplicates is likely equivalent. If RPD is >20% samples were reanalyzed and confirmed.
(5) Analysis completed within 48h after laboratory receipt to a maximum of five days from sampling is satisfactory for compliance purposes.
(6) The APHA Standard Method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time. Maxxam endeavors to analyze samples as soon as possible after receipt.
(7) TOC present in the sample should be considered as non-purgeable TOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Robin Weaver, Environmental Project Manager
Email: RWeaver@maxxam.ca
Phone# (403)735-2258
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

AT1 BTEX AND F1-F2 IN WATER (WATER)

Maxxam ID		QS2248	QS2249	QS2250	QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00	2017/03/14 12:00	2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01	512239-01-01	512239-01-01		
	UNITS	**XCG4**	**XCG13**	**MW-07**	**MW-06**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon							
F2 (C10-C16 Hydrocarbons)	mg/L	<0.10	<0.10	<0.10	0.52	0.10	8578535
Volatiles							
Benzene	ug/L	<0.40	0.86	1.7	4.8	0.40	8577787
Toluene	ug/L	<0.40	<0.40	<0.40	3.5	0.40	8577787
Ethylbenzene	ug/L	<0.40	<0.40	<0.40	58	0.40	8577787
m & p-Xylene	ug/L	<0.80	<0.80	<0.80	30	0.80	8577787
o-Xylene	ug/L	<0.40	<0.40	<0.40	15	0.40	8577787
Xylenes (Total)	ug/L	<0.80	<0.80	<0.80	45	0.80	8577787
F1 (C6-C10) - BTEX	ug/L	<100	<100	<100	<100	100	8577787
F1 (C6-C10)	ug/L	<100	<100	<100	<100	100	8577787
Surrogate Recovery (%)							
1,4-Difluorobenzene (sur.)	%	103	105	104	104	N/A	8577787
4-Bromofluorobenzene (sur.)	%	95	97	96	94	N/A	8577787
D4-1,2-Dichloroethane (sur.)	%	89	91	91	90	N/A	8577787
O-TERPHENYL (sur.)	%	96	120	115	111	N/A	8578535

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS2248	QS2249		QS2250		QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00		2017/03/14 12:00		2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01		512239-01-01		512239-01-01		
	UNITS	**XCG4**	**XCG13**	**RDL**	**MW-07**	**RDL**	**MW-06**	**RDL**	**QC Batch**
Calculated Parameters									
Anion Sum	meq/L	12	24	N/A	25	N/A	32	N/A	8577685
Cation Sum	meq/L	12	23	N/A	26	N/A	30	N/A	8577685
Hardness (CaCO3)	mg/L	480	1000	0.50	1100	0.50	970	0.50	8577683
Ion Balance (% Difference)	N/A	0.87	2.3	0.010	0.66	0.010	3.5	0.010	8577684
Dissolved Nitrate (NO3)	mg/L	<0.044	<0.044	0.044	0.20	0.044	0.14	0.044	8577686
Nitrate plus Nitrite (N)	mg/L	<0.010	<0.010	0.010	0.044	0.010	0.031	0.010	8577687
Dissolved Nitrite (NO2)	mg/L	<0.033	<0.033	0.033	<0.033	0.033	<0.033	0.033	8577686
Calculated Total Dissolved Solids	mg/L	580	1100	10	1300	10	1500	10	8577688
Misc. Inorganics									
Conductivity	uS/cm	1000	2100	1.0	2400	1.0	2800	1.0	8578153
pH	pH	7.74	7.15	N/A	7.12	N/A	7.10	N/A	8578144
Low Level Elements									
Dissolved Cadmium (Cd)	ug/L	0.29	0.088	0.020	0.022	0.020	<0.020	0.020	8577679
Anions									
Alkalinity (PP as CaCO3)	mg/L	<0.50	<0.50	0.50	<0.50	0.50	<0.50	0.50	8578151
Alkalinity (Total as CaCO3)	mg/L	550	920	0.50	890	0.50	1500	0.50	8578151
Bicarbonate (HCO3)	mg/L	670	1100	0.50	1100	0.50	1800	0.50	8578151
Carbonate (CO3)	mg/L	<0.50	<0.50	0.50	<0.50	0.50	<0.50	0.50	8578151
Hydroxide (OH)	mg/L	<0.50	<0.50	0.50	<0.50	0.50	<0.50	0.50	8578151
Dissolved Sulphate (SO4)	mg/L	9.3	6.8	1.0	7.2	1.0	<1.0	1.0	8578822
Dissolved Chloride (Cl)	mg/L	17	200	1.0	260 (1)	5.0	83	1.0	8578705
Nutrients									
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	0.010	<0.010	0.010	<0.010	0.010	8578099
Dissolved Nitrate (N)	mg/L	<0.010	<0.010	0.010	0.044	0.010	0.031	0.010	8578099
Lab Filtered Elements									
Dissolved Aluminum (Al)	mg/L	0.0044	0.0042	0.0030	<0.0030	0.0030	0.0057	0.0030	8579121
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	<0.00060	0.00060	<0.00060	0.00060	8579121
Dissolved Arsenic (As)	mg/L	0.00044	0.0014	0.00020	0.0073	0.00020	0.0092	0.00020	8579121
Dissolved Barium (Ba)	mg/L	0.22	0.94	0.010	1.1	0.010	0.99	0.010	8578069
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010	8579121

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS2248	QS2249		QS2250		QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00		2017/03/14 12:00		2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01		512239-01-01		512239-01-01		
	UNITS	**XCG4**	**XCG13**	**RDL**	**MW-07**	**RDL**	**MW-06**	**RDL**	**QC Batch**
Dissolved Boron (B)	mg/L	0.038	0.050	0.020	0.066	0.020	0.23	0.020	8578069
Dissolved Calcium (Ca)	mg/L	130	190	0.30	230	0.30	230	0.30	8578069
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	0.0019	0.0010	8579121
Dissolved Cobalt (Co)	mg/L	0.00099	0.0068	0.00030	0.012	0.00030	0.014	0.00030	8579121
Dissolved Copper (Cu)	mg/L	0.0019	0.00089	0.00020	<0.00020	0.00020	<0.00020	0.00020	8579121
Dissolved Iron (Fe)	mg/L	<0.060	0.066	0.060	12	0.060	29	0.060	8578069
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	<0.00020	0.00020	<0.00020	0.00020	8579121
Dissolved Lithium (Li)	mg/L	<0.020	0.051	0.020	0.038	0.020	<0.020	0.020	8578069
Dissolved Magnesium (Mg)	mg/L	38	140	0.20	130	0.20	97	0.20	8578069
Dissolved Manganese (Mn)	mg/L	0.29	0.71	0.0040	1.8	0.0040	0.49	0.0040	8578069
Dissolved Molybdenum (Mo)	mg/L	0.00081	0.00055	0.00020	0.0024	0.00020	0.00074	0.00020	8579121
Dissolved Nickel (Ni)	mg/L	0.0081	0.015	0.00050	0.016	0.00050	0.012	0.00050	8579121
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	<0.10	0.10	<0.10	0.10	8578069
Dissolved Potassium (K)	mg/L	25	3.2	0.30	3.7	0.30	33	0.30	8578069
Dissolved Selenium (Se)	mg/L	<0.00020	0.00027	0.00020	0.00026	0.00020	0.00050	0.00020	8579121
Dissolved Silicon (Si)	mg/L	7.6	9.4	0.10	11	0.10	15	0.10	8578069
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	<0.00010	0.00010	8579121
Dissolved Sodium (Na)	mg/L	29	54	0.50	73	0.50	88	0.50	8578069
Dissolved Strontium (Sr)	mg/L	0.38	1.9	0.020	1.7	0.020	1.2	0.020	8578069
Dissolved Sulphur (S)	mg/L	3.1	2.7	0.20	3.4	0.20	2.3	0.20	8578069
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	<0.00020	0.00020	<0.00020	0.00020	8579121
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	0.0018	0.0010	8579121
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	0.0022	0.0010	8579121
Dissolved Uranium (U)	mg/L	0.0028	0.011	0.00010	0.010	0.00010	0.00060	0.00010	8579121
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	<0.0010	0.0010	8579121
Dissolved Zinc (Zn)	mg/L	0.0073	0.0034	0.0030	<0.0030	0.0030	0.013	0.0030	8579121

RDL = Reportable Detection Limit

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS2252		
Sampling Date		2017/03/14 09:00		
COC Number		512239-01-01		
	UNITS	**XCG12**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	meq/L	12	N/A	8577685
Cation Sum	meq/L	12	N/A	8577685
Hardness (CaCO3)	mg/L	550	0.50	8577683
Ion Balance (% Difference)	N/A	1.5	0.010	8577684
Dissolved Nitrate (NO3)	mg/L	0.17	0.044	8577686
Nitrate plus Nitrite (N)	mg/L	0.037	0.010	8577687
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	8577686
Calculated Total Dissolved Solids	mg/L	580	10	8577688
Misc. Inorganics				
Conductivity	uS/cm	1000	1.0	8578153
pH	pH	7.59	N/A	8578144
Low Level Elements				
Dissolved Cadmium (Cd)	ug/L	0.023	0.020	8577679
Anions				
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	8578151
Alkalinity (Total as CaCO3)	mg/L	530	0.50	8578151
Bicarbonate (HCO3)	mg/L	640	0.50	8578151
Carbonate (CO3)	mg/L	<0.50	0.50	8578151
Hydroxide (OH)	mg/L	<0.50	0.50	8578151
Dissolved Sulphate (SO4)	mg/L	42	1.0	8578822
Dissolved Chloride (Cl)	mg/L	22	1.0	8578705
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	8578099
Dissolved Nitrate (N)	mg/L	0.037	0.010	8578099
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	0.0054	0.0030	8579121
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	8579121
Dissolved Arsenic (As)	mg/L	0.019	0.00020	8579121
Dissolved Barium (Ba)	mg/L	1.2	0.010	8578069
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	8579121
Dissolved Boron (B)	mg/L	0.054	0.020	8578069

RDL = Reportable Detection Limit
N/A = Not Applicable

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		QS2252		
Sampling Date		2017/03/14 09:00		
COC Number		512239-01-01		
	UNITS	**XCG12**	**RDL**	**QC Batch**
Dissolved Calcium (Ca)	mg/L	130	0.30	8578069
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	8579121
Dissolved Cobalt (Co)	mg/L	0.00080	0.00030	8579121
Dissolved Copper (Cu)	mg/L	0.00047	0.00020	8579121
Dissolved Iron (Fe)	mg/L	<0.060	0.060	8578069
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	8579121
Dissolved Lithium (Li)	mg/L	0.031	0.020	8578069
Dissolved Magnesium (Mg)	mg/L	56	0.20	8578069
Dissolved Manganese (Mn)	mg/L	0.61	0.0040	8578069
Dissolved Molybdenum (Mo)	mg/L	0.0034	0.00020	8579121
Dissolved Nickel (Ni)	mg/L	0.0021	0.00050	8579121
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	8578069
Dissolved Potassium (K)	mg/L	7.7	0.30	8578069
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	8579121
Dissolved Silicon (Si)	mg/L	7.6	0.10	8578069
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	8579121
Dissolved Sodium (Na)	mg/L	11	0.50	8578069
Dissolved Strontium (Sr)	mg/L	0.72	0.020	8578069
Dissolved Sulphur (S)	mg/L	12	0.20	8578069
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	8579121
Dissolved Tin (Sn)	mg/L	0.0014	0.0010	8579121
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	8579121
Dissolved Uranium (U)	mg/L	0.0013	0.00010	8579121
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	8579121
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	8579121
RDL = Reportable Detection Limit				

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QS2248	QS2249	QS2250	QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00	2017/03/14 12:00	2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01	512239-01-01	512239-01-01		
	UNITS	**XCG4**	**XCG13**	**MW-07**	**MW-06**	**RDL**	**QC Batch**
Low Level Elements							
Total Cadmium (Cd)	ug/L	12	0.17	0.25	0.77	0.020	8577680
Elements							
Total Aluminum (Al)	mg/L	3.3	0.18	0.39	11	0.0030	8578678
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00096	0.00060	8578678
Total Arsenic (As)	mg/L	0.0030	0.0018	0.015	0.023	0.00020	8578678
Total Barium (Ba)	mg/L	0.27	0.91	1.2	1.5	0.010	8578681
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	8578678
Total Boron (B)	mg/L	0.039	0.050	0.064	0.25	0.020	8578681
Total Calcium (Ca)	mg/L	140	190	240	280	0.30	8578681
Total Chromium (Cr)	mg/L	0.0060	<0.0010	<0.0010	0.019	0.0010	8578678
Total Cobalt (Co)	mg/L	0.0035	0.0070	0.014	0.024	0.00030	8578678
Total Copper (Cu)	mg/L	0.0095	0.0012	0.0017	0.032	0.00020	8578678
Total Iron (Fe)	mg/L	5.6	0.52	19	69	0.060	8578681
Total Lead (Pb)	mg/L	0.010	0.00024	0.00084	0.021	0.00020	8578678
Total Lithium (Li)	mg/L	<0.020	0.047	0.036	0.026	0.020	8578681
Total Magnesium (Mg)	mg/L	41	140	130	120	0.20	8578681
Total Manganese (Mn)	mg/L	0.37	0.71	1.8	0.79	0.0040	8578681
Total Molybdenum (Mo)	mg/L	0.0014	0.00061	0.0025	0.0018	0.00020	8578678
Total Nickel (Ni)	mg/L	0.019	0.015	0.018	0.039	0.00050	8578678
Total Phosphorus (P)	mg/L	0.10	<0.10	<0.10	1.1	0.10	8578681
Total Potassium (K)	mg/L	26	3.3	3.7	38	0.30	8578681
Total Selenium (Se)	mg/L	0.00029	0.00025	0.00021	0.00076	0.00020	8578678
Total Silicon (Si)	mg/L	17	10	12	36	0.10	8578681
Total Silver (Ag)	mg/L	0.00011	<0.00010	<0.00010	0.00023	0.00010	8578678
Total Sodium (Na)	mg/L	35	56	76	95	0.50	8578681
Total Strontium (Sr)	mg/L	0.38	1.7	1.6	1.3	0.020	8578681
Total Sulphur (S)	mg/L	4.5	2.8	3.8	3.0	0.20	8578681
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	8578678
Total Tin (Sn)	mg/L	0.0020	<0.0010	<0.0010	0.0065	0.0010	8578678
Total Titanium (Ti)	mg/L	0.13	0.0050	0.014	0.19	0.0010	8578678
Total Uranium (U)	mg/L	0.0035	0.011	0.0099	0.0016	0.00010	8578678
Total Vanadium (V)	mg/L	0.010	<0.0010	0.0017	0.031	0.0010	8578678

RDL = Reportable Detection Limit

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		QS2248	QS2249	QS2250	QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00	2017/03/14 12:00	2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01	512239-01-01	512239-01-01		
	UNITS	**XCG4**	**XCG13**	**MW-07**	**MW-06**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/L	0.044	0.0053	0.0071	0.099	0.0030	8578678

RDL = Reportable Detection Limit

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QS2248		QS2249			QS2250		
Sampling Date		2017/03/14 10:00		2017/03/14 11:00			2017/03/14 12:00		
COC Number		512239-01-01		512239-01-01			512239-01-01		
	UNITS	**XCG4**	**QC Batch**	**XCG13**	**RDL**	**QC Batch**	**MW-07**	**RDL**	**QC Batch**
Demand Parameters									
Biochemical Oxygen Demand	mg/L	<2.0	8577635	3.1	2.0	8577635	7.8	2.0	8577635
Total Chemical Oxygen Demand	mg/L	41	8577974	41	5.0	8577974	64	5.0	8577974
Misc. Inorganics									
Total Organic Carbon (C)	mg/L	4.3	8578226	15	0.50	8578226	19	0.50	8578226
Nutrients									
Total Ammonia (N)	mg/L	0.17	8578021	0.18	0.050	8578021	0.87	0.050	8578021
Total Nitrogen (N)	mg/L	0.64	8577922	0.93	0.055	8577922	1.9	0.055	8577922
Total Phosphorus (P)	mg/L	0.11	8578808	0.020	0.0030	8578808	0.030	0.0030	8578808
Total Total Kjeldahl Nitrogen	mg/L	0.64	8577986	0.93	0.050	8577986	1.9 (1)	0.10	8577986
Organic Acids									
Formic Acid	mg/L	<0.50	8579332	<0.50	0.50	8579332	<0.50	0.50	8579332
Acetic Acid	mg/L	<0.50	8579332	<0.50	0.50	8579332	<0.50	0.50	8579332
Propionic Acid	mg/L	<0.50	8579332	<0.50	0.50	8579332	<0.50	0.50	8579332
Butyric Acid	mg/L	<10 (1)	8579332	<10 (1)	10	8579332	<10 (1)	10	8579332
Misc. Organics									
Adsorbable Organic Halogen	mg/L	0.03	8580620	0.60	0.01	8578814	0.06	0.01	8580620

RDL = Reportable Detection Limit

(1) Detection limits raised due to matrix interference.

