



FINAL REPORT

Phase II Environmental Site Assessment

159 Forward Avenue, Ottawa, Ontario

Submitted to:

City of Ottawa

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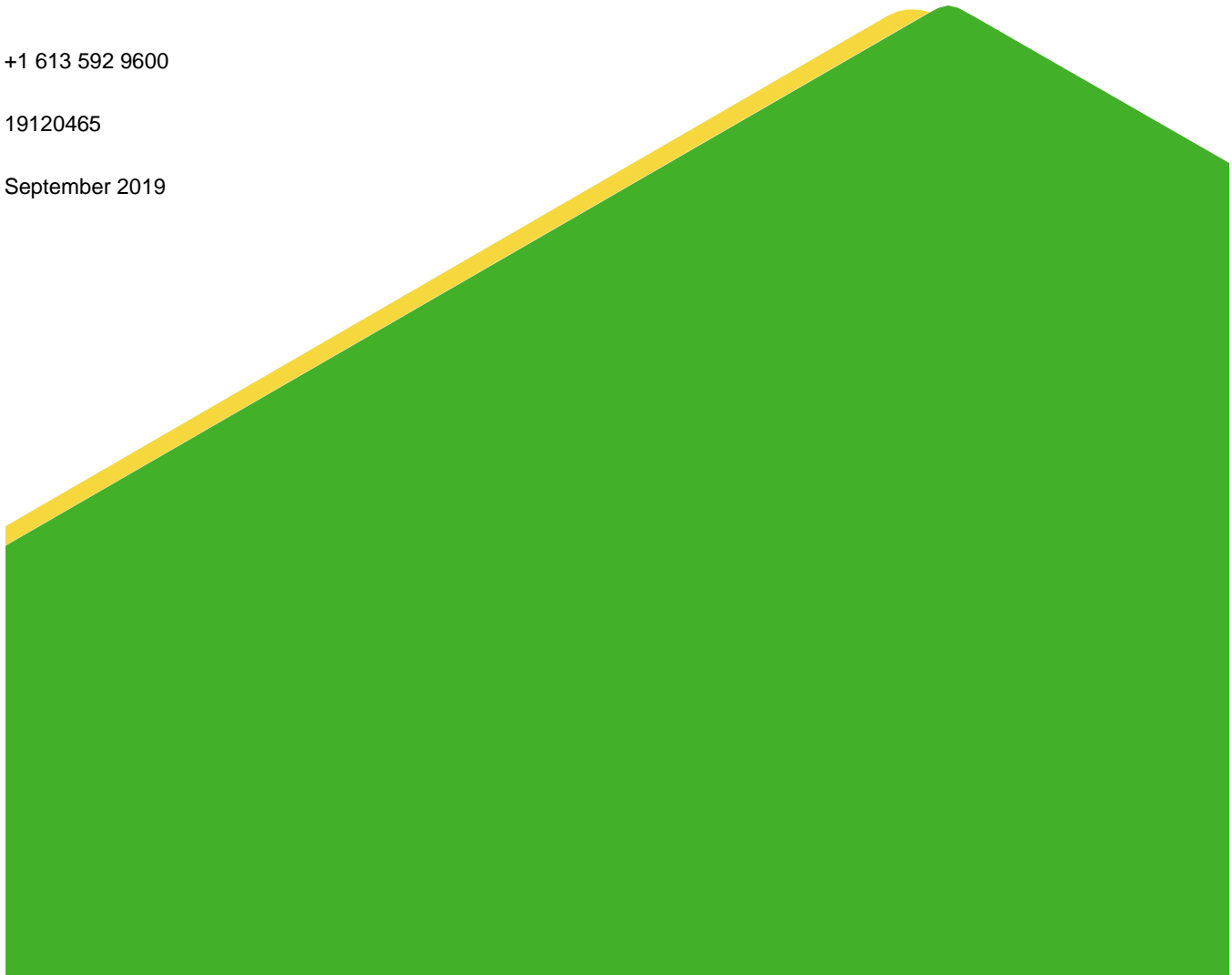
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Executive Summary

Golder Associates Ltd. (Golder) was retained by the City of Ottawa (City) to conduct a Phase II Environmental Site Assessment (Phase II ESA) on the property located at 159 Forward Avenue, Ottawa, Ontario (hereinafter collectively referred to as the “Site”), as shown on the attached Figure 1.

The Phase II ESA was initiated in August 2019 and was completed following recommendations to conduct a Phase II ESA in Golder’s Phase I ESA report dated May 2019, entitled “*Phase I Environmental Site Assessment, 159 Forward Avenue, Ottawa, Ontario*”. This Phase II ESA investigation was conducted for due diligence purposes.

Based on the information obtained during the Phase I ESA conducted at the Site, the following issues of Areas of Potential Environmental Concern (APECs) were identified on the Site:

- APEC 1 - Potential for soil and/or groundwater impacts in the vicinity of the former heating oil underground storage tanks which was located at the rear (east side) of the Site building and which was removed in 2002
- APEC 2 - Potential for poor quality fill to be present across the Site outside of the Site building
- APEC 3 - Potential for soil and/or groundwater impacts related to a transformer located on the southwest corner of the Site
- APEC 4 - Potential for soil and/or groundwater impacts in the northeast corner of the Site as a result of an off-site release of fuel oil and a former fuel product wholesaler

In order to address the above issues of potential environmental concern, a Phase II ESA was completed at the Site and consisted of six boreholes, three of which were completed as monitoring wells.

Based on the soil analytical results, the fill samples collected from three boreholes located on the south and east sides of the Site (boreholes 19-02, 19-03 and 19-06) had polycyclic aromatic hydrocarbons (PAHs) and/or metals impacts above the applicable Ministry of Environmental, Conservation and Parks (MECP) Table 7 Standards combined with the presence of the debris and black staining in the fill at locations across the Site, it is considered that widespread fill impacted by PAHs and/or metals and containing debris is present across the Site at levels above the MECP Table 7 Standards. The extent of the impacted fill is shown on Figure 3 and covers the exterior portions of the Site (approximately 870 m² in area). Based on the thickness of the fill material which was found to be 2.4, 1.1, 0.62, 0.72 and 0.28 m at boreholes 19-02 through 19-06, respectively, the average fill thickness at the Site was estimated to be 1.0 m. As such, the estimated volume of impacted fill present at the Site is 870 m³.

The highest concentration of PAHs were found in the fill at borehole 19-02 at concentrations up to 15 times of the applicable site standard. Given the groundwater level at this location was found to be within the fill, there is a possibility that PAHs may be present in the groundwater at this location. However, PAHs were not included as a chemical of concern for the groundwater analysis as the groundwater was believed to be deeper within the bedrock and PAH concentrations of this magnitude were not expected to be present in saturated overburden.

As there were no exceedances of petroleum hydrocarbons (PHCs), benzene, toluene, ethylbenzene and xylenes (BTEX) or polychlorinated biphenyls (PCBs) in any of the tested soil and groundwater samples, the on-Site transformer, former on-site heating oil UST and the off-Site fuel spill and former fuel product wholesaler (APECs 1, 3 and 4) do not appear to have resulted in current soil or groundwater impacts at the Site.

Considering the widespread presence of impacted fill across the Site, it is recommended that remediation or risk assessment be undertaken. In the event remediation is undertaken, it would include removal and off-site disposal of the fill material to bedrock. However, future redevelopment may require the removal of the fill material for construction purposes and as such it may be possible to complete the remediation in conjunction with the redevelopment at that time. If remediation is not undertaken, a site-specific risk assessment should be completed to evaluate potential risks to human health and the environment associated with identified contaminants. It is also recommended that groundwater sampling for PAHs be undertaken at the Site, specifically at monitoring well 19-02, to assess the potential for PAH impacted groundwater at the Site.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by the City of Ottawa (City) to conduct a Phase II Environmental Site Assessment (Phase II ESA) on the property located at 159 Forward Avenue, Ottawa, Ontario (hereinafter collectively referred to as the “Site”), as shown on the attached Figure 1.

The Phase II ESA was initiated in August 2019 and was completed following recommendations to conduct a Phase II ESA in Golder’s Phase One ESA report dated May 2019, entitled “*Phase One Environmental Site Assessment, 159 Forward Avenue, Ottawa, Ontario*”. This Phase II ESA investigation was conducted for due diligence purposes and for consideration as part of the City’s potential plans for the property redevelopment.