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		QS2251	QS2252		
Sampling Date		2017/03/14 14:30	2017/03/14 09:00		
COC Number		512239-01-01	512239-01-01		
	UNITS	**MW-06**	**XCG12**	**RDL**	**QC Batch**
Demand Parameters					
Biochemical Oxygen Demand	mg/L	22 (1)	N/A	10	8577635
Total Chemical Oxygen Demand	mg/L	330	N/A	5.0	8577974
Misc. Inorganics					
Total Organic Carbon (C)	mg/L	72 (2)	N/A	2.5	8578226
Nutrients					
Total Ammonia (N)	mg/L	69 (2)	N/A	2.5	8578021
Total Nitrogen (N)	mg/L	96	N/A	0.055	8577922
Total Phosphorus (P)	mg/L	1.1 (2)	N/A	0.030	8578808
Total Total Kjeldahl Nitrogen	mg/L	96 (2)	N/A	2.5	8577986
Organic Acids					
Formic Acid	mg/L	<0.50	<0.50	0.50	8579332
Acetic Acid	mg/L	<0.50	<0.50	0.50	8579332
Propionic Acid	mg/L	<0.50	<0.50	0.50	8579332
Butyric Acid	mg/L	<10 (3)	<10 (3)	10	8579332
Misc. Organics					
Adsorbable Organic Halogen	mg/L	0.14	N/A	0.01	8578814

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limit raised based on sample volume used for analysis.
(2) Detection limits raised due to dilution to bring analyte within the calibrated range.

(3) Detection limits raised due to matrix interference.

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QS2248	QS2249	QS2250	QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00	2017/03/14 12:00	2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01	512239-01-01	512239-01-01		
	UNITS	**XCG4**	**XCG13**	**MW-07**	**MW-06**	**RDL**	**QC Batch**
Volatiles							
Total Trihalomethanes	ug/L	<1.3	<1.3	<1.3	<1.3	1.3	8577924
Bromodichloromethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Bromoform	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Bromomethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8578107
Carbon tetrachloride	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Chlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Chlorodibromomethane	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8578107
Chloroethane	ug/L	<1.0	<1.0	1.2	<1.0	1.0	8578107
Chloroform	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Chloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8578107
1,2-dibromoethane	ug/L	<0.20	<0.20	<0.20	0.30 (1)	0.20	8578107
1,2-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	0.52	0.50	8578107
1,3-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,4-dichlorobenzene	ug/L	<0.50	<0.50	<0.50	1.2	0.50	8578107
1,1-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,2-dichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,1-dichloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
cis-1,2-dichloroethene	ug/L	<0.50	130	120	18	0.50	8578107
trans-1,2-dichloroethene	ug/L	<0.50	1.9	2.9	<0.50	0.50	8578107
Dichloromethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8578107
1,2-dichloropropane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
cis-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
trans-1,3-dichloropropene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Methyl methacrylate	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Methyl-tert-butylether (MTBE)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
Styrene	ug/L	<0.50	<0.50	<0.50	0.75 (1)	0.50	8578107
1,1,1,2-tetrachloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8578107
1,1,2,2-tetrachloroethane	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	8578107
Tetrachloroethene	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,2,3-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8578107
1,2,4-trichlorobenzene	ug/L	<1.0	<1.0	<1.0	<1.0	1.0	8578107

RDL = Reportable Detection Limit

(1) Qualifying ion outside of acceptance criteria. Results are tentatively identified and potentially biased high.

VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		QS2248	QS2249	QS2250	QS2251		
Sampling Date		2017/03/14 10:00	2017/03/14 11:00	2017/03/14 12:00	2017/03/14 14:30		
COC Number		512239-01-01	512239-01-01	512239-01-01	512239-01-01		
	UNITS	**XCG4**	**XCG13**	**MW-07**	**MW-06**	**RDL**	**QC Batch**
1,3,5-trichlorobenzene	ug/L	<0.50	<0.50	<0.50	0.73	0.50	8578107
1,1,1-trichloroethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,1,2-trichloroethane	ug/L	<0.50	<0.50	<0.50	0.56	0.50	8578107
Trichloroethene	ug/L	<0.50	0.68	7.4	<0.50	0.50	8578107
Trichlorofluoromethane	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	8578107
1,2,4-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	14	0.50	8578107
1,3,5-trimethylbenzene	ug/L	<0.50	<0.50	<0.50	3.8	0.50	8578107
Vinyl chloride	ug/L	<0.50	21	39	8.4	0.50	8578107
Surrogate Recovery (%)							
1,4-Difluorobenzene (sur.)	%	97	98	97	97	N/A	8578107
4-Bromofluorobenzene (sur.)	%	102	101	103	102	N/A	8578107
D4-1,2-Dichloroethane (sur.)	%	97	97	92	101	N/A	8578107

RDL = Reportable Detection Limit
N/A = Not Applicable

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	4.7°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8577787	1,4-Difluorobenzene (sur.)	2017/03/15	99	70 - 130	102	70 - 130	101	%				
8577787	4-Bromofluorobenzene (sur.)	2017/03/15	93	70 - 130	96	70 - 130	96	%				
8577787	D4-1,2-Dichloroethane (sur.)	2017/03/15	93	70 - 130	91	70 - 130	91	%				
8578107	1,4-Difluorobenzene (sur.)	2017/03/20	97	70 - 130	98	70 - 130	99	%				
8578107	4-Bromofluorobenzene (sur.)	2017/03/20	107	70 - 130	104	70 - 130	101	%				
8578107	D4-1,2-Dichloroethane (sur.)	2017/03/20	113	70 - 130	94	70 - 130	91	%				
8578535	O-TERPHENYL (sur.)	2017/03/16	97	60 - 130	96	60 - 130	98	%				
8577635	Biochemical Oxygen Demand	2017/03/20			105	85 - 115	<2.0	mg/L	12	20		
8577787	Benzene	2017/03/15	92	70 - 130	91	70 - 130	<0.40	ug/L	NC	30		
8577787	Ethylbenzene	2017/03/15	96	70 - 130	99	70 - 130	<0.40	ug/L	NC	30		
8577787	F1 (C6-C10) - BTEX	2017/03/15					<100	ug/L	NC	30		
8577787	F1 (C6-C10)	2017/03/15	76	70 - 130	93	70 - 130	<100	ug/L	NC	30		
8577787	m & p-Xylene	2017/03/15	97	70 - 130	99	70 - 130	<0.80	ug/L	NC	30		
8577787	o-Xylene	2017/03/15	98	70 - 130	96	70 - 130	<0.40	ug/L	NC	30		
8577787	Toluene	2017/03/15	92	70 - 130	93	70 - 130	<0.40	ug/L	NC	30		
8577787	Xylenes (Total)	2017/03/15					<0.80	ug/L	NC	30		
8577974	Total Chemical Oxygen Demand	2017/03/15	99	80 - 120	100	80 - 120	<5.0	mg/L	2.4	20		
8577986	Total Total Kjeldahl Nitrogen	2017/03/16	101	80 - 120	100	80 - 120	<0.050	mg/L	16	20	105	80 - 120
8578021	Total Ammonia (N)	2017/03/15	99	80 - 120	107	80 - 120	<0.050	mg/L	2.8	20		
8578069	Dissolved Barium (Ba)	2017/03/15	103	80 - 120	99	80 - 120	<0.010	mg/L				
8578069	Dissolved Boron (B)	2017/03/15	106	80 - 120	103	80 - 120	<0.020	mg/L				
8578069	Dissolved Calcium (Ca)	2017/03/15	NC	80 - 120	96	80 - 120	<0.30	mg/L	0.29	20		
8578069	Dissolved Iron (Fe)	2017/03/15	101	80 - 120	101	80 - 120	<0.060	mg/L	NC	20		
8578069	Dissolved Lithium (Li)	2017/03/15	108	80 - 120	105	80 - 120	<0.020	mg/L				
8578069	Dissolved Magnesium (Mg)	2017/03/15	101	80 - 120	101	80 - 120	<0.20	mg/L	0.059	20		
8578069	Dissolved Manganese (Mn)	2017/03/15	98	80 - 120	98	80 - 120	<0.0040	mg/L	NC	20		
8578069	Dissolved Phosphorus (P)	2017/03/15	107	80 - 120	102	80 - 120	<0.10	mg/L				
8578069	Dissolved Potassium (K)	2017/03/15	106	80 - 120	101	80 - 120	<0.30	mg/L	1.2	20		
8578069	Dissolved Silicon (Si)	2017/03/15	95	80 - 120	96	80 - 120	<0.10	mg/L				
8578069	Dissolved Sodium (Na)	2017/03/15	101	80 - 120	100	80 - 120	<0.50	mg/L	0.30	20		
8578069	Dissolved Strontium (Sr)	2017/03/15	NC	80 - 120	101	80 - 120	<0.020	mg/L				

Maxxam Job #: B718663
Report Date: 2017/03/21

QUALITY ASSURANCE REPORT(CONT'D)

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8578069	Dissolved Sulphur (S)	2017/03/15					<0.20	mg/L				
8578099	Dissolved Nitrate (N)	2017/03/15	107	80 - 120	103	80 - 120	<0.010	mg/L	NC	20		
8578099	Dissolved Nitrite (N)	2017/03/15	104	80 - 120	103	80 - 120	<0.010	mg/L	NC	20		
8578107	1,1,1,2-tetrachloroethane	2017/03/20	94	70 - 130	97	70 - 130	<1.0	ug/L	NC	40		
8578107	1,1,1-trichloroethane	2017/03/20	95	70 - 130	98	70 - 130	<0.50	ug/L	NC	40		
8578107	1,1,2,2-tetrachloroethane	2017/03/20	101	70 - 130	104	70 - 130	<2.0	ug/L	NC	40		
8578107	1,1,2-trichloroethane	2017/03/20	100	70 - 130	101	70 - 130	<0.50	ug/L	NC	40		
8578107	1,1-dichloroethane	2017/03/20	101	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8578107	1,1-dichloroethene	2017/03/20	101	70 - 130	103	70 - 130	<0.50	ug/L	NC	40		
8578107	1,2,3-trichlorobenzene	2017/03/20	110	70 - 130	101	70 - 130	<1.0	ug/L	NC	40		
8578107	1,2,4-trichlorobenzene	2017/03/20	108	70 - 130	101	70 - 130	<1.0	ug/L	NC	40		
8578107	1,2,4-trimethylbenzene	2017/03/20	106	70 - 130	107	70 - 130	<0.50	ug/L	NC	40		
8578107	1,2-dibromoethane	2017/03/20	93	70 - 130	96	70 - 130	<0.20	ug/L	NC	40		
8578107	1,2-dichlorobenzene	2017/03/20	103	70 - 130	103	70 - 130	<0.50	ug/L	NC	40		
8578107	1,2-dichloroethane	2017/03/20	98	70 - 130	100	70 - 130	<0.50	ug/L	NC	40		
8578107	1,2-dichloropropane	2017/03/20	102	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8578107	1,3,5-trichlorobenzene	2017/03/20	104	70 - 130	100	70 - 130	<0.50	ug/L	NC	40		
8578107	1,3,5-trimethylbenzene	2017/03/20	105	70 - 130	106	70 - 130	<0.50	ug/L	NC	40		
8578107	1,3-dichlorobenzene	2017/03/20	102	70 - 130	105	70 - 130	<0.50	ug/L	NC	40		
8578107	1,4-dichlorobenzene	2017/03/20	102	70 - 130	104	70 - 130	<0.50	ug/L	NC	40		
8578107	Bromodichloromethane	2017/03/20	96	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8578107	Bromoform	2017/03/20	90	70 - 130	94	70 - 130	<0.50	ug/L	NC	40		
8578107	Bromomethane	2017/03/20	100	70 - 130	108	70 - 130	<2.0	ug/L	NC	40		
8578107	Carbon tetrachloride	2017/03/20	95	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8578107	Chlorobenzene	2017/03/20	96	70 - 130	98	70 - 130	<0.50	ug/L	NC	40		
8578107	Chlorodibromomethane	2017/03/20	92	70 - 130	96	70 - 130	<1.0	ug/L	NC	40		
8578107	Chloroethane	2017/03/20	97	70 - 130	99	70 - 130	<1.0	ug/L	NC	40		
8578107	Chloroform	2017/03/20	100	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8578107	Chloromethane	2017/03/20	101	70 - 130	106	70 - 130	<2.0	ug/L	NC	40		
8578107	cis-1,2-dichloroethene	2017/03/20	104	70 - 130	100	70 - 130	<0.50	ug/L	NC	40		
8578107	cis-1,3-dichloropropene	2017/03/20	109	70 - 130	115	70 - 130	<0.50	ug/L	NC	40		

Maxxam Job #: B718663
Report Date: 2017/03/21

QUALITY ASSURANCE REPORT(CONT'D)

XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Location: MONTFORT LANDFILL, RED DEER

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8578107	Dichloromethane	2017/03/20	103	70 - 130	104	70 - 130	<2.0	ug/L	NC	40		
8578107	Methyl methacrylate	2017/03/20	101	70 - 130	101	70 - 130	<0.50	ug/L	NC	40		
8578107	Methyl-tert-butylether (MTBE)	2017/03/20	108	70 - 130	110	70 - 130	<0.50	ug/L	NC	40		
8578107	Styrene	2017/03/20	100	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8578107	Tetrachloroethene	2017/03/20	95	70 - 130	97	70 - 130	<0.50	ug/L	NC	40		
8578107	trans-1,2-dichloroethene	2017/03/20	100	70 - 130	102	70 - 130	<0.50	ug/L	NC	40		
8578107	trans-1,3-dichloropropene	2017/03/20	113	70 - 130	123	70 - 130	<0.50	ug/L	NC	40		
8578107	Trichloroethene	2017/03/20	98	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8578107	Trichlorofluoromethane	2017/03/20	97	70 - 130	99	70 - 130	<0.50	ug/L	NC	40		
8578107	Vinyl chloride	2017/03/20	103	70 - 130	101	70 - 130	<0.50	ug/L	NC	40		
8578144	pH	2017/03/15			100	97 - 103			0.35	N/A		
8578151	Alkalinity (PP as CaCO3)	2017/03/15					<0.50	mg/L	NC	20		
8578151	Alkalinity (Total as CaCO3)	2017/03/15			100	80 - 120	<0.50	mg/L	0.11	20		
8578151	Bicarbonate (HCO3)	2017/03/15					<0.50	mg/L	0.11	20		
8578151	Carbonate (CO3)	2017/03/15					<0.50	mg/L	NC	20		
8578151	Hydroxide (OH)	2017/03/15					<0.50	mg/L	NC	20		
8578153	Conductivity	2017/03/15			99	90 - 110	<1.0	uS/cm	0.60	10		
8578226	Total Organic Carbon (C)	2017/03/15	NC	80 - 120	107	80 - 120	<0.50	mg/L	11	20		
8578535	F2 (C10-C16 Hydrocarbons)	2017/03/16	109	60 - 130	107	70 - 130	<0.10	mg/L	NC	30		
8578678	Total Aluminum (Al)	2017/03/16	NC	80 - 120	96	80 - 120	<0.0030	mg/L	2.0	20		
8578678	Total Antimony (Sb)	2017/03/16	97	80 - 120	101	80 - 120	<0.00060	mg/L	NC	20		
8578678	Total Arsenic (As)	2017/03/16	102	80 - 120	103	80 - 120	<0.00020	mg/L	0.51	20		
8578678	Total Beryllium (Be)	2017/03/16	99	80 - 120	97	80 - 120	<0.0010	mg/L	NC	20		
8578678	Total Chromium (Cr)	2017/03/16	101	80 - 120	102	80 - 120	<0.0010	mg/L	15	20		
8578678	Total Cobalt (Co)	2017/03/16	98	80 - 120	101	80 - 120	<0.00030	mg/L	1.2	20		
8578678	Total Copper (Cu)	2017/03/16	97	80 - 120	102	80 - 120	<0.00020	mg/L	1.4	20		
8578678	Total Lead (Pb)	2017/03/16	100	80 - 120	104	80 - 120	<0.00020	mg/L	2.9	20		
8578678	Total Molybdenum (Mo)	2017/03/16	106	80 - 120	102	80 - 120	<0.00020	mg/L	5.1	20		
8578678	Total Nickel (Ni)	2017/03/16	98	80 - 120	102	80 - 120	<0.00050	mg/L	1.8	20		
8578678	Total Selenium (Se)	2017/03/16	104	80 - 120	105	80 - 120	<0.00020	mg/L	16	20		
8578678	Total Silver (Ag)	2017/03/16	102	80 - 120	102	80 - 120	<0.00010	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8578678	Total Thallium (Tl)	2017/03/16	105	80 - 120	108	80 - 120	<0.00020	mg/L	NC	20		
8578678	Total Tin (Sn)	2017/03/16	101	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20		
8578678	Total Titanium (Ti)	2017/03/16	92	80 - 120	96	80 - 120	<0.0010	mg/L	5.0	20		
8578678	Total Uranium (U)	2017/03/16	89	80 - 120	89	80 - 120	<0.00010	mg/L	1.2	20		
8578678	Total Vanadium (V)	2017/03/16	103	80 - 120	102	80 - 120	<0.0010	mg/L	1.8	20		
8578678	Total Zinc (Zn)	2017/03/16	97	80 - 120	101	80 - 120	<0.0030	mg/L	8.2	20		
8578681	Total Barium (Ba)	2017/03/16	95	80 - 120	97	80 - 120	<0.010	mg/L	0.62	20		
8578681	Total Boron (B)	2017/03/16	98	80 - 120	100	80 - 120	<0.020	mg/L	4.5	20		
8578681	Total Calcium (Ca)	2017/03/16	NC	80 - 120	92	80 - 120	<0.30	mg/L	0.54	20		
8578681	Total Iron (Fe)	2017/03/16	99	80 - 120	99	80 - 120	<0.060	mg/L	0.65	20		
8578681	Total Lithium (Li)	2017/03/16	96	80 - 120	97	80 - 120	<0.020	mg/L	10	20		
8578681	Total Magnesium (Mg)	2017/03/16	NC	80 - 120	100	80 - 120	<0.20	mg/L	0.48	20		
8578681	Total Manganese (Mn)	2017/03/16	94	80 - 120	98	80 - 120	<0.0040	mg/L	0.59	20		
8578681	Total Phosphorus (P)	2017/03/16	99	80 - 120	98	80 - 120	<0.10	mg/L	NC	20		
8578681	Total Potassium (K)	2017/03/16	99	80 - 120	99	80 - 120	<0.30	mg/L	1.3	20		
8578681	Total Silicon (Si)	2017/03/16	NC	80 - 120	105	80 - 120	<0.10	mg/L	1.6	20		
8578681	Total Sodium (Na)	2017/03/16	NC	80 - 120	98	80 - 120	<0.50	mg/L	1.0	20		
8578681	Total Strontium (Sr)	2017/03/16	92	80 - 120	97	80 - 120	<0.020	mg/L	0.62	20		
8578681	Total Sulphur (S)	2017/03/16					<0.20	mg/L	0.56	20		
8578705	Dissolved Chloride (Cl)	2017/03/16	110	80 - 120	105	80 - 120	<1.0	mg/L	6.5	20		
8578808	Total Phosphorus (P)	2017/03/17	NC	80 - 120	99	80 - 120	<0.0030	mg/L	0.86	20	86	80 - 120
8578814	Adsorbable Organic Halogen	2017/03/16					<0.5	mg/L			101	84 - 111
8578822	Dissolved Sulphate (SO4)	2017/03/16	NC	80 - 120	100	80 - 120	<1.0	mg/L	0.040	20		
8579121	Dissolved Aluminum (Al)	2017/03/16	95	80 - 120	101	80 - 120	<0.0030	mg/L	4.6	20		
8579121	Dissolved Antimony (Sb)	2017/03/16	102	80 - 120	100	80 - 120	<0.00060	mg/L	NC	20		
8579121	Dissolved Arsenic (As)	2017/03/16	100	80 - 120	99	80 - 120	<0.00020	mg/L	0.69	20		
8579121	Dissolved Beryllium (Be)	2017/03/16	98	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20		
8579121	Dissolved Chromium (Cr)	2017/03/16	98	80 - 120	99	80 - 120	<0.0010	mg/L	NC	20		
8579121	Dissolved Cobalt (Co)	2017/03/16	95	80 - 120	99	80 - 120	<0.00030	mg/L	2.9	20		
8579121	Dissolved Copper (Cu)	2017/03/16	93	80 - 120	99	80 - 120	<0.00020	mg/L	4.6	20		
8579121	Dissolved Lead (Pb)	2017/03/16	96	80 - 120	100	80 - 120	<0.00020	mg/L	NC	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8579121	Dissolved Molybdenum (Mo)	2017/03/16	104	80 - 120	101	80 - 120	<0.00020	mg/L	9.7	20		
8579121	Dissolved Nickel (Ni)	2017/03/16	97	80 - 120	99	80 - 120	<0.00050	mg/L	2.9	20		
8579121	Dissolved Selenium (Se)	2017/03/16	101	80 - 120	103	80 - 120	<0.00020	mg/L	NC	20		
8579121	Dissolved Silver (Ag)	2017/03/16	100	80 - 120	100	80 - 120	<0.00010	mg/L	NC	20		
8579121	Dissolved Thallium (Tl)	2017/03/16	101	80 - 120	104	80 - 120	<0.00020	mg/L	NC	20		
8579121	Dissolved Tin (Sn)	2017/03/16	103	80 - 120	101	80 - 120	<0.0010	mg/L	NC	20		
8579121	Dissolved Titanium (Ti)	2017/03/16	103	80 - 120	98	80 - 120	<0.0010	mg/L	NC	20		
8579121	Dissolved Uranium (U)	2017/03/16	90	80 - 120	91	80 - 120	<0.00010	mg/L	1.1	20		
8579121	Dissolved Vanadium (V)	2017/03/16	101	80 - 120	100	80 - 120	<0.0010	mg/L	NC	20		
8579121	Dissolved Zinc (Zn)	2017/03/16	96	80 - 120	99	80 - 120	<0.0030	mg/L	0.41	20		
8579332	Acetic Acid	2017/03/16	98	80 - 120	98	80 - 120	<0.50	mg/L	NC	20		
8579332	Butyric Acid	2017/03/16	90	80 - 120	97	80 - 120	<0.50	mg/L	NC	20		
8579332	Formic Acid	2017/03/16	111	80 - 120	99	80 - 120	<0.50	mg/L	NC	20		
8579332	Propionic Acid	2017/03/16	101	80 - 120	97	80 - 120	<0.50	mg/L	NC	20		
8580620	Adsorbable Organic Halogen	2017/03/17					<0.5	mg/L			95	84 - 111