The Phase II ESA was completed in general accordance with Canadian Standards Association (CSA) Standard Z769-00 (R2013), *Phase II Environmental Site Assessment* for the purpose of identifying contaminants of potential concern that may be present at concentrations exceeding the applicable regulatory criteria.

1.1 Background and Site Description

The Site is located at 159 Forward Avenue, Ottawa, Ontario and is currently owned by the City of Ottawa. The Site is occupied by a vacant building that was previously used as an emergency housing facility and also includes paved driveways and a private playground located on the south. The surrounding lands are occupied by residential and parkland land uses.

A Phase One ESA was completed for the Site by Golder in May 2019. Based on the information obtained during the Phase One ESA, the following issues of Areas of Potential Environmental Concern (APECs) were identified on the Site: The locations of the APECs are shown on Figure 1.

Table 1: Areas of Potential Environmental Concern (APECs)

APEC	Location of APEC on the Site (as indicated on Figure 1)	PCA and Description of the Activity	Location of PCA (on-Site or off-Site)	Contaminants of Potential Concern (COCs)	Media Potentially Impacted (groundwater, soil and/or sediment)
APEC 1 Potential for soil and/or groundwater impacts in the vicinity of the former heating oil UST which was located at the rear (east side) of the Site building and was removed in 2002.	Southeast portion of the Site, behind/ east of the building.	28. Gasoline and Associated Products Storage in Fixed Tanks – High concentrations of PHCs were measured in soil and groundwater samples taken from the location of the former on-Site fuel underground storage tank (UST) during its decommissioning in 2002.	On-Site	PHC F1-F4/BTEX	Soil and groundwater

APEC	Location of APEC on the Site (as indicated on Figure 1)	PCA and Description of the Activity	Location of PCA (on-Site or off-Site)	Contaminants of Potential Concern (COCs)	Media Potentially Impacted (groundwater, soil and/or sediment)
APEC 2 - Potential for poor quality fill to be present across the Site outside of the Site building.	All areas of the Site outside the building footprint.	30. Importation of Fill Materials of Unknown Quality – Fill containing brick and wood pieces was documented in the fuel UST excavation and may exist Site-wide.	On-Site	Metals, PAHs, PHCs F1-F4/BTEX	Soil
APEC 3 - Potential for soil and/or groundwater impacts related to a transformer located on the southwest corner of the Site.	Southwest corner of the Site.	18. Electricity Generation, Transformation and Power Stations, and 55. Transformer Manufacturing, Processing or Use – Current presence of a pad mounted transformer on the southwest corner of the Site.	On-Site	PHCs F1-F4/BTEX and PCBs	Soil and groundwater
APEC 4 - Potential for soil and/or groundwater impacts in the northeast corner of the Site as a result of an off-site release of fuel oil and a former fuel product wholesaler.	Northeast corner of the Site.	28. Gasoline and Associated Products Storage in Fixed Tanks – Fuel oil tank release and former fuel product wholesaler at adjacent property at 154 Hinchey Avenue.	Off-Site	PHCs F1-F4/BTEX	Soil and groundwater

In order to address the above APECs, a Phase II ESA was completed at the Site.

1.2 Scope of Investigation

To achieve the objectives of the Phase II ESA, the scope of work included:

- Drilling of six boreholes (19-01 through 19-06, inclusively) at six locations (see Figure 1) to assess the soil and groundwater quality at the Site, related to potential impacts from the APECs identified in the Phase I ESA
- Collection of soil samples during drilling for visual characterization, headspace screening or organic vapours and potential laboratory analysis. No soil samples could be collected from borehole 19-01 as the subsurface conditions at this borehole included asphalt over a thin layer of granular over inferred bedrock
- Analysis of one soil sample from each borehole excluding borehole 19-01 where a soil sample could not be collected. Analysis in soil included petroleum hydrocarbon fractions F1- F4 (PHCs F1-F4), benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and/or metals to evaluate the soil quality at the Site
- Completion of the three boreholes (boreholes 19-01, 19-02 and 19-03) as monitoring wells (hereinafter referred to as monitoring wells 19-01, 19-02 and 19-03, respectively)
- Collection of one groundwater sample from each of the three monitoring wells for submission to an accredited laboratory for analysis of PHCs F1-F4, BTEX, and polychlorinated biphenyls (PCBs) at monitoring well 19-03
- Collection of one duplicate soil sample for analysis of the PHCs F1-F4, BTEX, PAHs and metals for Quality Assurance and Quality Control (QA/QC)
- Collection of one duplicate groundwater sample for analysis of the PHCs F1-F4, BTEX, metals and PCBs for Quality Assurance and Quality Control (QA/QC)
- One waste classification soil sample will be submitted for potential landfill disposal, as per O.Reg. 347/558
- An elevation survey of borehole and monitoring well locations using a Trimble R10 GNSS System
- Interpretation of the results and preparation of this report.

2.0 APPLICABLE SITE CONDITION STANDARDS

The soil and groundwater analytical results obtained for this Phase II ESA were compared to the standards for a non-potable groundwater condition presented in the Ontario Ministry of the Environment, Conservation and Parks (MECP) “*Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act*”, dated April 15, 2011 (MOE 2011). The following was considered in selecting the applicable standards:

- The Site’s latest use was residential/institutional land use and is proposed to be redeveloped with another residential building
- The Site building is supplied with municipal water. As such, non-potable groundwater conditions have been selected
- The Site is not an environmentally sensitive site as defined by Section 41, Part IX, Ontario Regulation (O.Reg.) 153/04

- The nearest water body is the Ottawa River which is located approximately 400 m north of the Site. As such, the Site is not located within 30 m of a water body.
- The depth to bedrock encountered during borehole drilling on-Site completed as part of the Phase II ESA was less than 2 metres below ground surface (mbgs) at more than two-thirds of the Site.
- Based on field observations during the Phase II ESA, the soil is considered to be coarse-textured.

Based on the above, the applicable standards are considered to be the MECP Table 7 Standards, Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition for coarse-textured soil and Residential/Parkland/Institutional property use.

3.0 METHODOLOGY AND INVESTIGATIVE TECHNIQUES

The following sections describe the pre-field work activities and field investigation methodology employed during the Phase II ESA conducted at the Site. The field work was conducted between August 8 and 16, 2019.

Prior to initiating the fieldwork, Golder developed and implemented site-specific protocols to protect the health and safety of its employees, its subcontractors and the environment through a Site-specific Health, Safety and Environmental Plan. Prior to any intrusive investigations, Golder arranged for the completion of public and private utility clearances.

3.1 Borehole Drilling and Soil Sampling

Boreholes were advanced using a GM-100 track mounted drill rig operated by Strata Drilling Group to depths ranging from 0.44 to 3.53 mbgs. All boreholes were advanced through the overburden to practical refusal on inferred bedrock with the exception of boreholes 19-01 and 19-03 when were advanced beyond the overburden and into bedrock using air hammer techniques.

All intrusive investigations were monitored in the field by Golder field personnel. Soil samples were retrieved using split a 51 mm diameter PVC sleeve with macro sampler. Soil samples were logged as to soil type, texture, moisture content, presence of staining, odour and debris, if any. Field observations made during the borehole drilling activities are summarized in the Record of Borehole sheets provided in Appendix A. Soil samples were collected into laboratory supplied bottles, placed in coolers with ice, and where recovered soil volumes permitted, additional bagged samples were collected for soil vapour headspace readings, which were conducted in the field using a photoionization detector.

Based on field observations and soil headspace organic vapour measurements, one to two soil samples from each borehole were submitted under chain of custody documentation for laboratory analysis of PHCs F1- F4, BTEX, PAHs and/or metals with the exception of borehole 19-01 from which no soil samples could be retrieved and thus none were submitted for analysis.

3.2 Monitoring Well Installation

Monitoring wells were completed at three boreholes (boreholes 19-01, 19-02 and 19-03) by installing 1.5 m long screen (32 millimetre (mm) slotted schedule 40 PVC screens) and solid riser. The annular space from the base of the screen to up to approximately 0.3 m above the screen was backfilled with silica sand. A bentonite seal was placed from the top of the sand pack to approximately 0.3 to 0.6 metres below ground surface above which silica sand was placed up to ground surface. All monitoring wells were completed with flush mount style protective casings. The riser pipes were sealed with a protective cap.