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

A Koksharova

Anna Koksharova, M.Sc., Organics Senior Analyst

Daniel Reslan, cCT, QP, Organics Supervisor

Gayle Simpson, Analyst II

Justin Geisel

Justin Geisel, B.Sc., Organics Supervisor

Peng Liang

Harry (Peng) Liang, Senior Analyst

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Sandy Yuan, M.Sc., Scientific Specialist

Maxxam
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CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:

Company Name: #9475 XCG CONSULTING LIMITED
Attention: STEPHANIE BORGS
Address: 10455 84 AVENUE
EDMONTON AB T6E 2H3
Tel: Fax:
Email: stephanie.borgs@xcg.com

REPORT TO:

Company Name:
Attention:
Address:
Tel: Fax:
Email:

PROJECT INFORMATION:

Quotation #:
P.O. #: 4-2352-04-03
Project:
Project Name:
Site #: Montfort Landfill, Red Deer
Sampled By:

Laboratory Use Only:

Maxxam Job #: B718663 SUK
Bottle Order #: 512239
COC #: C#512239-01-01
Project Manager: Amanda L'Hirondelle

Regulatory Criteria:
☑ ATI
☐ CCME
☐ Other

Special Instructions

Turnaround Time (TAT) Required:

Please provide advance notice for rush projects

Regular (Standard) TAT: ☑
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: *(call lab for #)*

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Nitrogen (total), Calc. TKN, NO3, NO2	Organic Halogen (Adsorbable)	Regulated Metals (CCME/AT1) - Total	Formic, Acetic, Propionic & Butyric Acid	Routine Water & Diss. Regulated Metals	Biochemical Oxygen Demand	COD, Total Phosphorus	Ammonia-N (Total), TOC	BTEXF1-F2 and VOC		# of Bottles	Comments
1		~~[illegible]~~ XCG4	17/03/14	1000 am	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
2		~~MW-02~~ XCG13	17/03/14	1100 am	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
3		~~MW-03~~ MW-07	17/03/14	1200 pm	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
4		~~[illegible]~~ MW-06	17/03/14	230 pm	GW	N	✓	✓	✓	✓	✓	✓	✓	✓	✓		11	
5		~~MW-05~~ XCG12	17/03/14	900 am	GW	N				✓	✓						1	
6		~~MW-06~~																
7		~~MW-07~~																
8		~~MW16-08~~																
9		~~MW16-09~~																
10		~~MW16-10~~																

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
1) / Stephanie Borgs	17/03/14	22:55	Jenna Walter	20170315	0730	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
☒	6.4.4 ice yes	☐ Yes ☑ No

IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: Maxxam Yellow: Client

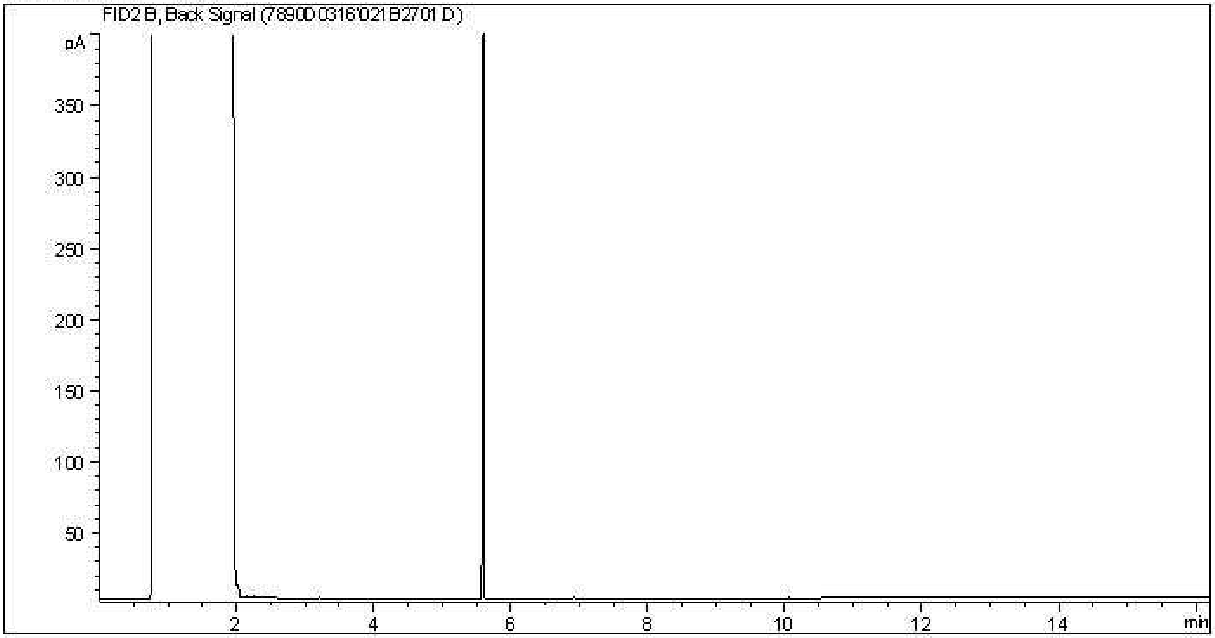
Maxxam Analytics International Corporation o/a Maxxam Analytics

Maxxam Job #: B718663
Report Date: 2017/03/21
Maxxam Sample: QS2248

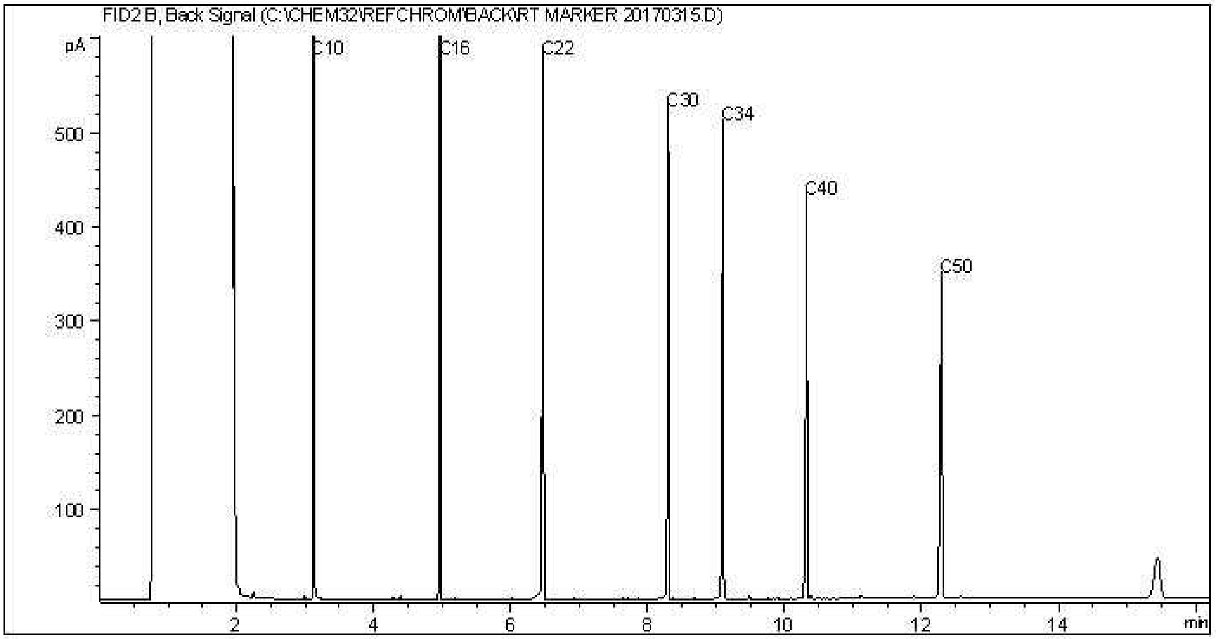
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: XCG4

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

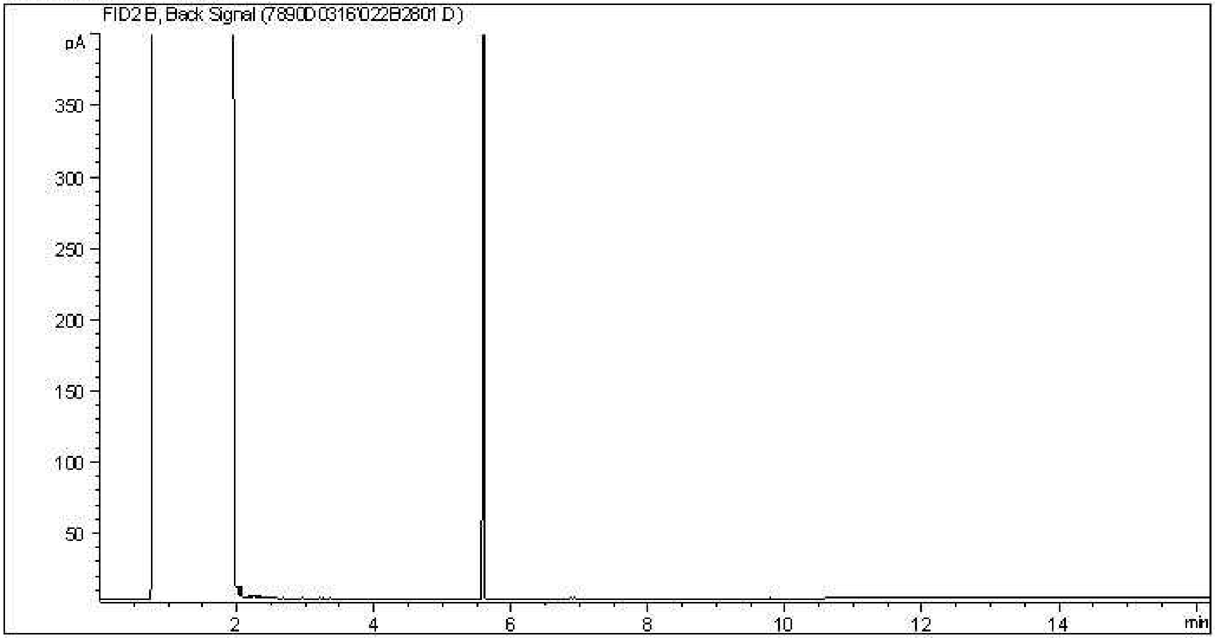
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718663
Report Date: 2017/03/21
Maxxam Sample: QS2249

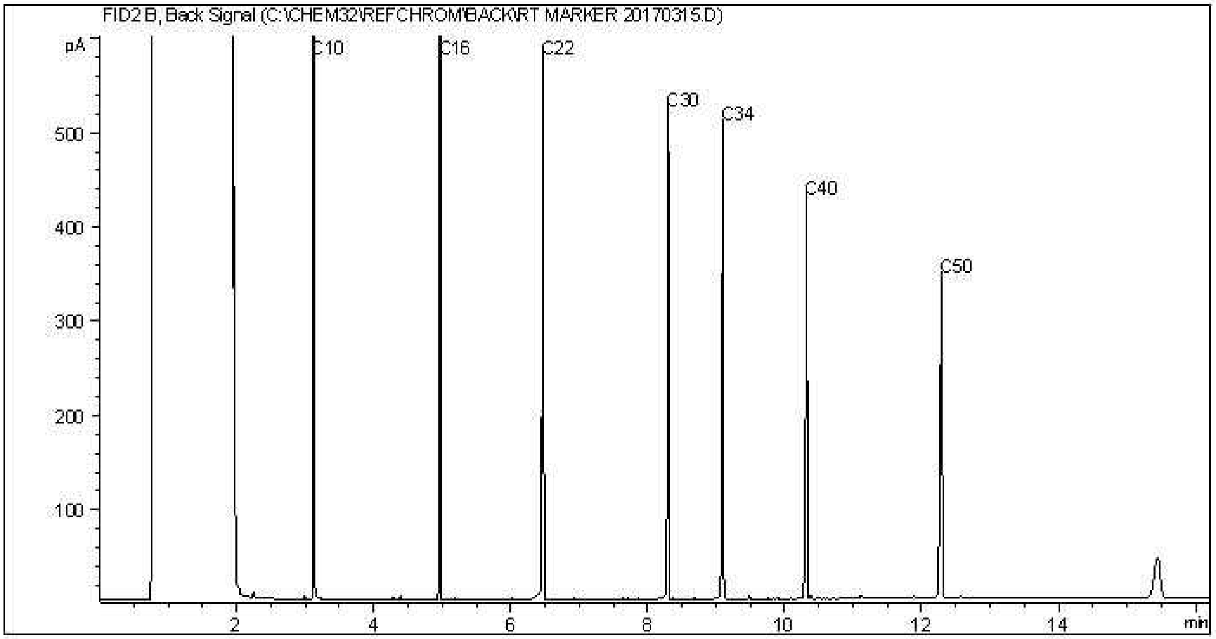
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: XCG13