3.3 Groundwater Sampling

Following monitoring well installation, the wells were developed by purging up to ten times the well using conventional purging methods (i.e., dedicated low-density polyethylene (LDPE) tubing and inertial foot valves). After allowing each well to recover, water levels were measured in each well and groundwater samples were collected from each well using the low flow sampling method (i.e., peristaltic pump) to reduce agitation of sediment in the water column and minimize the amount of sediment present in the groundwater samples. The groundwater samples were collected after the water quality parameters stabilized. All samples were placed directly into laboratory supplied bottles and vials, placed in coolers with ice, and submitted to for laboratory analysis of PHCs F1-F4 and BTEX for monitoring wells 19-01 and 19-02 and PHCs F1-F4, BTEX and PCBs at monitoring well 19-03.

3.4 Sampling Location Survey

The locations and elevations of the boreholes and monitoring wells were surveyed using a Trimble R10 GNSS System.

4.0 RESULTS

4.1 Geology and Soil Stratigraphy

Six boreholes were advanced at the Site as part of the Phase II ESA to depths ranging between 0.44 to 3.53 mbgs.

In general, the subsurface conditions across this Site consist of approximately 0.03 to 0.24 m of pavement structure comprised of asphaltic concrete and granular fill underlain by fill material and inferred bedrock. The fill material was present at all boreholes excluding borehole 19-01 at which bedrock was inferred to be present directly below the pavement structure and extended to the full depth of the borehole (3.53 mbgs).

The fill material extended to depths between 0.44 and 3.00 mbgs and mostly consisted of sand and gravel and was noted to contain black staining and debris including wood, drive, cinder and/or ash. A faint hydrocarbon odour was also noted in the fill at borehole 19-03. A clayey silt fill layer was also present in the upper 0.30 m of fill at borehole 19-06. Where present, the fill material extended to the full depth of the overburden.

A 0.16 m thick concrete slab was encountered in the fill at a depth of 2.5 m in borehole 19-02.

Borehole 19-01 and 19-03 were advanced through inferred bedrock using air hammer techniques. The bedrock was encountered at depths of 0.20 and 2.13 mbgs, respectively, at these locations.

4.2 Hydrogeological Conditions

The following groundwater elevations in relation to geodetic benchmark were measured on August 16, 2019:

Table 2: Groundwater Levels and Elevations

Location	Water Level (mbgs)	Groundwater Elevation (m)
19-01	1.99	60.70
19-02	1.41	61.22
19-03	1.52	60.94

Notes:

mbgs: metres below ground surface

Based on the hydrogeological study of the entire Site, local shallow groundwater flow is interpreted to be northwest.

No hydrocarbon sheens or odour were detected in the monitoring wells during groundwater sampling.

5.0 EVALUATION OF RESULTS

5.1 Soil

The following soil samples were submitted for laboratory analysis, based on field observations, soil headspace screening measurements, changes in stratigraphy and targeted depth intervals:

Table 3: Soil Quality Samples

Sample Location	Sample Name	Sample Depth (mbgs)	Soil Type	Analyses
19-02	19-02 SA2	1.30 – 2.00	Fill (sand and gravel, contains wood, ash cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals
	19-02 SA3	2.00 – 3.00	Fill (sand and gravel, contains wood, ash cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals
	19-02 SA3 DUP (duplicate of 19-02 SA3)	2.00 – 3.00	Fill (sand and gravel, contains wood, ash cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals
19-03	19-03 SA2	0.46 – 1.22	Fill (sand and gravel, contains wood, ash, cinder and black staining, faint hydrocarbon odour)	PHCs F1-F4, BTEX, PAHs and metals
19-04	19-04 SA1	0.18 – 0.80	Fill (sand and gravel, contains wood, ash, brick, cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals
19-05	19-05 SA1	0.24 – 0.96	Fill (sand and gravel, contains ash, cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals
19-06	19-06 SA2	0.30 – 0.44	Fill (sand and gravel, contains wood, ash cinder and black staining)	PHCs F1-F4, BTEX, PAHs and metals

The soil analytical results compared to the applicable standards (MECP Table 3) are provided in Tables 5a, 5b and 5c following the text of this report while the results of the TCLP soil testing are presented in Table 5d. The laboratory certificates of analysis are provided in Appendix B.

The fill samples at three of the five tested locations (borehole 19-02, 19-03 and 19-06) had exceedances of the MECP Table 7 Standards for several PAHs and/or metals (lead). More specifically, all fill samples collected from borehole 19-02 had concentrations of several PAHs above the MECP Table 7 Standards, the fill sample from borehole 19-06 had concentrations of several PAHs and lead above the MECP Table 7 Standards and the fill sample from borehole 19-03 showed an exceedance for lead. It is noted that the PAHs levels in the fill at borehole 19-02 were notably higher with concentrations up to 15 times the applicable site standard.

The fill samples analyzed from boreholes 19-04 and 19-05 satisfied the MECP Table 7 Standards for all parameters analyzed. The concentration of PHCs F1-F4 and BTEX were either below the laboratory detection limit or below the MECP Table 7 Standards in all analyzed samples.

The soil exceedances are presented on Figure 2.

The results from the TCLP soil testing under the O. Reg. 347/558 for the soil sample collected from borehole 19-01 (sample 19-02 SA2) indicated that the leachate concentrations of the parameters analyzed met the O. Reg. 347/558 Schedule 4 Leachate Quality Criteria and that the soil is not ignitable. As such, the soil is classified as non-hazardous waste and can be disposed of at non-hazardous landfill facility, should it be required.

5.2 Groundwater

The following groundwater samples were submitted for laboratory analysis as part of the Phase II ESA:

Table 4: Groundwater Quality Samples

Sample Location	Sample Name	Screened Unit	Analysis
19-01	19-01	Bedrock	PHCs F1-F4 and BTEX
19-02	19-02	Fill	PHCs F1-F4 and BTEX
19-03	19-03	Bedrock	PHCs F1-F4, BTEX and PCBs
	19-03 DUP		PHCs F1-F4, BTEX and PCBs

The groundwater analytical results compared to the applicable standards (MECP Table 7) are provided in Tables 6a and 6b following the text of the report. The laboratory certificates of analysis are provided in Appendix B.

The concentrations of PHCs F1-F4, BTEX and PCBs were below the laboratory detection limits and the MECP Table 7 Standards in all groundwater samples.

5.3 Quality Assurance and Quality Control

One duplicate soil sample was collected from borehole 19-02 (original sample 19-02 SA3 and duplicate sample 19-02 SA3 DUP) and submitted for analysis of PHCs F1-F4, BTEX, PAHs and metals. One duplicate groundwater sample was collected from monitoring well 19-03 (original sample 19-03 and duplicate sample DUP) and submitted for analysis of PHCs F1-F4, BTEX and PCBs.

The quality assurance assessment of the field duplicate sample results was conducted according to the document entitled Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act, March 9, 2004 (amended in July 2009 and effective as of July 1, 2011) ("Analytical Protocol").

To determine the precision of the analytical methods and field sampling procedures, blind duplicate samples were collected during soil sampling. Precision is determined by the relative percent difference (RPD) between the duplicate and original samples and was calculated as follows:

$$RPD = \frac{|x_1 - x_2|}{x_m}$$

Where

x_1 initial sample results

x_2 duplicate sample results

x_m mean of x_1 , x_2

Where, x_1 and x_2 are the original and duplicate concentrations. RPDs are calculated only if the concentrations of a parameter are greater than the laboratory RDL in both the duplicate and original samples. In addition, lower precision in the RPD calculation is expected when the average of the concentrations of the analytes is less than 5 times the RDL. Therefore, RPDs were calculated for the original and duplicate sample only in cases where the average of the measured concentrations of analytes was five (5) times greater than the RDL.

The following RPD limits were considered reasonable and are based on Analytical Protocol: RPDs in soil, 30% for metals, 30% for PHCs, 40% for PCBs and 40% for PAHs and in groundwater, 30% for PHCs, and 30% for PCBs.

RPDs could not be calculated for PHCs, BTEX or PCBs in the original and duplicate groundwater samples and for PCBs and BTEX in the original and duplicate soil samples, as these results were below the laboratory RDL or less than ten times greater than the RDL. The calculated RPDs for metals in the original and duplicate soil sample were within the acceptable limits except for copper and lead which were measured at beyond the control limits at 68 % and 34%, respectively. The RPDs for PAHs in soil were up to 59% which is above the acceptable limit. Although the RPDs for metals and PAHs in the original and duplicate soil samples were outside of the acceptable limits, the results of these samples not considered to be of unreliable data given the heterogenous nature of the fill and that the RPDs for all other parameters, including those for the groundwater samples, were within the control limits.

Considering the above, the analytical data generated during the investigation are generally considered valid and representative of Site conditions at the time of the investigation and may be used in this Phase II ESA without further qualification other than as described in this report.

6.0 SUMMARY AND CONCLUSIONS

Based on the soil analytical results, the fill samples collected from three boreholes located on the south and east sides of the Site (boreholes 19-02, 19-03 and 19-06) had PAHs and/or metals impacts above the applicable MECP Table 7 Standards combined with the presence of the debris and black staining in the fill at locations across the Site, it is considered that widespread fill impacted by PAHs and/or metals and containing debris is present across the exterior of the Site at levels above the MECP Table 7 Standards. The extent of the impacted fill is shown on Figure 3 and covers the exterior portions of the Site (approximately 870 m² in area). Based on the thickness of the fill material, which was found to be 2.4, 1.1, 0.62, 0.72 and 0.28 m at boreholes 19-02 through 19-06, respectively, the average fill thickness at the Site was estimated to be 1.0 m. As such, the estimated volume of impacted fill present at the Site is 870 m³.

The highest concentration of PAHs were found in the fill at borehole 19-02 at concentrations up to 15 times of the applicable site standard. Given the groundwater level at this location was found to be within the fill, there is a possibility that PAHs may be present in the groundwater at this location. However, PAHs were not included as a chemical of concern for the groundwater analysis as the groundwater was believed to be deeper within the bedrock and PAH concentrations of this magnitude were not expected to be present in saturated overburden.

As there were no exceedances of PHCs, BTEX or PCBs in any of the tested soil and groundwater samples, the on-Site transformer, former on-site heating oil UST and the off-Site fuel spill and former fuel product wholesaler (APECs 1, 3 and 4) do not appear to have resulted in current soil or groundwater impacts at the Site.

7.0 RECOMMENDATIONS

Considering the widespread presence of impacted fill across the Site, it is recommended that remediation or risk assessment be undertaken. In the event remediation is undertaken, it would include removal and off-site disposal of the fill material to bedrock. However, future redevelopment may require the removal of the fill material for construction purposes and as such it may be possible to complete the remediation in conjunction with the redevelopment at that time. If remediation is not undertaken, a site-specific risk assessment should be completed to evaluate potential risks to human health and the environment associated with identified contaminants. It is also recommended that groundwater sampling for PAHs be undertaken at the Site, specifically at monitoring well 19-02, to assess the potential for PAH impacted groundwater at the Site.

8.0 LIMITATIONS

This report was prepared for the exclusive use of the City of Ottawa. Any use of this document by a third party is expressly forbidden. No assurance is made regarding the accuracy and completeness of these data. Golder disclaims responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions and costs.

This report is intended to provide an assessment of the potential environmental conditions of the Site as defined by the Site boundaries in Figure 1, which is defined as the property located at 159 Forward Avenue in Ottawa, Ontario.

The assessment of the environmental conditions and hazards at this Site has been made using the results of chemical analysis of discrete samples from a limited number of locations. The Site conditions between sampling locations have been inferred based on conditions observed at test locations. Soil and groundwater conditions will vary between and beyond sample locations. Additional study can reduce the inherent uncertainties associated with this type of study. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility of undetected contamination.

The services performed as described in this document were conducted in a manner consistent with the level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

The content of this document is based on information collected during site investigations, our present understanding of the site conditions, and our professional judgment in light of such information at the time of this document. This document provides a professional opinion and, therefore, no warranty is either expressed, implied, or made as to the conclusions, advice and recommendations offered in this document. This document does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change. The groundwater monitors installed during the course of this investigation have been left in place. These monitors are the property of the owner/client and not Golder Associates Ltd.

Signature Page

We trust that the information presented in this report meets your current requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Golder Associates Ltd.



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Appended Tables

Parameter	Unit	MECP Table 7 Standards (R/P/I) ⁽¹⁾ ⁽²⁾	19-02			19-03	19-04	19-05	19-06
			08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19
			19-02 SA2	19-02 SA3	19-02 SA3 DUP (duplicate of 19-02 SA3)	19-03 SA2	19-04 SA1	19-05 SA1	19-06 SA2
Sample Depth	m		1.30 - 2.00	2.00 - 3.00	2.00 - 3.00	0.46 - 1.22	0.18 - 0.80	0.24 - 0.96	0.30 - 0.44
Benzene	µg/g	0.21	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g	2.3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Xylenes	µg/g	3.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Petroleum Hydrocarbons - F1 (C6-C10)	µg/g	55	<7	<7	<7	<7	<7	<7	<7
Petroleum Hydrocarbons - F2 (C10-C16)	µg/g	98	73	61	83	<4	<4	<4	<4
Petroleum Hydrocarbons - F3 (C16-C34)	µg/g	300	141	185	275	34	59	35	56
Petroleum Hydrocarbons - F4 (C34-C50)	µg/g	2800	82	178	218	29	27	19	30

Footnotes:

Tables should be read in conjunction with the accompanying document.

< value = Indicates parameter not detected above laboratory method detection limit.

> value = Indicates parameter detected above equipment analytical range.

-- Chemical not analyzed or criteria not defined.

(1) Ontario Reg 153/04 (2011) Table 7: Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition, Residential/Parkland/Institutional Property Use for Coarse Grained Soils

(2) Grey and bold background indicated parameter concentration greater than the MECP Table 7 Standards

Parameter	Unit	MECP Table 7 Standards (R/P/I) ⁽¹⁾ ⁽²⁾	19-02			19-03	19-04	19-05	19-06
			08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19
			19-02 SA2	19-02 SA3	19-02 SA3 DUP (duplicate of 19-02 SA3)	19-03 SA2	19-04 SA1	19-05 SA1	19-06 SA2
Sample Depth	m		1.30 - 2.00	2.00 - 3.00	2.00 - 3.00	0.46 - 1.22	0.18 - 0.80	0.24 - 0.96	0.30 - 0.44
Acenaphthene	µg/g	7.9	1.57	0.08	0.08	0.04	0.05	<0.02	0.05
Acenaphthylene	µg/g	0.15	0.28	0.54	0.30	0.03	0.04	0.05	0.11
Anthracene	µg/g	0.67	2.69	0.52	0.33	0.10	0.15	0.08	0.20
Benzo[a]anthracene	µg/g	0.5	3.60	1.05	0.88	0.26	0.29	0.22	0.76
Benzo[a]pyrene	µg/g	0.3	3.08	1.36	0.87	0.24	0.24	0.20	0.83
Benzo[b]fluoranthene	µg/g	0.78	4.28	2.12	1.30	0.39	0.35	0.27	1.17
Benzo[g,h,i]perylene	µg/g	6.6	1.88	1.19	0.65	0.17	0.16	0.13	0.55
Benzo[k]fluoranthene	µg/g	0.78	2.49	1.08	0.67	0.21	0.19	0.14	0.59
Chrysene	µg/g	7	3.98	1.07	1.04	0.27	0.30	0.23	0.86
Fluoranthene	µg/g	0.69	11.1	2.19	1.87	0.63	0.67	0.42	1.61
Fluorene	µg/g	62	1.35	0.10	0.09	0.03	0.06	0.02	0.07
Indeno[1,2,3-cd]pyrene	µg/g	0.38	1.77	1.09	0.61	0.16	0.15	0.12	0.52
1-Methylnaphthalene	µg/g	0.99	0.18	0.05	0.04	<0.02	0.02	<0.02	0.06
2-Methylnaphthalene	µg/g	0.99	0.26	0.08	0.05	<0.02	0.03	<0.02	0.06
Methylnaphthalene (1&2)	µg/g	0.99	0.44	0.14	0.09	<0.04	0.05	<0.04	0.12
Naphthalene	µg/g	0.6	0.33	0.14	0.09	0.01	0.04	0.02	0.08
Phenanthrene	µg/g	6.2	9.81	0.99	0.76	0.38	0.57	0.24	0.97
Pyrene	µg/g	78	8.45	2.01	1.64	0.54	0.53	0.38	1.41
Dibenzo (a,h) anthracene	µg/g	0.1	0.52	0.33	0.19	0.05	0.05	0.04	0.16

Footnotes:

Tables should be read in conjunction with the accompanying

< value = Indicates parameter not detected above laboratory

> value = Indicates parameter detected above equipment

-- Chemical not analyzed or criteria not defined.