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



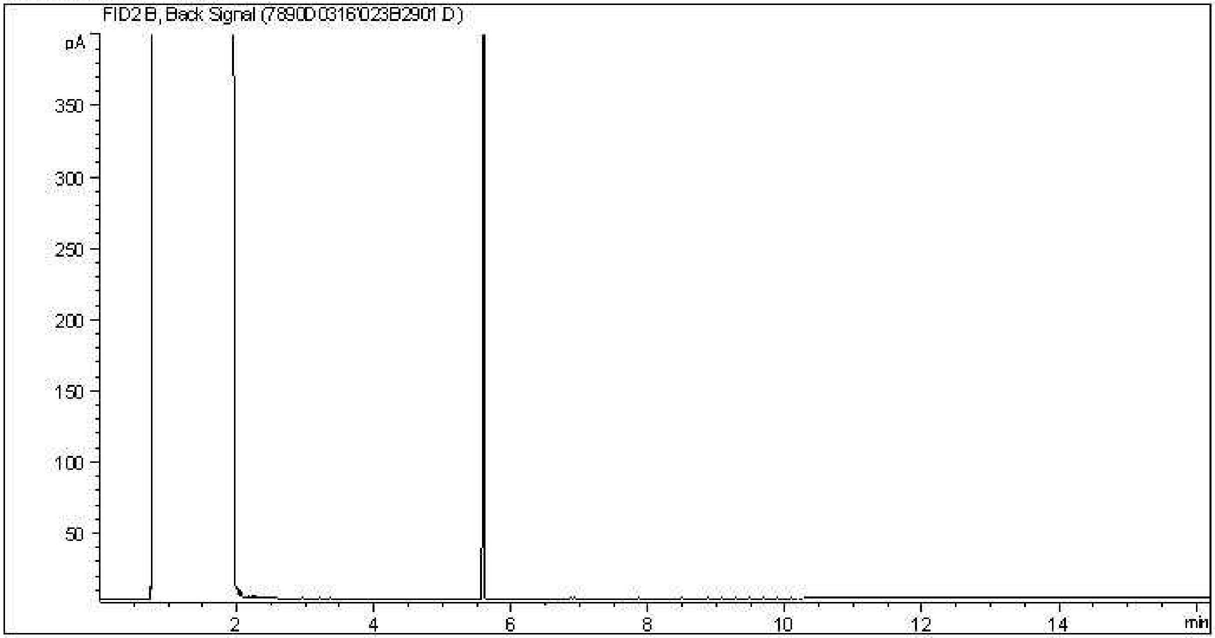
TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

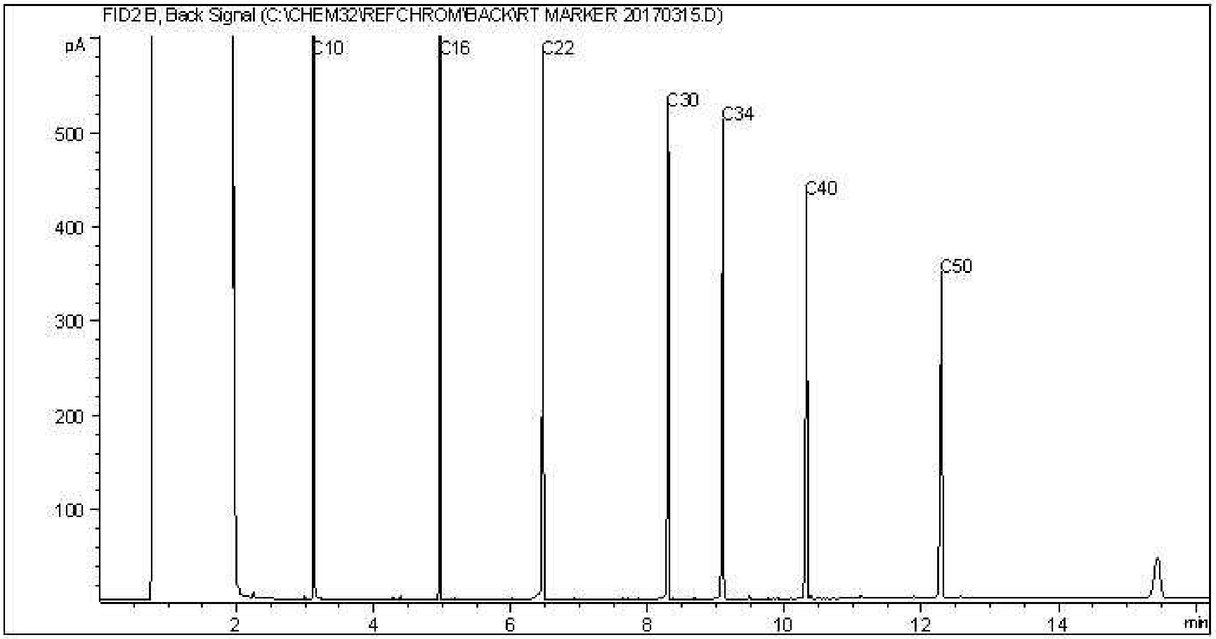
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40
Kerosene:	C7 - C16	Crude Oils:	C3 - C60+

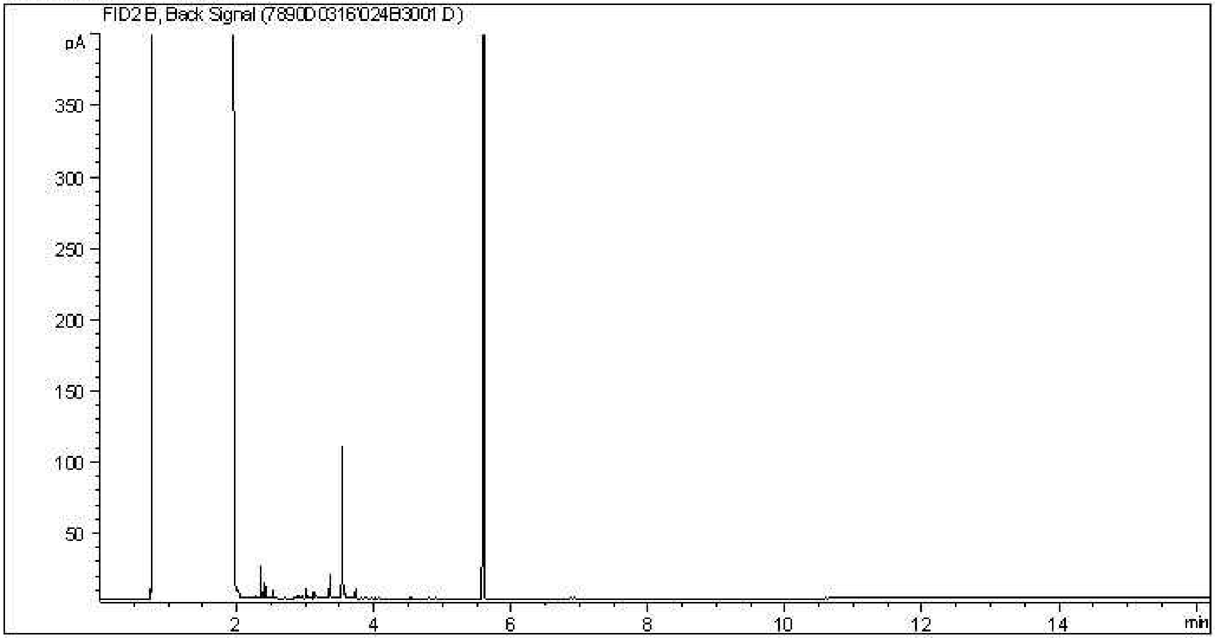
Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B718663
Report Date: 2017/03/21
Maxxam Sample: QS2251

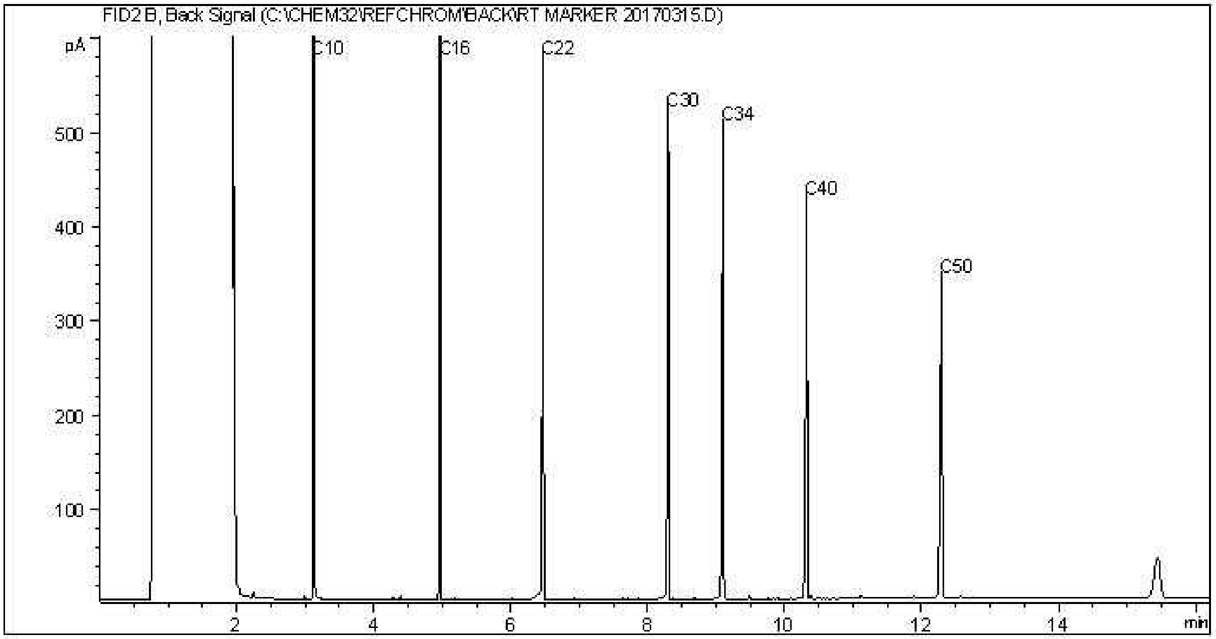
XCG CONSULTING LIMITED
Client Project #: 4-2352-04-03
Site Reference: MONTFORT LANDFILL, RED DEER
Client ID: MW-06

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram

Instrument: 7890D



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

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Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: 4-2352-04.03
Your C.O.C. #: 30585

Attention: Mary-Catherine Lanning

XCG Consulting Limited
820 Trillium Dr
Kitchener, ON
N2R 1K4

Report Date: 2018/01/23
Report #: R4947358
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B752667
Received: 2017/03/16, 10:00

Sample Matrix: AIR
Samples Received: 14

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
BTEX and CCME Compounds in Air(TO-15mod)	14	N/A	2017/03/17	BRL SOP-00304	EPA TO-15 m
Canister Pressure (TO-15)	14	N/A	2017/03/17	BRL SOP-00304	EPA TO-15 m
Light Hydrocarbons	1	N/A	2017/03/23	CAM SOP-00204	GC/FID
Light Hydrocarbons	12	N/A	2017/03/27	CAM SOP-00204	GC/FID
Matrix Gases (1)	13	N/A	2017/03/23	CAM SOP-00225	
Volatile Organics in Air (TO-15) (2)	14	N/A	2017/03/17	BRL SOP-00304	EPA TO-15 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

(1) Argon interferes with Oxygen and is included in the reported Oxygen concentration. The atmosphere contains about 0.9% Argon.
(2) Air sampling canisters have been cleaned in accordance with U.S. EPA Method TO14A. At the end of the cleaning, evacuation, and pressurization cycles, one canister was selected and was pressurized with Zero Air. This canister was then analyzed via TO14A on a GC/MS. The canister must have been found to contain <0.2 ppbv concentration of all target analytes in order for the batch to have been considered clean. Each canister also underwent a leak check prior to shipment.

Please Note: SUMMA® canister samples will be retained by Maxxam for a period of 5 calendar days or as contractually agreed from the date of this report, after which time they will be cleaned for reuse. If you require a longer sample storage period, please contact your service representative.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Marinela Sim, Project Manager
Email: MSim@maxxam.ca
Phone# (905) 817-5700
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

RESULTS OF ANALYSES OF AIR

Maxxam ID		EBG085			EBG086			EBG087		
Sampling Date		2017/03/14			2017/03/14			2017/03/14		
COC Number		30585			30585			30585		
	UNITS	**XCG-5 (SVP)/1380**	**RDL**	**QC Batch**	**XCG-4 (SVP)/1281**	**RDL**	**QC Batch**	**XCG-12 (SVP)/262**	**RDL**	**QC Batch**
Ethane	ppm	<0.26	0.26	4914918	0.24	0.23	4914918	<0.23	0.23	4914918
Ethylene	ppm	<0.26	0.26	4914918	6.2	0.23	4914918	<0.23	0.23	4914918
Methane	ppm	<5.2	5.2	4914918				32	4.5	4914918
Propane	ppm	<0.26	0.26	4914918	<0.23	0.23	4914918	<0.23	0.23	4914918
Propene	ppm	<0.26	0.26	4914918	<0.23	0.23	4914918	<0.23	0.23	4914918
Pressure on Receipt	psig	(-3.4)		4903766	(-3.4)		4903766	(-3.0)		4903766

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam ID		EBG088			EBG089			EBG090		
Sampling Date		2017/03/13			2017/03/11			2017/03/11		
COC Number		30585			30585			30585		
	UNITS	**XCG-6 (SVP)/238**	**RDL**	**QC Batch**	**XCG-2 (SVP)/243**	**RDL**	**QC Batch**	**VW-05/1800**	**RDL**	**QC Batch**
Ethane	ppm	<0.22	0.22	4914918	<0.27	0.27	4914918	2.3	0.21	4914918
Ethylene	ppm	0.57	0.22	4914918	<0.27	0.27	4914918	6.8	0.21	4914918
Methane	ppm				5.9	5.4	4914918			
Propane	ppm	<0.22	0.22	4914918	<0.27	0.27	4914918	<0.21	0.21	4914918
Propene	ppm	<0.22	0.22	4914918	<0.27	0.27	4914918	<0.21	0.21	4914918
Pressure on Receipt	psig	(-3.0)		4903766	(-3.6)		4903766	(-1.9)		4903766

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Maxxam ID		EBG091			EBG092			EBG093		
Sampling Date		2017/03/11			2017/03/11			2017/03/12		
COC Number		30585			30585			30585		
	UNITS	**XCG-100/3017**	**RDL**	**QC Batch**	**XCG-1 (SVP)/1470**	**RDL**	**QC Batch**	**XCG-13 (SVP)/354**	**RDL**	**QC Batch**
Ethane	ppm	2.1	0.2	4914918	<0.2	0.2	4914918	<0.19	0.19	4914918
Ethylene	ppm	6.3	0.2	4914918	<0.2	0.2	4914918	0.25	0.19	4914918
Methane	ppm				<3.9	3.9	4914918			
Propane	ppm	<0.2	0.2	4914918	<0.2	0.2	4914918	<0.19	0.19	4914918
Propene	ppm	<0.2	0.2	4914918	<0.2	0.2	4914918	<0.19	0.19	4914918
Pressure on Receipt	psig	(-2.0)		4903766	(-1.7)		4903766	(-1.7)		4903766

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

RESULTS OF ANALYSES OF AIR

Maxxam ID		EBG094		EBG095		EBG096		EBG097		
Sampling Date		2017/03/12		2017/03/12		2017/03/11		2017/03/12		
COC Number		30585		30585		30585		30585		
	UNITS	**XCG-10 (SVP)/1041**	**RDL**	**VW-01/332**	**RDL**	**XCG-9 (SVP)/333**	**RDL**	**VW-03/1280**	**RDL**	**QC Batch**
Ethane	ppm	<0.17	0.17	<0.21	0.21	<0.21	0.21	<0.19	0.19	4914918
Ethylene	ppm	<0.17	0.17	<0.21	0.21	<0.21	0.21	<0.19	0.19	4914918
Methane	ppm	<3.4	3.4	<4.3	4.3	<4.2	4.2	<3.8	3.8	4914918
Propane	ppm	<0.17	0.17	<0.21	0.21	<0.21	0.21	<0.19	0.19	4914918
Propene	ppm	<0.17	0.17	<0.21	0.21	<0.21	0.21	<0.19	0.19	4914918
Pressure on Receipt	psig	(-1.1)		(-2.9)		(-2.7)		(-3.1)		4903766

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG098	
Sampling Date		2017/03/12	
COC Number		30585	
	UNITS	**TRIP BLANK/215**	**QC Batch**
Pressure on Receipt	psig	(-14.3)	4903766

QC Batch = Quality Control Batch

COMPRESSED GAS PARAMETERS (AIR)

Maxxam ID		EBG085		EBG086	EBG087	EBG088		
Sampling Date		2017/03/14		2017/03/14	2017/03/14	2017/03/13		
COC Number		30585		30585	30585	30585		
	UNITS	**XCG-5 (SVP)/1380**	**RDL**	**XCG-4 (SVP)/1281**	**XCG-12 (SVP)/262**	**XCG-6 (SVP)/238**	**RDL**	**QC Batch**
Oxygen	% v/v	20.3	0.3	2.0	18.7	1.9	0.2	4914859
Nitrogen	% v/v	77.4	0.3	82.8	79.0	81.5	0.2	4914859
Carbon Monoxide	% v/v	<0.3	0.3	<0.2	<0.2	<0.2	0.2	4914859
Methane	% v/v	<0.3	0.3	5.7	<0.2	1.2	0.2	4914859
Carbon Dioxide	% v/v	2.3	0.3	9.5	2.3	15.4	0.2	4914859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG089		EBG090	EBG091	EBG092	EBG093		
Sampling Date		2017/03/11		2017/03/11	2017/03/11	2017/03/11	2017/03/12		
COC Number		30585		30585	30585	30585	30585		
	UNITS	**XCG-2 (SVP)/243**	**RDL**	**VW-05/1800**	**XCG-100/3017**	**XCG-1 (SVP)/1470**	**XCG-13 (SVP)/354**	**RDL**	**QC Batch**
Oxygen	% v/v	20.3	0.3	8.6	9.6	20.4	4.3	0.2	4914859
Nitrogen	% v/v	78.4	0.3	79.0	78.9	78.1	84.8	0.2	4914859
Carbon Monoxide	% v/v	<0.3	0.3	<0.2	<0.2	<0.2	<0.2	0.2	4914859
Methane	% v/v	<0.3	0.3	0.3	0.3	<0.2	1.1	0.2	4914859
Carbon Dioxide	% v/v	1.3	0.3	12.1	11.3	1.5	9.8	0.2	4914859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG094	EBG095	EBG096	EBG097		
Sampling Date		2017/03/12	2017/03/12	2017/03/11	2017/03/12		
COC Number		30585	30585	30585	30585		
	UNITS	**XCG-10 (SVP)/1041**	**VW-01/332**	**XCG-9 (SVP)/333**	**VW-03/1280**	**RDL**	**QC Batch**
Oxygen	% v/v	15.8	23.0	21.3	12.5	0.2	4914859
Nitrogen	% v/v	81.7	77.0	78.2	80.7	0.2	4914859
Carbon Monoxide	% v/v	<0.2	<0.2	<0.2	<0.2	0.2	4914859
Methane	% v/v	<0.2	<0.2	<0.2	<0.2	0.2	4914859
Carbon Dioxide	% v/v	2.5	<0.2	0.6	6.8	0.2	4914859

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANIC HYDROCARBONS BY GC/MS (AIR)

Maxxam ID		EBG085	EBG086	EBG087	EBG088	EBG089		
Sampling Date		2017/03/14	2017/03/14	2017/03/14	2017/03/13	2017/03/11		
COC Number		30585	30585	30585	30585	30585		
	UNITS	**XCG-5 (SVP)/1380**	**XCG-4 (SVP)/1281**	**XCG-12 (SVP)/262**	**XCG-6 (SVP)/238**	**XCG-2 (SVP)/243**	**RDL**	**QC Batch**
F1-BTEX, C6-C10 (as Toluene)	ug/m3	18.4	39.7	8.8	668	<5.0	5.0	4903767
F2, C10-C16 (as Decane)	ug/m3	6.2	<5.0	<5.0	<5.0	<5.0	5.0	4903767

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG090	EBG091	EBG092	EBG093	EBG094		
Sampling Date		2017/03/11	2017/03/11	2017/03/11	2017/03/12	2017/03/12		
COC Number		30585	30585	30585	30585	30585		
	UNITS	**VW-05/1800**	**XCG-100/3017**	**XCG-1 (SVP)/1470**	**XCG-13 (SVP)/354**	**XCG-10 (SVP)/1041**	**RDL**	**QC Batch**
F1-BTEX, C6-C10 (as Toluene)	ug/m3	486	530	36.1	5830	43.0	5.0	4903767
F2, C10-C16 (as Decane)	ug/m3	62.8	68.9	<5.0	972	<5.0	5.0	4903767

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG095	EBG096	EBG097	EBG098		
Sampling Date		2017/03/12	2017/03/11	2017/03/12	2017/03/12		
COC Number		30585	30585	30585	30585		
	UNITS	**VW-01/332**	**XCG-9 (SVP)/333**	**VW-03/1280**	**TRIP BLANK/215**	**RDL**	**QC Batch**
F1-BTEX, C6-C10 (as Toluene)	ug/m3	7.9	6.0	31.8	<5.0	5.0	4903767
F2, C10-C16 (as Decane)	ug/m3	12.7	<5.0	<5.0	<5.0	5.0	4903767

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG085				EBG086				
Sampling Date		2017/03/14				2017/03/14				
COC Number		30585				30585				
	UNITS	**XCG-5 (SVP)/1380**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-4 (SVP)/1281**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	56.5	0.20	280	0.989	8.35	0.20	41.3	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	<0.17	0.17	<1.19	1.19	6.34	0.17	44.4	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	<0.10	0.10	<0.256	0.256	8.53	0.10	21.8	0.256	4903440
Chloroethane	ppbv	<0.30	0.30	<0.792	0.792	<0.30	0.30	<0.792	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	0.23	0.20	1.31	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	1.5	1.0	2.74	1.88	95.8	1.0	180	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	1.39	0.80	3.29	1.90	<8.9	8.9	<21.1	21.1	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	1.0	<2.95	2.95	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	<0.10	0.10	<0.488	0.488	0.11	0.10	0.523	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	<0.10	0.10	<0.537	0.537	<0.10	0.10	<0.537	0.537	4903440
Tetrachloroethylene	ppbv	<0.10	0.10	<0.678	0.678	1.31	0.10	8.87	0.678	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG085				EBG086				
Sampling Date		2017/03/14				2017/03/14				
COC Number		30585				30585				
	UNITS	**XCG-5 (SVP)/1380**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-4 (SVP)/1281**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	<0.10	0.10	<0.319	0.319	<0.10	0.10	<0.319	0.319	4903440
Toluene	ppbv	0.38	0.10	1.43	0.377	0.29	0.10	1.10	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.20	0.20	<0.868	0.868	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	0.57	0.10	2.41	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	<0.30	0.30	<1.06	1.06	0.49	0.30	1.71	1.06	4903440
Heptane	ppbv	<0.30	0.30	<1.23	1.23	0.32	0.30	1.33	1.23	4903440
Cyclohexane	ppbv	<0.20	0.20	<0.688	0.688	<0.20	0.20	<0.688	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<0.50	0.50	<0.861	0.861	51.8	0.50	89.2	0.861	4903440
2,2,4-Trimethylpentane	ppbv	<0.20	0.20	<0.934	0.934	<0.20	0.20	<0.934	0.934	4903440
Carbon Disulfide	ppbv	1.12	0.50	3.48	1.56	<0.50	0.50	<1.56	1.56	4903440
Vinyl Acetate	ppbv	<0.20	0.20	<0.704	0.704	<0.20	0.20	<0.704	0.704	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	99		N/A	N/A	101		N/A	N/A	4903440
D5-Chlorobenzene	%	93		N/A	N/A	96		N/A	N/A	4903440
Difluorobenzene	%	96		N/A	N/A	98		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG087				EBG088				
Sampling Date		2017/03/14				2017/03/13				
COC Number		30585				30585				
	UNITS	**XCG-12 (SVP)/262**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-6 (SVP)/238**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	18.1	0.20	89.5	0.989	18.0	0.20	88.9	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	<0.17	0.17	<1.19	1.19	48.8	0.17	341	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	<0.10	0.10	<0.256	0.256	60.4	0.10	154	0.256	4903440
Chloroethane	ppbv	<0.30	0.30	<0.792	0.792	0.37	0.30	0.978	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	<0.20	0.20	<1.12	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	<1.0	1.0	<1.88	1.88	<1.0	1.0	<1.88	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	<0.80	0.80	<1.90	1.90	2.31	0.80	5.48	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	1.0	<2.95	2.95	<2.1	2.1	<6.19	6.19	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	1.76	0.10	6.99	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	0.40	0.10	1.60	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	0.16	0.10	0.793	0.488	<0.10	0.10	<0.488	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	<0.10	0.10	<0.537	0.537	0.11	0.10	0.566	0.537	4903440
Tetrachloroethylene	ppbv	<0.10	0.10	<0.678	0.678	0.15	0.10	0.991	0.678	4903440

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG087				EBG088				
Sampling Date		2017/03/14				2017/03/13				
COC Number		30585				30585				
	UNITS	**XCG-12 (SVP)/262**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-6 (SVP)/238**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	<0.10	0.10	<0.319	0.319	0.30	0.10	0.949	0.319	4903440
Toluene	ppbv	0.29	0.10	1.08	0.377	0.49	0.10	1.85	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.20	0.20	<0.868	0.868	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	<0.30	0.30	<1.06	1.06	2.03	0.30	7.14	1.06	4903440
Heptane	ppbv	<0.30	0.30	<1.23	1.23	0.47	0.30	1.92	1.23	4903440
Cyclohexane	ppbv	<0.20	0.20	<0.688	0.688	7.97	0.20	27.4	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<0.90	0.90	<1.55	1.55	22.6	0.50	38.9	0.861	4903440
2,2,4-Trimethylpentane	ppbv	<0.20	0.20	<0.934	0.934	0.98	0.20	4.56	0.934	4903440
Carbon Disulfide	ppbv	8.26	0.50	25.7	1.56	<0.50	0.50	<1.56	1.56	4903440
Vinyl Acetate	ppbv	<0.20	0.20	<0.704	0.704	<0.60	0.60	<2.11	2.11	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	100		N/A	N/A	103		N/A	N/A	4903440
D5-Chlorobenzene	%	94		N/A	N/A	105		N/A	N/A	4903440
Difluorobenzene	%	97		N/A	N/A	104		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG089				EBG090				
Sampling Date		2017/03/11				2017/03/11				
COC Number		30585				30585				
	UNITS	**XCG-2 (SVP)/243**	**RDL**	**ug/m3**	**DL (ug/m3)**	**VW-05/1800**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	0.54	0.20	2.68	0.989	175	1.0	867	4.95	4903440
1,2-Dichlorotetrafluoroethane	ppbv	<0.17	0.17	<1.19	1.19	73.8	0.17	516	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	<0.10	0.10	<0.256	0.256	462	0.50	1180	1.28	4903440
Chloroethane	ppbv	<0.30	0.30	<0.792	0.792	8.79	0.30	23.2	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	<0.20	0.20	<1.12	1.12	1.05	0.20	5.92	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	<1.0	1.0	<1.88	1.88	43.5	1.0	81.9	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	<0.80	0.80	<1.90	1.90	1.82	0.80	4.33	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	1.0	<2.95	2.95	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	23.0	0.10	91.0	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	1.28	0.10	5.07	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	0.66	0.10	3.24	0.488	<0.10	0.10	<0.488	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.30	0.30	<1.21	1.21	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	0.17	0.10	0.930	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	<0.10	0.10	<0.537	0.537	0.23	0.10	1.24	0.537	4903440
Tetrachloroethylene	ppbv	0.31	0.10	2.08	0.678	0.66	0.10	4.49	0.678	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG089				EBG090				
Sampling Date		2017/03/11				2017/03/11				
COC Number		30585				30585				
	UNITS	**XCG-2 (SVP)/243**	**RDL**	**ug/m3**	**DL (ug/m3)**	**VW-05/1800**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	<0.10	0.10	<0.319	0.319	0.42	0.10	1.35	0.319	4903440
Toluene	ppbv	0.23	0.10	0.880	0.377	1.76	0.10	6.62	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.20	0.20	<0.868	0.868	0.26	0.20	1.11	0.868	4903440
o-Xylene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	<0.30	0.30	<1.06	1.06	0.95	0.30	3.33	1.06	4903440
Heptane	ppbv	0.37	0.30	1.50	1.23	0.46	0.30	1.88	1.23	4903440
Cyclohexane	ppbv	<0.20	0.20	<0.688	0.688	9.16	0.20	31.5	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<0.50	0.50	<0.861	0.861	42.5	0.50	73.2	0.861	4903440
2,2,4-Trimethylpentane	ppbv	<0.20	0.20	<0.934	0.934	0.65	0.20	3.03	0.934	4903440
Carbon Disulfide	ppbv	1.18	0.50	3.69	1.56	<0.50	0.50	<1.56	1.56	4903440
Vinyl Acetate	ppbv	<0.20	0.20	<0.704	0.704	<0.80	0.80	<2.82	2.82	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	93		N/A	N/A	101		N/A	N/A	4903440
D5-Chlorobenzene	%	85		N/A	N/A	101		N/A	N/A	4903440
Difluorobenzene	%	91		N/A	N/A	103		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG091				EBG092				
Sampling Date		2017/03/11				2017/03/11				
COC Number		30585				30585				
	UNITS	**XCG-100/3017**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-1 (SVP)/1470**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	173	0.80	855	3.96	1.71	0.20	8.46	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	73.3	0.17	512	1.19	<0.17	0.17	<1.19	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	488	0.50	1250	1.28	<0.10	0.10	<0.256	0.256	4903440
Chloroethane	ppbv	8.76	0.30	23.1	0.792	<0.30	0.30	<0.792	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	1.04	0.20	5.85	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	43.3	1.0	81.7	1.88	<1.0	1.0	<1.88	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	1.87	0.80	4.45	1.90	<0.80	0.80	<1.90	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	1.0	<2.95	2.95	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	22.9	0.10	90.6	0.396	<0.10	0.10	<0.396	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	1.27	0.10	5.05	0.396	<0.10	0.10	<0.396	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	<0.10	0.10	<0.488	0.488	0.15	0.10	0.734	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	<0.30	0.30	<1.21	1.21	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	0.17	0.10	0.937	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	0.30	0.10	1.59	0.537	<0.10	0.10	<0.537	0.537	4903440
Tetrachloroethylene	ppbv	0.65	0.10	4.43	0.678	0.27	0.10	1.84	0.678	4903440

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG091				EBG092				
Sampling Date		2017/03/11				2017/03/11				
COC Number		30585				30585				
	UNITS	**XCG-100/3017**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-1 (SVP)/1470**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	0.41	0.10	1.31	0.319	<0.10	0.10	<0.319	0.319	4903440
Toluene	ppbv	0.65	0.10	2.46	0.377	0.29	0.10	1.08	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	0.25	0.20	1.08	0.868	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	0.90	0.30	3.17	1.06	0.83	0.30	2.94	1.06	4903440
Heptane	ppbv	0.33	0.30	1.34	1.23	0.36	0.30	1.48	1.23	4903440
Cyclohexane	ppbv	8.96	0.20	30.9	0.688	<0.20	0.20	<0.688	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	42.3	0.50	72.7	0.861	<1.7	1.7	<2.93	2.93	4903440
2,2,4-Trimethylpentane	ppbv	0.63	0.20	2.95	0.934	<0.20	0.20	<0.934	0.934	4903440
Carbon Disulfide	ppbv	<0.50	0.50	<1.56	1.56	1.96	0.50	6.11	1.56	4903440
Vinyl Acetate	ppbv	<0.70	0.70	<2.46	2.46	<0.20	0.20	<0.704	0.704	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	102		N/A	N/A	97		N/A	N/A	4903440
D5-Chlorobenzene	%	102		N/A	N/A	95		N/A	N/A	4903440
Difluorobenzene	%	103		N/A	N/A	94		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG093				EBG094				
Sampling Date		2017/03/12				2017/03/12				
COC Number		30585				30585				
	UNITS	**XCG-13 (SVP)/354**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-10 (SVP)/1041**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	597	2.0	2950	9.89	3.67	0.20	18.1	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	80.9	0.17	565	1.19	4.91	0.17	34.3	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	44.8	0.10	114	0.256	<0.10	0.10	<0.256	0.256	4903440
Chloroethane	ppbv	1.65	0.30	4.36	0.792	<0.30	0.30	<0.792	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	<0.20	0.20	<1.12	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	<1.0	1.0	<1.88	1.88	<1.0	1.0	<1.88	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	<20	20	<47.5	47.5	<0.80	0.80	<1.90	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.1	1.1	<3.24	3.24	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	1.44	0.10	5.72	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	56.3	0.10	223	0.396	0.59	0.10	2.36	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	1.39	0.10	5.49	0.396	<0.10	0.10	<0.396	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	0.27	0.10	1.32	0.488	3.03	0.10	14.8	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	0.43	0.10	1.74	0.405	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	2.18	0.10	11.7	0.537	1.01	0.10	5.42	0.537	4903440
Tetrachloroethylene	ppbv	0.21	0.10	1.40	0.678	1.86	0.10	12.6	0.678	4903440

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG093				EBG094				
Sampling Date		2017/03/12				2017/03/12				
COC Number		30585				30585				
	UNITS	**XCG-13 (SVP)/354**	**RDL**	**ug/m3**	**DL (ug/m3)**	**XCG-10 (SVP)/1041**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	0.29	0.10	0.921	0.319	<0.10	0.10	<0.319	0.319	4903440
Toluene	ppbv	0.58	0.10	2.18	0.377	0.20	0.10	0.747	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.30	0.30	<1.30	1.30	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	0.14	0.10	0.608	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	1.71	0.30	6.03	1.06	<0.30	0.30	<1.06	1.06	4903440
Heptane	ppbv	<0.30	0.30	<1.23	1.23	<0.30	0.30	<1.23	1.23	4903440
Cyclohexane	ppbv	26.9	0.20	92.6	0.688	<0.20	0.20	<0.688	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.40	0.40	<1.74	1.74	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<18	18	<31.0	31.0	<1.0	1.0	<1.72	1.72	4903440
2,2,4-Trimethylpentane	ppbv	1.75	0.20	8.17	0.934	<0.20	0.20	<0.934	0.934	4903440
Carbon Disulfide	ppbv	<0.50	0.50	<1.56	1.56	4.11	0.50	12.8	1.56	4903440
Vinyl Acetate	ppbv	<1.2	1.2	<4.23	4.23	<0.20	0.20	<0.704	0.704	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	102		N/A	N/A	96		N/A	N/A	4903440
D5-Chlorobenzene	%	101		N/A	N/A	94		N/A	N/A	4903440
Difluorobenzene	%	102		N/A	N/A	93		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG095			EBG096				
Sampling Date		2017/03/12			2017/03/11				
COC Number		30585			30585				
	UNITS	**VW-01/332**	**ug/m3**	**DL (ug/m3)**	**XCG-9 (SVP)/333**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	0.51	2.50	0.989	0.50	0.20	2.46	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	<0.17	<1.19	1.19	<0.17	0.17	<1.19	1.19	4903440
Chloromethane	ppbv	2.13	4.39	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	<0.10	<0.256	0.256	<0.10	0.10	<0.256	0.256	4903440
Chloroethane	ppbv	<0.30	<0.792	0.792	<0.30	0.30	<0.792	0.792	4903440
1,3-Butadiene	ppbv	<0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	0.21	1.21	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	11.2	21.1	1.88	<1.0	1.0	<1.88	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	4.69	11.1	1.90	<0.80	0.80	<1.90	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	<2.95	2.95	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	<0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	<0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	0.29	1.40	0.488	2.16	0.10	10.5	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	<0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	<0.10	<0.537	0.537	<0.10	0.10	<0.537	0.537	4903440
Tetrachloroethylene	ppbv	<0.10	<0.678	0.678	0.12	0.10	0.792	0.678	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG095			EBG096				
Sampling Date		2017/03/12			2017/03/11				
COC Number		30585			30585				
	UNITS	**VW-01/332**	**ug/m3**	**DL (ug/m3)**	**XCG-9 (SVP)/333**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	0.17	0.528	0.319	<0.10	0.10	<0.319	0.319	4903440
Toluene	ppbv	0.43	1.62	0.377	0.25	0.10	0.945	0.377	4903440
Ethylbenzene	ppbv	<0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.20	<0.868	0.868	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	<0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	<0.30	<1.06	1.06	<0.30	0.30	<1.06	1.06	4903440
Heptane	ppbv	<0.30	<1.23	1.23	<0.30	0.30	<1.23	1.23	4903440
Cyclohexane	ppbv	<0.20	<0.688	0.688	<0.20	0.20	<0.688	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<1.8	<3.10	3.10	<1.8	1.8	<3.10	3.10	4903440
2,2,4-Trimethylpentane	ppbv	<0.20	<0.934	0.934	<0.20	0.20	<0.934	0.934	4903440
Carbon Disulfide	ppbv	<0.50	<1.56	1.56	2.42	0.50	7.53	1.56	4903440
Vinyl Acetate	ppbv	<0.20	<0.704	0.704	<0.20	0.20	<0.704	0.704	4903440
Surrogate Recovery (%)									
Bromochloromethane	%	101	N/A	N/A	99		N/A	N/A	4903440
D5-Chlorobenzene	%	95	N/A	N/A	93		N/A	N/A	4903440
Difluorobenzene	%	98	N/A	N/A	97		N/A	N/A	4903440