(1) Ontario Reg 153/04 (2011) Table 7: Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition, Residential/Parkland/Institutional Property Use for Coarse Grained Soils

(2) Grey and bold background indicated parameter concentration greater than the MECP Table 7 Standards

Parameter	Unit	MECP Table 7 Standards (R/P/I) ⁽¹⁾ ⁽²⁾	19-02			19-03	19-04	19-05	19-06
			08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19	08-Aug-19
			19-02 SA2	19-02 SA3	19-02 SA3 DUP (duplicate of 19-02 SA3)	19-03 SA2	19-04 SA1	19-05 SA1	19-06 SA2
Sample Depth	m		1.30 - 2.00	2.00 - 3.00	2.00 - 3.00	0.46 - 1.22	0.18 - 0.80	0.24 - 0.96	0.30 - 0.44
Boron, available	µg/g	1.5	<0.5	<0.5	0.6	<0.5	0.6	0.6	<0.5
Chromium (VI)	ug/g	8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mercury	ug/g	0.27	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2
Antimony	ug/g	7.5	<1.0	<1.0	1.4	1.0	<1.0	<1.0	<1.0
Arsenic	ug/g	18	5.4	5.1	6.9	12.1	7.4	7.5	14.7
Barium	ug/g	390	173	112	143	157	101	137	203
Beryllium	ug/g	4	0.6	0.6	0.7	0.9	0.5	0.7	0.7
Boron	ug/g	120	5.6	<5.0	<5.0	<5.0	<5.0	8.7	5.4
Cadmium	ug/g	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	ug/g	160	35.0	15.9	17.7	18.5	13.8	22.8	21.0
Cobalt	ug/g	22	10.2	6.9	8.6	9.6	7.0	7.1	8.8
Copper	ug/g	140	29.2	26.3	53.2	29.6	25.8	19.7	42.2
Lead	ug/g	120	84.4	66.1	93.0	284	80	69.8	199
Molybdenum	ug/g	6.9	1.3	1.1	1.8	2.4	1.4	2.3	1.8
Nickel	ug/g	100	26.1	17.5	21.1	25.0	18.3	18.4	23.2
Selenium	ug/g	2.4	<1.0	<1.0	1.2	1.7	1.0	1.2	1.2
Silver	ug/g	20	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Thallium	ug/g	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Uranium	ug/g	23	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1
Vanadium	ug/g	86	35.6	25.0	29.4	26.8	22.0	25.8	33.3
Zinc	ug/g	340	110	104	107	88.4	70.9	210	181

Footnotes:

Tables should be read in conjunction with the accompanying

< value = Indicates parameter not detected above laboratory method detection

> value = Indicates parameter detected above equipment analytical range.

-- Chemical not analyzed or criteria not defined.

(1) Ontario Reg 153/04 (2011) Table 7: Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition, Residential/Parkland/Institutional Property Use for Coarse Grained Soils

(2) Grey and bold background indicated paramater concentration greater than the MECP Table 7 Standards

**Table 5d: Soil Analytical Results:
Toxicity Characteristic Leaching Procedure Testing Results**

Parameter	Unit	O.Reg. 347/558 Schedule 4 Leachate Quality Criteria ^{(1) (2)}	19-02
			08-Aug-19
Sample Depth	m		19-02 SA2 1.30 - 2.00
Physical Characteristics			
Ignitability	N/A	--	No
EPA 1311 - TCLP Leachate Inorganics			
Arsenic	mg/L	2.5 mg/L	<0.05
Barium	mg/L	100 mg/L	0.22
Boron	mg/L	500 mg/L	<0.05
Cadmium	mg/L	0.5 mg/L	<0.01
Chromium	mg/L	5 mg/L	<0.05
Lead	mg/L	5 mg/L	<0.05
Mercury	mg/L	0.1 mg/L	<0.005
Selenium	mg/L	1 mg/L	<0.05
Silver	mg/L	5 mg/L	<0.05
Uranium	mg/L	10 mg/L	<0.05
EPA 1311 - TCLP Leachate Organics			
Benzene	mg/L	0.5	<0.005
Benzo[a]pyrene	mg/L	0.001	<0.0001

Footnotes:

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> value = Indicates parameter detected above equipment analytical range.

-- Chemical not analyzed or criteria not defined.

(1) Ontario Regulation 347/558, as amended, under the Environmental Protection Act,
Schedule 4 Leachate Quality Criteria

(2) Grey and bold background indicated parameter concentration greater than O.Reg. 347
Schedule 4 Leachate Quality Criteria

Parameter	Units	MECP Table 7 Standards ^{(1) (2)}	19-01	19-02	19-03	
			19-01	19-02	19-03	DUP (duplicate of 19-03)
			16-Aug-19	16-Aug-19	16-Aug-19	16-Aug-19
Benzene	ug/L	0.50	<0.5	<0.5	<0.5	<0.5
Toluene	ug/L	320	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	ug/L	54	<0.5	<0.5	<0.5	<0.5
Total Xylenes	ug/L	72	<0.5	<0.5	<0.5	<0.5
Petroleum Hydrocarbons - F1 (C6-C10)	ug/L	420	<25	<25	<25	<25
Petroleum Hydrocarbons - F2 (C10-C16)	ug/L	150	<100	<100	<100	<100
Petroleum Hydrocarbons - F3 (C16-C34)	ug/L	500	<100	<100	<100	<100
Petroleum Hydrocarbons - F4 (C34-C50)	ug/L	500	<100	<100	<100	<100

Footnotes:

Tables should be read in conjunction with the accompanying document.

< value = Indicates parameter not detected above laboratory method detection limit.

> value = Indicates parameter detected above equipment analytical

-- Chemical not analyzed or criteria not defined.

(1) Ontario Reg 153/04 (2011) Table 7: Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition, All Types of Property Use

(2) Grey and bold background indicated parameter concentration greater than the MECP Table 7

Parameter	Units	MECP Table 7 Standards ⁽¹⁾ ⁽²⁾	19-03	
			19-03	DUP (duplicate of 19-03)
			16-Aug-19	16-Aug-19
PCBs, total	ug/L	0.2	<0.05	<0.05

Footnotes:

Tables should be read in conjunction with the accompanying document.

< value = Indicates parameter not detected above laboratory method detection limit.

> value = Indicates parameter detected above equipment analytical range.