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

Maxxam Job #: B752667
Report Date: 2018/01/23

XCG Consulting Limited
Client Project #: 4-2352-04.03
Sampler Initials: MCL

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG097				EBG098				
Sampling Date		2017/03/12				2017/03/12				
COC Number		30585				30585				
	UNITS	**VW-03/1280**	**RDL**	**ug/m3**	**DL (ug/m3)**	**TRIP BLANK/215**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Dichlorodifluoromethane (FREON 12)	ppbv	115	0.80	571	3.96	<0.20	0.20	<0.989	0.989	4903440
1,2-Dichlorotetrafluoroethane	ppbv	255	0.68	1790	4.75	<0.17	0.17	<1.19	1.19	4903440
Chloromethane	ppbv	<0.30	0.30	<0.620	0.620	<0.30	0.30	<0.620	0.620	4903440
Vinyl Chloride	ppbv	<0.10	0.10	<0.256	0.256	<0.10	0.10	<0.256	0.256	4903440
Chloroethane	ppbv	<0.30	0.30	<0.792	0.792	<0.30	0.30	<0.792	0.792	4903440
1,3-Butadiene	ppbv	<0.50	0.50	<1.11	1.11	<0.50	0.50	<1.11	1.11	4903440
Trichlorofluoromethane (FREON 11)	ppbv	<0.20	0.20	<1.12	1.12	<0.20	0.20	<1.12	1.12	4903440
Ethanol (ethyl alcohol)	ppbv	<1.0	1.0	<1.88	1.88	<1.0	1.0	<1.88	1.88	4903440
Trichlorotrifluoroethane	ppbv	<0.15	0.15	<1.15	1.15	<0.15	0.15	<1.15	1.15	4903440
2-propanol	ppbv	<1.0	1.0	<2.46	2.46	<1.0	1.0	<2.46	2.46	4903440
2-Propanone	ppbv	<0.80	0.80	<1.90	1.90	<0.80	0.80	<1.90	1.90	4903440
Methyl Ethyl Ketone (2-Butanone)	ppbv	<1.0	1.0	<2.95	2.95	<1.0	1.0	<2.95	2.95	4903440
Methyl Isobutyl Ketone	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl Butyl Ketone (2-Hexanone)	ppbv	<1.0	1.0	<4.10	4.10	<1.0	1.0	<4.10	4.10	4903440
Methyl t-butyl ether (MTBE)	ppbv	<0.20	0.20	<0.721	0.721	<0.20	0.20	<0.721	0.721	4903440
Ethyl Acetate	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
1,1-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
cis-1,2-Dichloroethylene	ppbv	0.35	0.10	1.39	0.396	<0.10	0.10	<0.396	0.396	4903440
trans-1,2-Dichloroethylene	ppbv	<0.10	0.10	<0.396	0.396	<0.10	0.10	<0.396	0.396	4903440
Methylene Chloride(Dichloromethane)	ppbv	<0.80	0.80	<2.78	2.78	<0.80	0.80	<2.78	2.78	4903440
Chloroform	ppbv	4.34	0.10	21.2	0.488	<0.10	0.10	<0.488	0.488	4903440
Carbon Tetrachloride	ppbv	<0.10	0.10	<0.629	0.629	<0.10	0.10	<0.629	0.629	4903440
1,1-Dichloroethane	ppbv	0.13	0.10	0.522	0.405	<0.10	0.10	<0.405	0.405	4903440
1,2-Dichloroethane	ppbv	<0.10	0.10	<0.405	0.405	<0.10	0.10	<0.405	0.405	4903440
Ethylene Dibromide	ppbv	<0.10	0.10	<0.768	0.768	<0.10	0.10	<0.768	0.768	4903440
1,1,1-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2-Trichloroethane	ppbv	<0.10	0.10	<0.546	0.546	<0.10	0.10	<0.546	0.546	4903440
1,1,2,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
cis-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
trans-1,3-Dichloropropene	ppbv	<0.10	0.10	<0.454	0.454	<0.10	0.10	<0.454	0.454	4903440
1,2-Dichloropropane	ppbv	<0.10	0.10	<0.462	0.462	<0.10	0.10	<0.462	0.462	4903440
Bromomethane	ppbv	<0.10	0.10	<0.388	0.388	<0.10	0.10	<0.388	0.388	4903440
Bromoform	ppbv	<0.20	0.20	<2.07	2.07	<0.20	0.20	<2.07	2.07	4903440
Bromodichloromethane	ppbv	<0.20	0.20	<1.34	1.34	<0.20	0.20	<1.34	1.34	4903440
Dibromochloromethane	ppbv	<0.20	0.20	<1.70	1.70	<0.20	0.20	<1.70	1.70	4903440
Trichloroethylene	ppbv	0.19	0.10	1.02	0.537	<0.10	0.10	<0.537	0.537	4903440
Tetrachloroethylene	ppbv	0.52	0.10	3.55	0.678	<0.10	0.10	<0.678	0.678	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG097				EBG098				
Sampling Date		2017/03/12				2017/03/12				
COC Number		30585				30585				
	UNITS	**VW-03/1280**	**RDL**	**ug/m3**	**DL (ug/m3)**	**TRIP BLANK/215**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Benzene	ppbv	0.11	0.10	0.366	0.319	<0.10	0.10	<0.319	0.319	4903440
Toluene	ppbv	0.14	0.10	0.530	0.377	<0.10	0.10	<0.377	0.377	4903440
Ethylbenzene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
p+m-Xylene	ppbv	<0.20	0.20	<0.868	0.868	<0.20	0.20	<0.868	0.868	4903440
o-Xylene	ppbv	<0.10	0.10	<0.434	0.434	<0.10	0.10	<0.434	0.434	4903440
Styrene	ppbv	<0.10	0.10	<0.426	0.426	<0.10	0.10	<0.426	0.426	4903440
4-ethyltoluene	ppbv	<0.50	0.50	<2.46	2.46	<0.50	0.50	<2.46	2.46	4903440
1,3,5-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
1,2,4-Trimethylbenzene	ppbv	<0.50	0.50	<2.45	2.45	<0.50	0.50	<2.45	2.45	4903440
Chlorobenzene	ppbv	<0.10	0.10	<0.460	0.460	<0.10	0.10	<0.460	0.460	4903440
Benzyl chloride	ppbv	<0.50	0.50	<2.59	2.59	<0.50	0.50	<2.59	2.59	4903440
1,3-Dichlorobenzene	ppbv	<0.40	0.40	<2.40	2.40	<0.40	0.40	<2.40	2.40	4903440
1,4-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2-Dichlorobenzene	ppbv	<0.10	0.10	<0.601	0.601	<0.10	0.10	<0.601	0.601	4903440
1,2,4-Trichlorobenzene	ppbv	<0.50	0.50	<3.71	3.71	<0.50	0.50	<3.71	3.71	4903440
Hexachlorobutadiene	ppbv	<0.50	0.50	<5.33	5.33	<0.50	0.50	<5.33	5.33	4903440
Hexane	ppbv	<0.30	0.30	<1.06	1.06	<0.30	0.30	<1.06	1.06	4903440
Heptane	ppbv	<0.30	0.30	<1.23	1.23	<0.30	0.30	<1.23	1.23	4903440
Cyclohexane	ppbv	<0.20	0.20	<0.688	0.688	<0.20	0.20	<0.688	0.688	4903440
Tetrahydrofuran	ppbv	<0.40	0.40	<1.18	1.18	<0.40	0.40	<1.18	1.18	4903440
1,4-Dioxane	ppbv	<1.0	1.0	<3.60	3.60	<1.0	1.0	<3.60	3.60	4903440
Naphthalene	ppbv	<0.50	0.50	<2.62	2.62	<0.50	0.50	<2.62	2.62	4903440
Total Xylenes	ppbv	<0.30	0.30	<1.30	1.30	<0.30	0.30	<1.30	1.30	4903440
1,1,1,2-Tetrachloroethane	ppbv	<0.10	0.10	<0.687	0.687	<0.10	0.10	<0.687	0.687	4903440
Vinyl Bromide	ppbv	<0.20	0.20	<0.875	0.875	<0.20	0.20	<0.875	0.875	4903440
Propene	ppbv	<1.0	1.0	<1.72	1.72	<0.50	0.50	<0.861	0.861	4903440
2,2,4-Trimethylpentane	ppbv	<0.20	0.20	<0.934	0.934	<0.20	0.20	<0.934	0.934	4903440
Carbon Disulfide	ppbv	<0.50	0.50	<1.56	1.56	<0.50	0.50	<1.56	1.56	4903440
Vinyl Acetate	ppbv	<0.20	0.20	<0.704	0.704	<0.20	0.20	<0.704	0.704	4903440
Surrogate Recovery (%)										
Bromochloromethane	%	99		N/A	N/A	95		N/A	N/A	4903440
D5-Chlorobenzene	%	92		N/A	N/A	90		N/A	N/A	4903440
Difluorobenzene	%	95		N/A	N/A	95		N/A	N/A	4903440

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

GENERAL COMMENTS

Matrix Gas/Light Hydrocarbon Analysis: Canisters were pressurized with Helium to enable sampling. Results and DLs adjusted accordingly.

Matrix Gas Analysis: Results normalized to 100% dry volume.

Sample EBG086 [XCG-4 (SVP)/1281] : Increased DL for 2-propanone due to hydrocarbon interference.

Sample EBG087 [XCG-12 (SVP)/262] : Increased DL for propene due to interference from propane.

Sample EBG088 [XCG-6 (SVP)/238] : Increased DL for Vinyl acetate and 2-Butanone due to hydrocarbon interference.

Sample EBG090 [VW-05/1800] : Increased DL for 1,1-dichloroethane and vinyl acetate due to hydrocarbon interference. Dichlorodifluoromethane and vinyl chloride were analyzed at a 5X dilution. The DL's were adjusted accordingly.

Sample EBG091 [XCG-100/3017] : Increased DL for 1,1-dichloroethane and vinyl acetate due to hydrocarbon interference. Dichlorodifluoromethane was analyzed at a 4X dilution and Vinyl chloride was analyzed at a 5X dilution The DL's were adjusted accordingly.

Sample EBG092 [XCG-1 (SVP)/1470] : Increased DL for propene due to interference from propane.

Sample EBG093 [XCG-13 (SVP)/354] : Increased DL for propene due to interference from propane.
Increased DL for 2-propanone, 2-butanone, M&P-xylenes and vinyl acetate due to hydrocarbon interference. Dichlorodifluoromethane was analyzed at a 10x dilution. The DL was adjusted accordingly.

Sample EBG094 [XCG-10 (SVP)/1041] : Increased DL for propene due to interference from propane.

Sample EBG095 [VW-01/332] : Increased DL for propene due to interference from propane.

Sample EBG096 [XCG-9 (SVP)/333] : Increased DL for propene due to interference from propane.