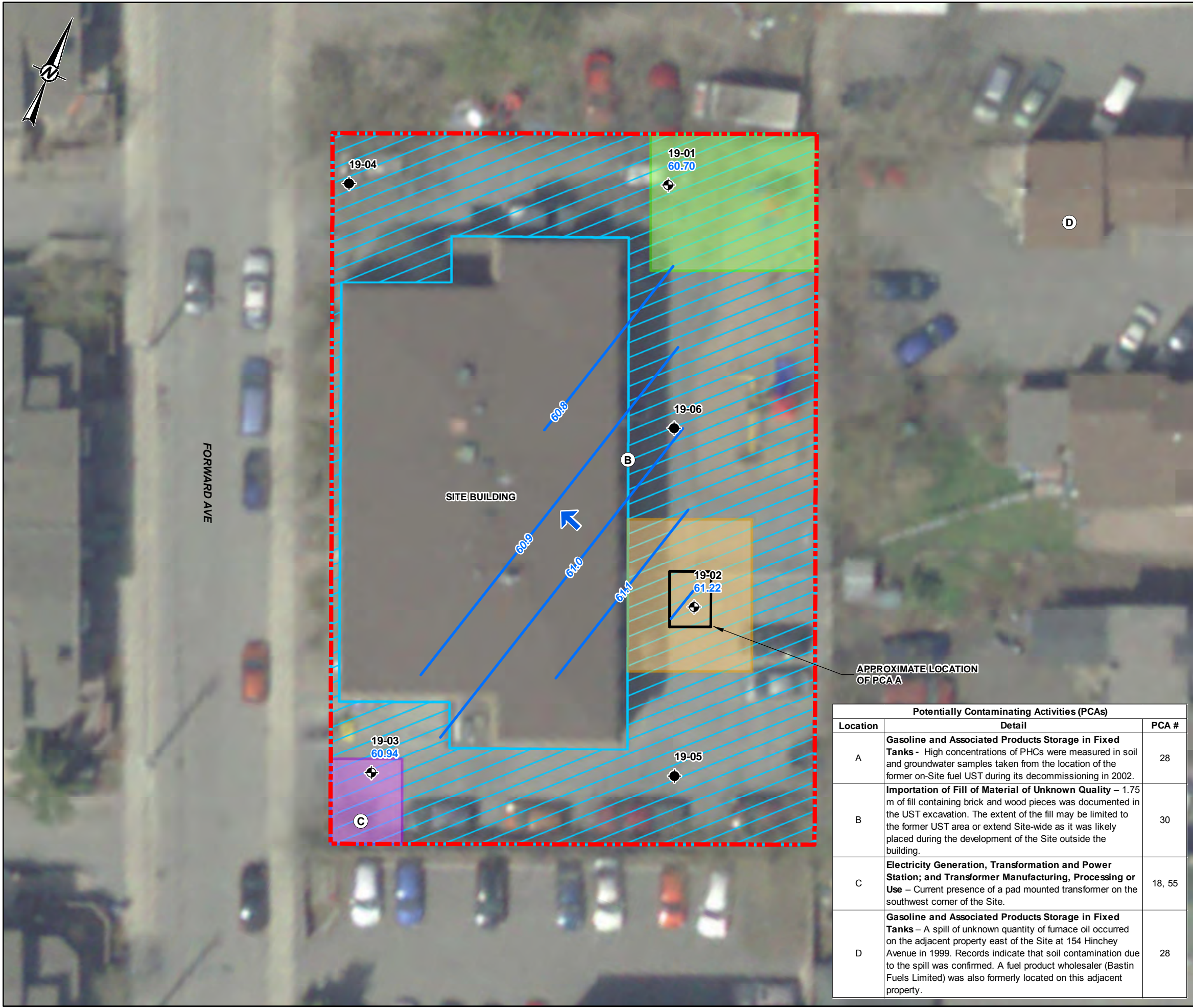
-- Chemical not analyzed or criteria not defined.

(1) Ontario Reg 153/04 (2011) Table 7: Generic Site Condition Standards for Shallow Soils in a Non-Potable Ground Water Condition, All Types of Property Use

(2) Grey and bold background indicated parameter concentration greater than the MECP Table 7 Standards

Figures

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APPROXIMATE LOCATION
OF PCA A

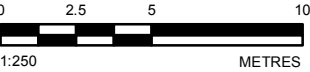
Potentially Contaminating Activities (PCAs)		
Location	Detail	PCA #
A	Gasoline and Associated Products Storage in Fixed Tanks - High concentrations of PHCs were measured in soil and groundwater samples taken from the location of the former on-Site fuel UST during its decommissioning in 2002.	28
B	Importation of Fill of Material of Unknown Quality - 1.75 m of fill containing brick and wood pieces was documented in the UST excavation. The extent of the fill may be limited to the former UST area or extend Site-wide as it was likely placed during the development of the Site outside the building.	30
C	Electricity Generation, Transformation and Power Station; and Transformer Manufacturing, Processing or Use - Current presence of a pad mounted transformer on the southwest corner of the Site.	18, 55
D	Gasoline and Associated Products Storage in Fixed Tanks - A spill of unknown quantity of furnace oil occurred on the adjacent property east of the Site at 154 Hinchey Avenue in 1999. Records indicate that soil contamination due to the spill was confirmed. A fuel product wholesaler (Bastin Fuels Limited) was also formerly located on this adjacent property.	28



LEGEND	
	APPROXIMATE BOREHOLE LOCATION
	APPROXIMATE MONITORING WELL LOCATION
	APEC 1
	APEC 2 AND PCA B
	APEC 3
	APEC 4
	APPROXIMATE SITE BOUNDARY
	GROUNDWATER ELEVATION, mASL (AUGUST 16, 2019)
	GROUNDWATER ELEVATION CONTOUR, mASL
	INTERPRETED GROUNDWATER FLOW DIRECTION

Areas of Potential Environmental Concern (APECs)		
APEC #	Detail	PCA #
1	Potential for soil and/or groundwater impacts in the vicinity of the former heating oil UST which was located at the rear (east side) of the Site building and was removed in 2002.	28
2	Potential for poor quality fill to be present across the Site outside of the Site building.	30
3	Potential for soil and/or groundwater impacts related to a transformer located on the southwest corner of the Site.	18, 55
4	Potential for soil and/or groundwater impacts in the northeast corner of the Site as a result of an off-site release of fuel oil and a former fuel product wholesaler.	28

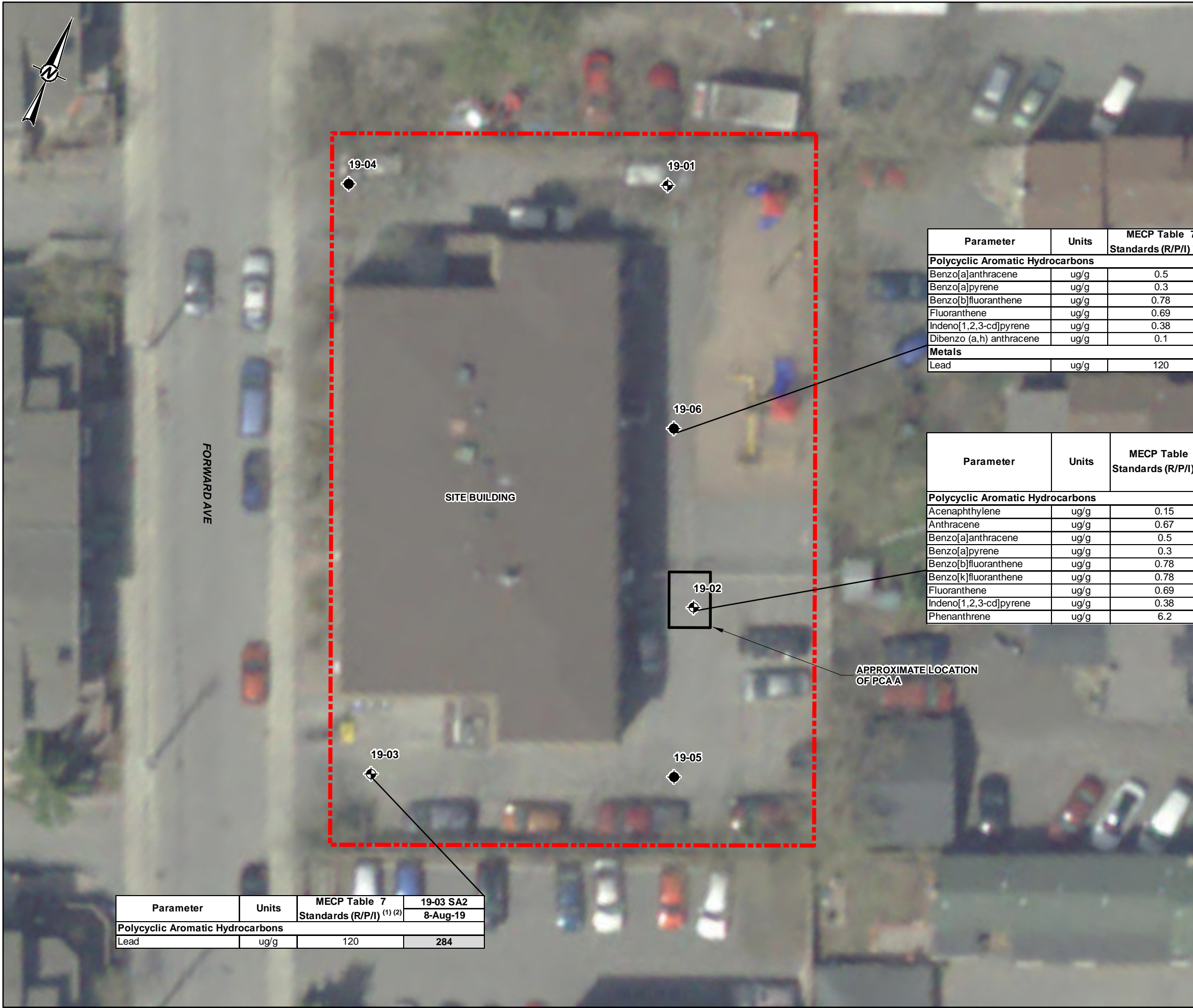
REFERENCE(S)
1. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83,
COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28