Sample EBG097 [VW-03/1280] : Increased DL for propene due to interference from propane.
Dichlorodifluoromethane and 1,2-Dichlorotetrafluoroethane were analyzed at a 4X dilution. The DL's were adjusted accordingly.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
4903440	KM2	Spiked Blank	Bromochloromethane	2017/03/17		110	%	60 - 140
			D5-Chlorobenzene	2017/03/17		115	%	60 - 140
			Difluorobenzene	2017/03/17		111	%	60 - 140
			Dichlorodifluoromethane (FREON 12)	2017/03/17		92	%	70 - 130
			1,2-Dichlorotetrafluoroethane	2017/03/17		87	%	70 - 130
			Chloromethane	2017/03/17		87	%	70 - 130
			Vinyl Chloride	2017/03/17		96	%	70 - 130
			Chloroethane	2017/03/17		92	%	70 - 130
			1,3-Butadiene	2017/03/17		101	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/03/17		85	%	70 - 130
			Ethanol (ethyl alcohol)	2017/03/17		70	%	70 - 130
			Trichlorotrifluoroethane	2017/03/17		99	%	70 - 130
			2-propanol	2017/03/17		91	%	70 - 130
			2-Propanone	2017/03/17		86	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/03/17		101	%	70 - 130
			Methyl Isobutyl Ketone	2017/03/17		87	%	70 - 130
			Methyl Butyl Ketone (2-Hexanone)	2017/03/17		77	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/03/17		97	%	70 - 130
			Ethyl Acetate	2017/03/17		91	%	70 - 130
			1,1-Dichloroethylene	2017/03/17		88	%	70 - 130
			cis-1,2-Dichloroethylene	2017/03/17		89	%	70 - 130
			trans-1,2-Dichloroethylene	2017/03/17		96	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/03/17		83	%	70 - 130
			Chloroform	2017/03/17		90	%	70 - 130
			Carbon Tetrachloride	2017/03/17		92	%	70 - 130
			1,1-Dichloroethane	2017/03/17		93	%	70 - 130
			1,2-Dichloroethane	2017/03/17		84	%	70 - 130
			Ethylene Dibromide	2017/03/17		101	%	70 - 130
			1,1,1-Trichloroethane	2017/03/17		89	%	70 - 130
			1,1,2-Trichloroethane	2017/03/17		104	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/03/17		104	%	70 - 130
			cis-1,3-Dichloropropene	2017/03/17		110	%	70 - 130
			trans-1,3-Dichloropropene	2017/03/17		96	%	70 - 130
			1,2-Dichloropropane	2017/03/17		101	%	70 - 130
			Bromomethane	2017/03/17		104	%	70 - 130
			Bromoform	2017/03/17		105	%	70 - 130
			Bromodichloromethane	2017/03/17		104	%	70 - 130
			Dibromochloromethane	2017/03/17		108	%	70 - 130
			Trichloroethylene	2017/03/17		112	%	70 - 130
			Tetrachloroethylene	2017/03/17		113	%	70 - 130
			Benzene	2017/03/17		103	%	70 - 130
			Toluene	2017/03/17		108	%	70 - 130
			Ethylbenzene	2017/03/17		96	%	70 - 130
			p+m-Xylene	2017/03/17		93	%	70 - 130
			o-Xylene	2017/03/17		95	%	70 - 130
			Styrene	2017/03/17		95	%	70 - 130
			4-ethyltoluene	2017/03/17		98	%	70 - 130
			1,3,5-Trimethylbenzene	2017/03/17		92	%	70 - 130
			1,2,4-Trimethylbenzene	2017/03/17		92	%	70 - 130
			Chlorobenzene	2017/03/17		104	%	70 - 130
			Benzyl chloride	2017/03/17		98	%	70 - 130
			1,3-Dichlorobenzene	2017/03/17		103	%	70 - 130
			1,4-Dichlorobenzene	2017/03/17		97	%	70 - 130
			1,2-Dichlorobenzene	2017/03/17		99	%	70 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2,4-Trichlorobenzene	2017/03/17		116	%	70 - 130
			Hexachlorobutadiene	2017/03/17		103	%	70 - 130
			Hexane	2017/03/17		95	%	70 - 130
			Heptane	2017/03/17		96	%	70 - 130
			Cyclohexane	2017/03/17		101	%	70 - 130
			Tetrahydrofuran	2017/03/17		92	%	70 - 130
			1,4-Dioxane	2017/03/17		84	%	70 - 130
			Naphthalene	2017/03/17		114	%	70 - 130
			Total Xylenes	2017/03/17		94	%	70 - 130
			Vinyl Bromide	2017/03/17		110	%	70 - 130
			Propene	2017/03/17		94	%	70 - 130
			2,2,4-Trimethylpentane	2017/03/17		112	%	70 - 130
			Carbon Disulfide	2017/03/17		117	%	70 - 130
			Vinyl Acetate	2017/03/17		87	%	70 - 130
4903440	KM2	Method Blank	Bromochloromethane	2017/03/17		106	%	60 - 140
			D5-Chlorobenzene	2017/03/17		108	%	60 - 140
			Difluorobenzene	2017/03/17		109	%	60 - 140
			Dichlorodifluoromethane (FREON 12)	2017/03/17	<0.20		ppbv	
			1,2-Dichlorotetrafluoroethane	2017/03/17	<0.17		ppbv	
			Chloromethane	2017/03/17	<0.30		ppbv	
			Vinyl Chloride	2017/03/17	<0.10		ppbv	
			Chloroethane	2017/03/17	<0.30		ppbv	
			1,3-Butadiene	2017/03/17	<0.50		ppbv	
			Trichlorofluoromethane (FREON 11)	2017/03/17	<0.20		ppbv	
			Ethanol (ethyl alcohol)	2017/03/17	<1.0		ppbv	
			Trichlorotrifluoroethane	2017/03/17	<0.15		ppbv	
			2-propanol	2017/03/17	<1.0		ppbv	
			2-Propanone	2017/03/17	<0.80		ppbv	
			Methyl Ethyl Ketone (2-Butanone)	2017/03/17	<1.0		ppbv	
			Methyl Isobutyl Ketone	2017/03/17	<1.0		ppbv	
			Methyl Butyl Ketone (2-Hexanone)	2017/03/17	<1.0		ppbv	
			Methyl t-butyl ether (MTBE)	2017/03/17	<0.20		ppbv	
			Ethyl Acetate	2017/03/17	<1.0		ppbv	
			1,1-Dichloroethylene	2017/03/17	<0.10		ppbv	
			cis-1,2-Dichloroethylene	2017/03/17	<0.10		ppbv	
			trans-1,2-Dichloroethylene	2017/03/17	<0.10		ppbv	
			Methylene Chloride(Dichloromethane)	2017/03/17	<0.80		ppbv	
			Chloroform	2017/03/17	<0.10		ppbv	
			Carbon Tetrachloride	2017/03/17	<0.10		ppbv	
			1,1-Dichloroethane	2017/03/17	<0.10		ppbv	
			1,2-Dichloroethane	2017/03/17	<0.10		ppbv	
			Ethylene Dibromide	2017/03/17	<0.10		ppbv	
			1,1,1-Trichloroethane	2017/03/17	<0.10		ppbv	
			1,1,2-Trichloroethane	2017/03/17	<0.10		ppbv	
			1,1,2,2-Tetrachloroethane	2017/03/17	<0.10		ppbv	
			cis-1,3-Dichloropropene	2017/03/17	<0.10		ppbv	
			trans-1,3-Dichloropropene	2017/03/17	<0.10		ppbv	
			1,2-Dichloropropane	2017/03/17	<0.10		ppbv	
			Bromomethane	2017/03/17	<0.10		ppbv	
			Bromoform	2017/03/17	<0.20		ppbv	
			Bromodichloromethane	2017/03/17	<0.20		ppbv	
			Dibromochloromethane	2017/03/17	<0.20		ppbv	
			Trichloroethylene	2017/03/17	<0.10		ppbv	
			Tetrachloroethylene	2017/03/17	<0.10		ppbv	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzene	2017/03/17	<0.10		ppbv	
			Toluene	2017/03/17	<0.10		ppbv	
			Ethylbenzene	2017/03/17	<0.10		ppbv	
			p+m-Xylene	2017/03/17	<0.20		ppbv	
			o-Xylene	2017/03/17	<0.10		ppbv	
			Styrene	2017/03/17	<0.10		ppbv	
			4-ethyltoluene	2017/03/17	<0.50		ppbv	
			1,3,5-Trimethylbenzene	2017/03/17	<0.50		ppbv	
			1,2,4-Trimethylbenzene	2017/03/17	<0.50		ppbv	
			Chlorobenzene	2017/03/17	<0.10		ppbv	
			Benzyl chloride	2017/03/17	<0.50		ppbv	
			1,3-Dichlorobenzene	2017/03/17	<0.40		ppbv	
			1,4-Dichlorobenzene	2017/03/17	<0.10		ppbv	
			1,2-Dichlorobenzene	2017/03/17	<0.10		ppbv	
			1,2,4-Trichlorobenzene	2017/03/17	<0.50		ppbv	
			Hexachlorobutadiene	2017/03/17	<0.50		ppbv	
			Hexane	2017/03/17	<0.30		ppbv	
			Heptane	2017/03/17	<0.30		ppbv	
			Cyclohexane	2017/03/17	<0.20		ppbv	
			Tetrahydrofuran	2017/03/17	<0.40		ppbv	
			1,4-Dioxane	2017/03/17	<1.0		ppbv	
			Naphthalene	2017/03/17	<0.50		ppbv	
			Total Xylenes	2017/03/17	<0.30		ppbv	
			1,1,1,2-Tetrachloroethane	2017/03/17	<0.10		ppbv	
			Vinyl Bromide	2017/03/17	<0.20		ppbv	
			Propene	2017/03/17	<0.50		ppbv	
			2,2,4-Trimethylpentane	2017/03/17	<0.20		ppbv	
			Carbon Disulfide	2017/03/17	<0.50		ppbv	
			Vinyl Acetate	2017/03/17	<0.20		ppbv	
4903440	KM2	RPD [EBG089-01]	Dichlorodifluoromethane (FREON 12)	2017/03/17	1.2		%	25
			1,2-Dichlorotetrafluoroethane	2017/03/17	NC		%	25
			Chloromethane	2017/03/17	NC		%	25
			Vinyl Chloride	2017/03/17	NC		%	25
			Chloroethane	2017/03/17	NC		%	25
			1,3-Butadiene	2017/03/17	NC		%	25
			Trichlorofluoromethane (FREON 11)	2017/03/17	NC		%	25
			Ethanol (ethyl alcohol)	2017/03/17	NC		%	25
			Trichlorotrifluoroethane	2017/03/17	NC		%	25
			2-propanol	2017/03/17	NC		%	25
			2-Propanone	2017/03/17	NC		%	25
			Methyl Ethyl Ketone (2-Butanone)	2017/03/17	NC		%	25
			Methyl Isobutyl Ketone	2017/03/17	NC		%	25
			Methyl Butyl Ketone (2-Hexanone)	2017/03/17	NC		%	25
			Methyl t-butyl ether (MTBE)	2017/03/17	NC		%	25
			Ethyl Acetate	2017/03/17	NC		%	25
			1,1-Dichloroethylene	2017/03/17	NC		%	25
			cis-1,2-Dichloroethylene	2017/03/17	NC		%	25
			trans-1,2-Dichloroethylene	2017/03/17	NC		%	25
			Methylene Chloride(Dichloromethane)	2017/03/17	NC		%	25
			Chloroform	2017/03/17	0.70		%	25
			Carbon Tetrachloride	2017/03/17	NC		%	25
			1,1-Dichloroethane	2017/03/17	NC		%	25
			1,2-Dichloroethane	2017/03/17	NC		%	25
			Ethylene Dibromide	2017/03/17	NC		%	25

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,1,1-Trichloroethane	2017/03/17	NC		%	25
			1,1,2-Trichloroethane	2017/03/17	NC		%	25
			1,1,2,2-Tetrachloroethane	2017/03/17	NC		%	25
			cis-1,3-Dichloropropene	2017/03/17	NC		%	25
			trans-1,3-Dichloropropene	2017/03/17	NC		%	25
			1,2-Dichloropropane	2017/03/17	NC		%	25
			Bromomethane	2017/03/17	NC		%	25
			Bromoform	2017/03/17	NC		%	25
			Bromodichloromethane	2017/03/17	NC		%	25
			Dibromochloromethane	2017/03/17	NC		%	25
			Trichloroethylene	2017/03/17	NC		%	25
			Tetrachloroethylene	2017/03/17	4.0		%	25
			Benzene	2017/03/17	NC		%	25
			Toluene	2017/03/17	4.7		%	25
			Ethylbenzene	2017/03/17	NC		%	25
			p+m-Xylene	2017/03/17	NC		%	25
			o-Xylene	2017/03/17	NC		%	25
			Styrene	2017/03/17	NC		%	25
			4-ethyltoluene	2017/03/17	NC		%	25
			1,3,5-Trimethylbenzene	2017/03/17	NC		%	25
			1,2,4-Trimethylbenzene	2017/03/17	NC		%	25
			Chlorobenzene	2017/03/17	NC		%	25
			Benzyl chloride	2017/03/17	NC		%	25
			1,3-Dichlorobenzene	2017/03/17	NC		%	25
			1,4-Dichlorobenzene	2017/03/17	NC		%	25
			1,2-Dichlorobenzene	2017/03/17	NC		%	25
			1,2,4-Trichlorobenzene	2017/03/17	NC		%	25
			Hexachlorobutadiene	2017/03/17	NC		%	25
			Hexane	2017/03/17	NC		%	25
			Heptane	2017/03/17	3.5		%	25
			Cyclohexane	2017/03/17	NC		%	25
			Tetrahydrofuran	2017/03/17	NC		%	25
			1,4-Dioxane	2017/03/17	NC		%	25
			Naphthalene	2017/03/17	NC		%	25
			Total Xylenes	2017/03/17	NC		%	25
			1,1,1,2-Tetrachloroethane	2017/03/17	NC		%	25
			Vinyl Bromide	2017/03/17	NC		%	25
			Propene	2017/03/17	NC		%	25
			2,2,4-Trimethylpentane	2017/03/17	NC		%	25
			Carbon Disulfide	2017/03/17	0.36		%	25
			Vinyl Acetate	2017/03/17	NC		%	25
4903767	KM2	Method Blank	F1-BTEX, C6-C10 (as Toluene)	2017/03/17	<5.0		ug/m3	
			F2, C10-C16 (as Decane)	2017/03/17	<5.0		ug/m3	
4903767	KM2	RPD [EBG089-01]	F1-BTEX, C6-C10 (as Toluene)	2017/03/17	NC		%	25
			F2, C10-C16 (as Decane)	2017/03/17	NC		%	25
4914859	VTH	Method Blank	Oxygen	2017/03/23	<0.1		% v/v	
			Nitrogen	2017/03/23	<0.1		% v/v	
			Carbon Monoxide	2017/03/23	<0.1		% v/v	
			Methane	2017/03/23	<0.1		% v/v	
			Carbon Dioxide	2017/03/23	<0.1		% v/v	
4914859	VTH	RPD [EBG085-01]	Oxygen	2017/03/23	0.049		%	20
			Nitrogen	2017/03/23	0		%	20
			Carbon Monoxide	2017/03/23	NC		%	20
			Methane	2017/03/23	NC		%	20

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Carbon Dioxide	2017/03/23	0		%	20
4914918	VTH	Method Blank	Ethane	2017/03/23	<0.1		ppm	
			Ethylene	2017/03/23	<0.1		ppm	
			Methane	2017/03/23	<2		ppm	
			Propane	2017/03/23	<0.1		ppm	
			Propene	2017/03/23	<0.1		ppm	
4914918	VTH	RPD [EBG085-01]	Ethane	2017/03/27	NC		%	30
			Ethylene	2017/03/27	NC		%	30
			Methane	2017/03/27	NC		%	30
			Propane	2017/03/27	NC		%	30
			Propene	2017/03/27	NC		%	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Angel Guerrero, Team Leader, VOC Air

Tom Mitchell, B.Sc, Supervisor, Compressed Gases

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Chain of Custody Fo ... ter

AIR

Maxxam
A Bureau Veritas Group Company
6740 Campobell
Mississauga Ont
www.maxxam.ca

16-Mar-17 10:00
Cristina (Maria) Bacchus
B752667
J_L AIR-001

504 (17)

30585

CAM FCD-01302 /1

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INVOICE INFORMATION	
Company Name: XCG Consulting	**Company Name:** XCG
Contact Name: V. Schiesholtz	**Project Manager:** E Mence
Address:	**Address:**
E-mail:	**E-mail:** elisabeth.
Ph:	**Ph:** mence@xcg.com marycatherine L@ xcg.com
Sampled by: MCL	

ANALYSIS REQUESTED

Field Sample ID	Canister Serial #	Flow Regulator Serial #	Collection Date	START VACUUM (inches of Hg)	END VACUUM (inches of Hg)	SOIL VAPOUR	AMBIENT/INDOOR AIR	AMBIENT/COMMERCIAL/INDUSTRIAL	SUB-SLAB GAS	FULL LIST OF VOCs (reference TO15A)	Aromatic/Aliphatic Hydrocarbon Fractions	F1 (C6-C10) and F2 (C10-C16)	Selected VOC's - please specify	Other	O_2, CO_2, CO, CH_4, Nitrogen			CANISTERS NOT USED
XCG-5 (SVP)	1380	1485	03/14/17	-26	-5½							✓	✓		✓			
XCG-4 (SVP)	1281	561	"	-25	-5							✓	✓		✓			
XCG-12 (SVP)	262	258	"	-24½	-5							✓	✓		✓			
XCG-6 (SVP)	238	694	03/13/17	-24½	-4							✓	✓		✓			
XCG-2 (SVP)	243	552	03/11/17	-25½	-7							✓	✓		✓			
VW-05	1800	592	"	-26	-4							✓	✓		✓			
XCG-100	3017	592	"	-26	-4							✓	✓		✓			
XCG-1 (SVP)	1470	284	03/11/17	-25½								✓	✓		✓			
XCG-13 (SVP)	354	936	03/12/17	-26	-4½							✓	✓		✓			
XCG-10 (SVP)	1041	677	"	-26	-2½							✓	✓		✓			
VW-01	332	379	03/12/17	-26								✓	✓		✓			
XCG-9 (SVP)	333	603	03/11/17	-25	-5							✓	✓		✓			

TAT Requirement

- STD 10 Business day ☑
- Rush 5 Business day * ☐
- Rush 2 Business day * ☐
- Rush Other * ☐

* need approval from Maxxam

PROJECT INFORMATION

Project #: 4-2352-04:03
Name:
PO #:
Maxxam Quote #:
Maxxam Contact:
Task Order/Line Item

REPORTING REQUIREMENTS

EDD ☐
Regulations ON 153 ☐
ON 419 ☐
BC CSR ☐
Other

Notes
1) please indicate on chain of custody if your samples are soil vapour or ambient air
2) please list all canisters on the chain of custody even if unused

PROJECT SPECIFIC COMMENTS

VOC list will be sent via email.

Client Signature:
Date/Time: Mar 15/17.

Received by: David Tidman
Date/Time: 20170315 12:44

No - Seal all

PLEASE RETURN ALL UNUSED EQUIPMENT

2017/03/16 10:00

COC-1003 (07/16) - Summa Canister

Chain of Custody Form - Summa™ Canister

30581

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CAM FCD-01302 /1

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INVOICE INFORMATION		REPORT INFORMATION	
Company Name:	XCG Consulting	Company Name:	
Contact Name:		Project Manager:	
Address:		Address:	
E-mail:		E-mail:	
Ph:		Ph:	
Sampled by:			

ANALYSIS REQUESTED

Field Sample ID	Canister Serial #	Flow Regulator Serial #	Collection Date	START VACUUM (inches of Hg)	END VACUUM (inches of Hg)	SOIL VAPOUR	AMBIENT/INDOOR AIR	AMBIENT/COMMERCIAL/INDUSTRIAL	SUB-SLAB GAS	FULL LIST OF VOCs (reference TO15A)	Aromatic/Aliphatic Hydrocarbon Fractions	F1 (C6-C10) and F2 (C10-C16)	Selected VOC's - please specify	Other	O2, CO, CO2, CH4, Nitrogen			CANISTERS NOT USED
VW-03	1280	931	03/12/17									✓	✓		✓			
Trip Blank	215	N/A	N/A									✓	✓					
	2069																	✓
	2500																	✓

TAT Requirement

STD 10 Business day ☐
Rush 5 Business day * ☐
Rush 2 Business day * ☐
Rush Other * ☐

* need approval from Maxxam

PROJECT INFORMATION

Project #: 4-2352-04-03
Name:
PO #:
Maxxam Quote #:
Maxxam Contact:
Task Order/Line Item

REPORTING REQUIREMENTS

EDD ☐
Regulations ON 153 ☐
ON 419 ☐
BC CSR ☐
Other

Notes

1) please indicate on chain of custody if your samples are soil vapour or ambient air
2) please list all canisters on the chain of custody even if unused

PROJECT SPECIFIC COMMENTS

Client Signature:
Date/Time: Mar 15/17

Received by: David Tidman
Date/Time: 20170315 1244
No seal 911

PLEASE RETURN ALL UNUSED EQUIPMENT

2017/03/16 10:00

COC-1003 (07/16) - Summa Canister

Maxxam
A Bureau Veritas Group Company

Your Project #: 4-2352-04-03
Your C.O.C. #: 30583

Attention:Mary-Catherine Lanning

XCG Consulting Limited
820 Trillium Dr
Kitchener, ON
N2R 1K4

Report Date: 2017/04/10
Report #: R4420991
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B752696
Received: 2017/03/16, 10:00

Sample Matrix: AIR
Samples Received: 12

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Canister Pressure (TO-15)	12	N/A	2017/03/30	BRL SOP-00304	EPA TO-15 m
Matrix Gases (1)	12	N/A	2017/04/06	CAM SOP-00225	
VOCs in Air (TO-15)	12	N/A	2017/03/30	BRL SOP-00304	EPA TO-15 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
(1) Argon interferes with in the reported Oxygen concentration. The atmosphere contains about 0.9% Argon.

Encryption Key M Sim

Marinela Sim
Project Manager
10 Apr 2017 16:47:51

Please direct all question :ate of Analysis to your Project Manager.
Marinela Sim, Project Manager
Email: MSim@maxxam.ca
Phone# (905) 817-5700
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF AIR

Maxxam ID		EBG194	EBG195	EBG196	EBG197	
Sampling Date		2017/03/14	2017/03/14	2017/03/14	2017/03/14	
COC Number		30583	30583	30583	30583	
	UNITS	Residence B/**T21636**	Residence H **/18260**	Residence C/**14258**	Residence A/**2758**	**QC Batch**
Volatile Organics						
Pressure on Receipt	psig	(-5.0)	(-3.6)	(-4.5)	(-3.9)	4920443
QC Batch = Quality Control Batch						

Maxxam ID		EBG198	EBG199	EBG200	EBG201	
Sampling Date		2017/03/14	2017/03/14	2017/03/14	2017/03/14	
COC Number		30583	30583	30583	30583	
	UNITS	Residence G **/14531**	Residence F **/14918**	Residence E/**129**	Residence D/**18232**	**QC Batch**
Volatile Organics						
Pressure on Receipt	psig	(-4.0)	(-4.0)	(-4.5)	(-4.6)	4920443
QC Batch = Quality Control Batch						

Maxxam ID		EBG202	EBG203	EBG204	EBG205	
Sampling Date		2017/03/14	2017/03/14	2017/03/14	2017/03/14	
COC Number		30583	30583	30583	30583	
	UNITS	Residence I/**14530**	Residence J **/2813**	**OAQ/2595**	**XCG-300/2580**	**QC Batch**
Volatile Organics						
Pressure on Receipt	psig	(-4.5)	(-4.3)	(-2.2)	(-4.5)	4920443
QC Batch = Quality Control Batch						

COMPRESSED GAS PARAMETERS (AIR)

Maxxam ID		EBG194	EBG195	EBG196		
Sampling Date		2017/03/14	2017/03/14	2017/03/14		
COC Number		30583	30583	30583		
	UNITS	Residence B/**T21636**	Residence H /**18260**	Residence C/**14258**	**RDL**	**QC Batch**
Fixed Gases						
Methane	% v/v	<0.2	<0.2	<0.2	0.2	4930064

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG197		EBG198	EBG199		
Sampling Date		2017/03/14		2017/03/14	2017/03/14		
COC Number		30583		30583	30583		
	UNITS	Residence A/**2758**	**RDL**	Residence G /**14531**	Residence F /**14918**	**RDL**	**QC Batch**
Fixed Gases							
Methane	% v/v	<0.1	0.1	<0.2	<0.2	0.2	4930064

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG200	EBG201	EBG202	EBG203		
Sampling Date		2017/03/14	2017/03/14	2017/03/14	2017/03/14		
COC Number		30583	30583	30583	30583		
	UNITS	Residence E/**129**	Residence D/**18232**	Residence I/**14530**	Residence J/**2813**	**RDL**	**QC Batch**
Fixed Gases							
Methane	% v/v	<0.2	<0.2	<0.2	<0.2	0.2	4930064

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		EBG204	EBG205	EBG205		
Sampling Date		2017/03/14	2017/03/14	2017/03/14		
COC Number		30583	30583	30583		
	UNITS	**OAQ/2595**	**XCG-300/2580**	**XCG-300/2580 Lab-Dup**	**RDL**	**QC Batch**
Fixed Gases						
Methane	% v/v	<0.2	<0.2	<0.2	0.2	4930064

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG194			EBG195				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence B/**T21636**	**ug/m3**	**DL (ug/m3)**	Residence H **/18260**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	89	N/A	N/A	90		N/A	N/A	4920442
D5-Chlorobenzene	%	91	N/A	N/A	85		N/A	N/A	4920442
Difluorobenzene	%	86	N/A	N/A	83		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam ID		EBG195			EBG196				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence H **/18260 Lab-Dup**	**ug/m3**	**DL (ug/m3)**	Residence C/**14258**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	86	N/A	N/A	83		N/A	N/A	4920442
D5-Chlorobenzene	%	81	N/A	N/A	80		N/A	N/A	4920442
Difluorobenzene	%	79	N/A	N/A	78		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG197			EBG198				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence A/**2758**	**ug/m3**	**DL (ug/m3)**	Residence G **/14531**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	85	N/A	N/A	83		N/A	N/A	4920442
D5-Chlorobenzene	%	82	N/A	N/A	78		N/A	N/A	4920442
Difluorobenzene	%	79	N/A	N/A	78		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam ID		EBG199			EBG200				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence F **/14918**	**ug/m3**	**DL (ug/m3)**	Residence E/**129**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	84	N/A	N/A	82		N/A	N/A	4920442
D5-Chlorobenzene	%	81	N/A	N/A	80		N/A	N/A	4920442
Difluorobenzene	%	78	N/A	N/A	76		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG201			EBG202				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence D/**18232**	**ug/m3**	**DL (ug/m3)**	Residence I/**14530**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	82	N/A	N/A	81		N/A	N/A	4920442
D5-Chlorobenzene	%	77	N/A	N/A	76		N/A	N/A	4920442
Difluorobenzene	%	76	N/A	N/A	75		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam ID		EBG203			EBG204				
Sampling Date		2017/03/14			2017/03/14				
COC Number		30583			30583				
	UNITS	Residence J/**2813**	**ug/m3**	**DL (ug/m3)**	**OAQ/2595**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics									
Vinyl Chloride	ppbv	<0.02	<0.051	0.051	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	<0.20	0.20	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)									
Bromochloromethane	%	83	N/A	N/A	81		N/A	N/A	4920442
D5-Chlorobenzene	%	80	N/A	N/A	74		N/A	N/A	4920442
Difluorobenzene	%	79	N/A	N/A	74		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

VOLATILE ORGANICS BY GC/MS (AIR)

Maxxam ID		EBG205				
Sampling Date		2017/03/14				
COC Number		30583				
	UNITS	**XCG-300/2580**	**RDL**	**ug/m3**	**DL (ug/m3)**	**QC Batch**
Volatile Organics						
Vinyl Chloride	ppbv	<0.02	0.02	<0.051	0.051	4920442
cis-1,2-Dichloroethylene	ppbv	<0.05	0.05	<0.20	0.20	4920442
Surrogate Recovery (%)						
Bromochloromethane	%	80		N/A	N/A	4920442
D5-Chlorobenzene	%	75		N/A	N/A	4920442
Difluorobenzene	%	74		N/A	N/A	4920442

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

GENERAL COMMENTS

Matrix Gas Analysis: Canisters were pressurized with Helium to enable sampling. Results and DLs adjusted accordingly.

Matrix Gas Analysis: Results normalized to 100% dry volume.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
4920442	MM2	Spiked Blank	Bromochloromethane	2017/03/30		99	%	60 - 140
			D5-Chlorobenzene	2017/03/30		95	%	60 - 140
			Difluorobenzene	2017/03/30		95	%	60 - 140
			Vinyl Chloride	2017/03/30		94	%	70 - 130
			cis-1,2-Dichloroethylene	2017/03/30		93	%	70 - 130
4920442	MM2	Method Blank	Bromochloromethane	2017/03/30		99	%	60 - 140
			D5-Chlorobenzene	2017/03/30		86	%	60 - 140
			Difluorobenzene	2017/03/30		91	%	60 - 140
			Vinyl Chloride	2017/03/30	<0.02		ppbv	
			cis-1,2-Dichloroethylene	2017/03/30	<0.05		ppbv	
4920442	MM2	RPD [EBG195-01]	Vinyl Chloride	2017/03/30	NC		%	25
			cis-1,2-Dichloroethylene	2017/03/30	NC		%	25
4930064	VTH	Method Blank	Methane	2017/04/07	<0.1		% v/v	
4930064	VTH	RPD [EBG205-01]	Methane	2017/04/06	NC		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Angel Guerrero, Team Leader, VOC Air

Tom Mitchell, B.Sc, Supervisor, Compressed Gases

XCG Consulting Limited (Kitchener)
ATTN: MARY-CATHERINE LANNING
820 TRILLIUM DRIVE
KITCHENER ON N2R 1K4

Date Received: 15-MAR-17
Report Date: 29-MAR-17 14:02 (MT)
Version: FINAL

Client Phone: 519-741-5774

Certificate of Analysis

Lab Work Order #: L1901643
Project P.O. #: NOT SUBMITTED
Job Reference: 4-2352-04-03
C of C Numbers:
Legal Site Desc:

Taryn Williams, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1901643-1 VW-03 G01506875SVI							
Sampled By: CLIENT on 12-MAR-17 @ 14:30							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	90.0		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150687SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-2 VW-01 G0150695SVI							
Sampled By: CLIENT on 12-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	91.0		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150695SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805

* 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
L1901643-2 VW-01 G0150695SVI							
Sampled By: CLIENT on 12-MAR-17							
Matrix: TUBE							
Tube Information							
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-3 VW-05 G0150642SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	98.5		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150642SVI					29-MAR-17	R3686805
Batch Proof ID	6-Jan-17					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-4 XCG-290 G0150640SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757

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

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1901643-4 XCG-290 G0150640SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Linear & Cyclic Methyl Siloxanes							
Surrogate: 4-Bromofluorobenzene	92.5		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150640SVI					29-MAR-17	R3686805
Batch Proof ID	7-Feb-17					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-5 XCG-1 (SVP) G0150699SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	92.8		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150699SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-6 XCG-13 (SVP) G0150688SVI							
Sampled By: CLIENT on 12-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757

* 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
L1901643-6 XCG-13 (SVP) G0150688SVI							
Sampled By: CLIENT on 12-MAR-17							
Matrix: TUBE							
Linear & Cyclic Methyl Siloxanes							
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	93.2		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150688SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-7 XCG-6 (SVP) G0150069SVI							
Sampled By: CLIENT on 13-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	92.0		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150069SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-8 XCG-2 (SVP) G0150637SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757

* 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
L1901643-8 XCG-2 (SVP) G0150637SVI							
Sampled By: CLIENT on 11-MAR-17							
Matrix: TUBE							
Linear & Cyclic Methyl Siloxanes							
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	87.5		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150637SVI					29-MAR-17	R3686805
Batch Proof ID	7-Feb-17					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-9 XCG-10 (SVP) G0150698SVI							
Sampled By: CLIENT on 12-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	91.7		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150698SVI					29-MAR-17	R3686805
Batch Proof ID	6-Nov-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805
L1901643-10 XCG-4 (SVP0 G0150677SVI							
Sampled By: CLIENT on 14-MAR-17							
Matrix: TUBE							
Miscellaneous Parameters							
Air volume	.06			L		21-MAR-17	R3680758
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757

* 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
L1901643-10 XCG-4 (SVP0 G0150677SVI							
Sampled By: CLIENT on 14-MAR-17							
Matrix: TUBE							
Linear & Cyclic Methyl Siloxanes							
D3(CVMS)	<10		10	ng		29-MAR-17	R3686757
D4(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D4(CVMS)	<10		10	ng		29-MAR-17	R3686757
D5(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D5(CVMS)	<10		10	ng		29-MAR-17	R3686757
D6(CVMS)	<170		170	ug/m3		29-MAR-17	R3686757
D6(CVMS)	<10		10	ng		29-MAR-17	R3686757
MM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MDM(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MDM(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD2M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD2M(LVMS)	<10		10	ng		29-MAR-17	R3686757
MD3M(LVMS)	<170		170	ug/m3		29-MAR-17	R3686757
MD3M(LVMS)	<10		10	ng		29-MAR-17	R3686757
Surrogate: 4-Bromofluorobenzene	91.2		50-150	%		29-MAR-17	R3686757
Tube Information							
Tube ID	G0150677SVI					29-MAR-17	R3686805
Batch Proof ID	25-Oct-16					29-MAR-17	R3686805
Tube Usage Number	N/A					29-MAR-17	R3686805
Tube Manufacturer Date	N/A					29-MAR-17	R3686805

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

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AIR VOLUME-WT	Misc.	Air volume (L)	DATA ENTRY
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.

** 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.

Quality Control Report

Workorder: L1901643 Report Date: 29-MAR-17

Client: XCG Consulting Limited (Kitchener)
820 TRILLIUM DRIVE
KITCHENER ON N2R 1K4
Contact: MARY-CATHERINE LANNING

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SILOXANES-GCMS-WT	**Tube**							
Batch R3686757								
WG2501885-2 LCS								
D3(CVMS)			127.8		%		70-130	29-MAR-17
D4(CVMS)			106.3		%		70-130	29-MAR-17
D5(CVMS)			107.0		%		70-130	29-MAR-17
D6(CVMS)			115.3		%		70-130	29-MAR-17
MM(LVMS)			119.5		%		70-130	29-MAR-17
MDM(LVMS)			107.3		%		70-130	29-MAR-17
MD2M(LVMS)			110.5		%		70-130	29-MAR-17
MD3M(LVMS)			120.0		%		70-130	29-MAR-17
WG2501885-3 LCSD		**WG2501885-2**						
D3(CVMS)		127.8	153		%	18	50	29-MAR-17
D4(CVMS)		106.3	98		%	8.4	50	29-MAR-17
D5(CVMS)		107.0	94		%	13	50	29-MAR-17
D6(CVMS)		115.3	113		%	2.4	50	29-MAR-17
MM(LVMS)		119.5	124		%	4.1	50	29-MAR-17
MDM(LVMS)		107.3	121		%	12	50	29-MAR-17
MD2M(LVMS)		110.5	107		%	3.0	50	29-MAR-17
MD3M(LVMS)		120.0	114		%	5.1	50	29-MAR-17
WG2501885-1 MB								
D3(CVMS)			<10		ng		10	29-MAR-17
D4(CVMS)			<10		ng		10	29-MAR-17
D5(CVMS)			<10		ng		10	29-MAR-17
D6(CVMS)			<10		ng		10	29-MAR-17
MM(LVMS)			<10		ng		10	29-MAR-17
MDM(LVMS)			<10		ng		10	29-MAR-17
MD2M(LVMS)			<10		ng		10	29-MAR-17
MD3M(LVMS)			<10		ng		10	29-MAR-17
Surrogate: 4-Bromofluorobenzene			91.5		%		50-150	29-MAR-17

Quality Control Report

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

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.

L1901643

60 NORTHLAND ROAD, UNIT 1
WATERLOO, ON N2V 2B8

Phone: (519) 886-6910

Fax: (519) 886-9047

Toll Free: 1-800-668-9878

ALS Environmental

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

Page 1 of 1

Note: All TAT Quoted is in business days which exclude statutory holidays and weekends. TAT of samples received past 3:00 pm or Saturday / Sunday begin the next day.

DATE REQUIRED	SERVICE REQUESTED			
	10 day (regular)	☑	Rush 3 day (100%)	☐
	Rush 5 day (50%)	☐	Rush 2 day (200%)	☐
			Rush 1 day (300%) - Enquire	☐

COMPANY NAME	XCG Consulting
OFFICE	Kitchener
PROJECT MANAGER	Elisabeth Mance
PROJECT #	4-2352-04-03
PHONE	
FAX	
ACCOUNT #	
QUOTATION #	
PO #	

REGULATION

CRITERIA

OTHER INFORMATION

REPORT FORMAT/DISTRIBUTION

EMAIL ✓ FAX ____ BOTH ____
SELECT: PDF ____ DIGITAL ____ BOTH __
EMAIL 1 elisabeth.mance@xcg.com
EMAIL 2 marycatherine1@xcg.com

All rush work requires lab approval before sample submission

SUBMISSION #:

ENTERED BY:

DATE/TIME ENTERED:

BIN #:

SAMPLING INFORMATION

ANALYSIS REQUEST

Sample Date/Time: Date (dd-mmm-yy)	Time (24hr) (hh:mm)	Canister or Tube ID# (e.g. 06000-XXXX or G0XXXXXXSVI)	Regulator Serial # CS1200-XXXX or GXX	Matrix Type	SAMPLE DESCRIPTION TO APPEAR ON REPORT	TUBE AIR VOLUME - L ☒ or m³ ☐	Siloxanes						STARTING PRESSURE - Pre-Sampling ("Hg)	ENDING PRESSURE - Post Sampling ("Hg)	COLLECTION TIME (HRS)	Field Conditions (Rain/Wind/Dust/Odour) Field PID Reading	LAB ID
12-03-17	14:30	G0150687SVI	N/A	SV	VW-03	0.06	✓										
"		G0150695SVI	"	"	VW-01	"	✓										
11-03-17		G0150642SVI	"	"	VW-05	"	✓										
~~XCG-200~~ "		G0150640SVI	"	"	XCG-200	"	✓										
"		G0150699SVI	"	"	XCG-1 (SVP)	"	✓										
12-03-17		G0150688SVI	"	"	XCG-13 (SVP)	"	✓										
13-03-17		G0150069SVI	"	"	XCG-6 (SVP)	"	✓										
11-03-17		G0150637SVI	"	"	XCG-2 (SVP)	"	✓										
12-03-17		G0150698SVI	"	"	XCG-10 (SVP)	"	✓										
14-03-17		G0150677SVI	"	"	XCG-4 (SVP)	"	✓										

L1901643-COFC

SPECIAL INSTRUCTIONS/COMMENTS

This Chain of Custody Form is only to be used for Air Quality Samples

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

SAMPLE CONDITION AS RECEIVED
FROZEN ☐
COLD ☐
COOLING INITIATED ☐
AMBIENT ☐
MEAN TEMP 22.3°C

SAMPLED BY: M.C.Hanning	DATE & TIME	RECEIVED BY: RS	DATE & TIME 2/15/2017 4:51 pm
RELINQUISHED BY:	DATE & TIME	RECEIVED AT LAB BY:	DATE & TIME

OBSERVATIONS
Yes ☐ No ☐
If yes add SIF

INIT

Notes

1. Quote number must be provided to ensure proper pricing

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

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

REV6-2015