CLIENT CITY OF OTTAWA		
PROJECT PHASE II ENVIRONMENTAL SITE ASSESSMENT 159 FORWARD AVENUE, OTTAWA, ONTARIO		
TITLE SITE PLAN		
CONSULTANT	YYYY-MM-DD	2019-09-04
	DESIGNED	---
	PREPARED	JEM
	REVIEWED	BEM
	APPROVED	KPH
PROJECT NO. 19120465	CONTROL 0002	REV. 0
		FIGURE 1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm

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LEGEND

APPROXIMATE BOREHOLE LOCATION

APPROXIMATE MONITORING WELL LOCATION

APPROXIMATE SITE BOUNDARY

NOTE(S)

1. ONTARIO REG 153/04 (2011) TABLE 7: GENERIC SITE CONDITION STANDARDS FOR SHALLOW SOILS IN A NON-POTABLE GROUND WATER CONDITION, RESIDENTIAL/PARKLAND/INSTITUTIONAL PROPERTY USE FOR COARSE GRAINED SOILS

2. GREY AND BOLD BACKGROUND INDICATES EXCEEDANCE OF THE MECP TABLE 7

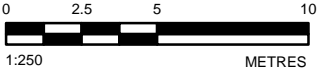
REFERENCE(S)

1. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

Parameter	Units	MECP Table 7	19-06 SA2
		Standards (R/P/I) ^{(1) (2)}	8-Aug-19
Polycyclic Aromatic Hydrocarbons			
Benzo[a]anthracene	ug/g	0.5	0.76
Benzo[a]pyrene	ug/g	0.3	0.83
Benzo[b]fluoranthene	ug/g	0.78	1.17
Fluoranthene	ug/g	0.69	1.61
Indeno[1,2,3-cd]pyrene	ug/g	0.38	0.52
Dibenzo (a,h) anthracene	ug/g	0.1	0.16
Metals			
Lead	ug/g	120	199

Parameter	Units	MECP Table 7 Standards (R/P/I) ^{(1) (2)}	19-02 SA2	19-02 SA3	19-02 SA3 DUP (duplicate of 19-02 SA3)
			8-Aug-19	8-Aug-19	8-Aug-19
Polycyclic Aromatic Hydrocarbons					
Acenaphthylene	ug/g	0.15	0.28	0.54	0.30
Anthracene	ug/g	0.67	2.69	0.52	0.33
Benzo[a]anthracene	ug/g	0.5	3.60	1.05	0.88
Benzo[a]pyrene	ug/g	0.3	3.08	1.36	0.87
Benzo[b]fluoranthene	ug/g	0.78	4.28	2.12	1.30
Benzo[k]fluoranthene	ug/g	0.78	2.49	1.08	0.67
Fluoranthene	ug/g	0.69	11.1	2.19	1.87
Indeno[1,2,3-cd]pyrene	ug/g	0.38	1.77	1.09	0.61
Phenanthrene	ug/g	6.2	9.81	0.99	0.76

Parameter	Units	MECP Table 7	19-03 SA2
		Standards (R/P/I) ^{(1) (2)}	8-Aug-19
Polycyclic Aromatic Hydrocarbons			
Lead	ug/g	120	284



CLIENT

CITY OF OTTAWA

PROJECT

PHASE II ENVIRONMENTAL SITE ASSESSMENT
159 FORWARD AVENUE, OTTAWA, ONTARIO

TITLE

SOIL EXCEEDANCES

CONSULTANT	YYYY-MM-DD	2019-09-04
	DESIGNED	----
	PREPARED	JEM
	REVIEWED	BEM
	APPROVED	KPH

PROJECT NO.	CONTROL	REV.	FIGURE
19120465	0002	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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LEGEND

- APPROXIMATE BOREHOLE LOCATION
- APPROXIMATE MONITORING WELL LOCATION
- 0.62 FILL THICKNESS, metres
- AREA OF IMPACTED FILL BY PAHS AND/OR METALS AND CONTAINING DEBRIS
- APPROXIMATE SITE BOUNDARY

REFERENCE(S)

1. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83,
COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

02.5510

1:250METRES

CLIENT


CITY OF OTTAWA

PROJECT

PHASE II ENVIRONMENTAL SITE ASSESSMENT
159 FORWARD AVENUE, OTTAWA, ONTARIO

TITLE

EXTENT OF IMPACTED FILL

CONSULTANT	YYYY-MM-DD	2019-09-04
	DESIGNED	----
	PREPARED	JEM
	REVIEWED	BEM
	APPROVED	KPH

PROJECT NO. 19120465	CONTROL 0002	REV. 0	FIGURE 3
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 28mm

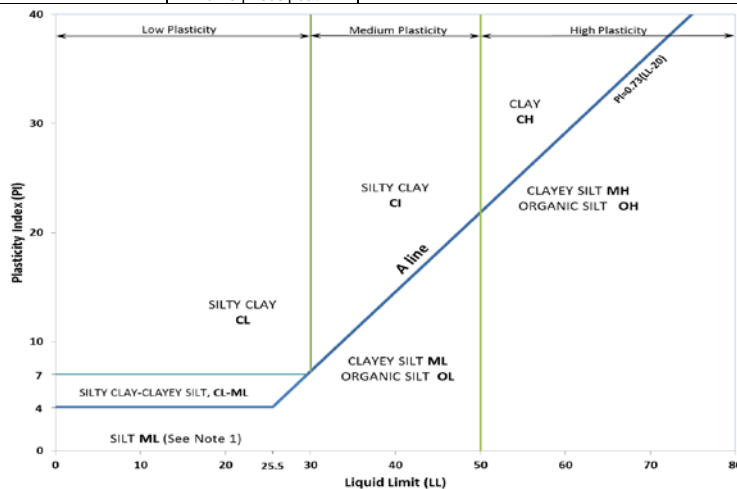
APPENDIX A

Record of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$		$Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$			Organic Content	USCS Group Symbol	Group Name			
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4		≤1 or ≥3			≤30%	GP	GRAVEL			
				Well Graded	≥4		1 to 3				GW	GRAVEL			
			Gravels with >12% fines (by mass)	Below A Line	n/a						GM	SILTY GRAVEL			
				Above A Line	n/a						GC	CLAYEY GRAVEL			
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6		≤1 or ≥3				SP	SAND			
				Well Graded	≥6		1 to 3				SW	SAND			
			Sands with >12% fines (by mass)	Below A Line	n/a						SM	SILTY SAND			
				Above A Line	n/a						SC	CLAYEY SAND			
			Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name	
							Dilatancy	Dry Strength	Shine Test		Thread Diameter				Toughness (of 3 mm thread)
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or Pl and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT				
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT				
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT				
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT				
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT				
		CLAYS (Pl and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30%	CL	SILTY CLAY				
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium	(see Note 2)	CI	SILTY CLAY				
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY				
		HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT		
				Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT		



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor “trace organics” for soils with between 5% and 30% organic content include the prefix “organic” before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between “clean” and “dirty” sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (i.e., SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample

SOIL TESTS

w	water content
PL , w _p	plastic limit
LL , w _L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D _R	relative density (specific gravity, G _s)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness²

Term	SPT 'N' (blows/0.3m) ¹
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

- SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.
- Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grain size. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' ^{1,2} (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

- SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
- SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
NP	non-plastic
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$

PROJECT: 19120465

RECORD OF BOREHOLE: 19-01

SHEET 1 OF 1

LOCATION: N 5030046.1 ; E 364935.6

BORING DATE: August 8, 2019

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m										
								SHEAR STRENGTH Cu, kPa		nat V. + Q - rem V. ⊕ U - ⊙		WATER CONTENT PERCENT					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴			10 ⁻³
0		GROUND SURFACE		62.68													
		ASPHALTIC CONCRETE		0.00													
		GRANULAR FILL		0.04													
		Inferred BEDROCK		62.48													
				0.20													
1																	
2																	
3																	
		End of Borehole		59.15													
				3.53													
4																	
5																	

Flush Mount
Casing

Bentonite Seal

Silica Sand

32 mm Diam. PVC
#10 Slot ScreenW.L. in Screen at
Elev. 60.70 m on
August 16, 2019

DEPTH SCALE

1 : 25

**GOLDER**

LOGGED: JD

CHECKED: ADW

MIS-BHS 001 19120465.GPJ GAL-MIS.GDT 09/26/19 JEM

PROJECT: 19120465

RECORD OF BOREHOLE: 19-04

SHEET 1 OF 1

LOCATION: N 5030038.1 ;E 364916.5

BORING DATE: August 8, 2019

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	20 40 60 80				10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴ 10 ⁻³					
								HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected				WATER CONTENT PERCENT					
								20 40 60 80				Wp — W — Wi 20 40 60 80					
0		GROUND SURFACE		62.46													
		ASPHALTIC CONCRETE		0.00													
		GRANULAR FILL		0.04													
				62.28													
		FILL - (SW) SAND and GRAVEL, angular; brown black with black staining, contains wood, cinder, ash and brick; non-cohesive, moist, compact		0.18	1	SH	- ⊕										
													</				

DEPTH SCALE

1 : 25

**GOLDER**

LOGGED: JD

CHECKED: ADW

MIS-BHS 001 19120465.GPJ GAL-MIS.GDT 09/26/19 JEM

PROJECT: 19120465

RECORD OF BOREHOLE: 19-05

SHEET 1 OF 1

LOCATION: N 5030011.1 ;E 364950.9

BORING DATE: August 8, 2019

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected				HYDRAULIC CONDUCTIVITY, k, cm/s				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected				WATER CONTENT PERCENT					
								20	40	60	80	10 ⁻⁶	10 ⁻⁵	10 ⁻⁴	10 ⁻³		
								20	40	60	80	Wp	W	Wi	20		
0		GROUND SURFACE		62.64													
		ASPHALTIC CONCRETE		0.00													
GRAVEL (PAVEMENT STRUCTURE)			0.04														
			62.40														
		FILL - (SW) SAND and GRAVEL, angular; brown black with black staining, contains cinder, ash and brick; non-cohesive, moist, compact		0.24													
					1	SS	- ⊕										
1		End of Borehole Auger Refusal		61.68													
				0.96													

DEPTH SCALE

1 : 25

**GOLDER**

LOGGED: JD

CHECKED: ADW

MIS-BHS 001 19120465.GPJ GAL-MIS.GDT 09/26/19 JEM

APPENDIX B

Laboratory Certificates of Analysis

Certificate of Analysis

Golder Associates Ltd. (Ottawa)

1931 Robertson Rd.
Ottawa, ON K2H 5B7
Attn: Alyssa Whiteduck

Client PO:
Project: 19120465/159 Forward Avenue
Custody: 113605

Report Date: 19-Aug-2019
Order Date: 9-Aug-2019

Order #: 1932561

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1932561-01	19-02 SA2

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Ignitability	Match Test	12-Aug-19	12-Aug-19
Metals, ICP-MS	TCLP EPA 6020 - Digestion - ICP-MS	15-Aug-19	15-Aug-19
REG 558 - Benzene	EPA 624 - P&T GC-MS	14-Aug-19	15-Aug-19
REG 558 - Mercury by CVAA	EPA 7470A - Cold Vapour AA	15-Aug-19	15-Aug-19
REG 558 - PAHs	EPA 625 - GC-MS	19-Aug-19	19-Aug-19
Solids, %	Gravimetric, calculation	15-Aug-19	15-Aug-19

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Client ID:	19-02 SA2	-	-	-
Sample Date:	08-Aug-19 09:00	-	-	-
Sample ID:	1932561-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	94.2	-	-	-
Ignitability	N/A	Negative	-	-	-

EPA 1311 - TCLP Leachate Metals

Arsenic	0.05 mg/L	<0.05	-	-	-
Barium	0.05 mg/L	0.22	-	-	-
Boron	0.05 mg/L	<0.05	-	-	-
Cadmium	0.01 mg/L	<0.01	-	-	-
Chromium	0.05 mg/L	<0.05	-	-	-
Lead	0.05 mg/L	<0.05	-	-	-
Mercury	0.005 mg/L	<0.005	-	-	-
Selenium	0.05 mg/L	<0.05	-	-	-
Silver	0.05 mg/L	<0.05	-	-	-
Uranium	0.05 mg/L	<0.05	-	-	-

EPA 1311 - TCLP Leachate Volatiles

Benzene	0.005 mg/L	<0.005	-	-	-
Toluene-d8	Surrogate	99.4%	-	-	-

EPA 1311 - TCLP Leachate Organics

Benzo [a] pyrene	0.0001 mg/L	<0.0001	-	-	-
Terphenyl-d14	Surrogate	115%	-	-	-

Certificate of Analysis
 Client: **Golder Associates Ltd. (Ottawa)**
 Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: **19120465/159 Forward Avenue**

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
EPA 1311 - TCLP Leachate Metals									
Arsenic	ND	0.05	mg/L						
Barium	ND	0.05	mg/L						
Boron	ND	0.05	mg/L						
Cadmium	ND	0.01	mg/L						
Chromium	ND	0.05	mg/L						
Lead	ND	0.05	mg/L						
Mercury	ND	0.005	mg/L						
Selenium	ND	0.05	mg/L						
Silver	ND	0.05	mg/L						
Uranium	ND	0.05	mg/L						
EPA 1311 - TCLP Leachate Organics									
Benzo [a] pyrene	ND	0.0001	mg/L						
Surrogate: Terphenyl-d14	0.23		mg/L		113	37.1-155.6			
EPA 1311 - TCLP Leachate Volatiles									
Benzene	ND	0.005	mg/L						
Surrogate: Toluene-d8	0.667		mg/L		96.9	76-118			

Certificate of Analysis
 Client: **Golder Associates Ltd. (Ottawa)**
 Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: **19120465/159 Forward Avenue**

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
EPA 1311 - TCLP Leachate Metals									
Arsenic	ND	0.05	mg/L	ND			0.0	29	
Barium	0.539	0.05	mg/L	0.604			11.4	34	
Boron	0.072	0.05	mg/L	0.072			0.2	33	
Cadmium	ND	0.01	mg/L	ND			0.0	33	
Chromium	ND	0.05	mg/L	ND			0.0	32	
Lead	ND	0.05	mg/L	ND			0.0	32	
Mercury	ND	0.005	mg/L	ND			0.0	30	
Selenium	ND	0.05	mg/L	ND			0.0	28	
Silver	ND	0.05	mg/L	ND			0.0	28	
Uranium	ND	0.05	mg/L	ND			0.0	27	
EPA 1311 - TCLP Leachate Organics									
Benzo [a] pyrene	ND	0.0001	mg/L	ND				50	
Surrogate: Terphenyl-d14	0.21		mg/L		107	37.1-155.6			
EPA 1311 - TCLP Leachate Volatiles									
Benzene	ND	0.005	mg/L	ND				25	
Surrogate: Toluene-d8	0.687		mg/L		99.9	76-118			
Physical Characteristics									
% Solids	31.1	0.1	% by Wt.	31.4			0.8	25	

Certificate of Analysis
 Client: **Golder Associates Ltd. (Ottawa)**
 Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: **19120465/159 Forward Avenue**

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
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EPA 1311 - TCLP Leachate Metals

Arsenic	48.5		ug/L	0.091	96.8	83-119			
Barium	102		ug/L	60.4	83.1	83-116			
Boron	47.1		ug/L	7.19	79.8	71-128			
Cadmium	41.5		ug/L	0.184	82.5	78-119			
Chromium	51.7		ug/L	0.116	103	80-124			
Lead	40.9		ug/L	0.795	80.1	77-126			
Mercury	0.0276	0.005	mg/L	ND	92.1	70-130			
Selenium	41.0		ug/L	0.086	81.8	81-125			
Silver	40.2		ug/L	ND	80.4	70-128			
Uranium	42.8		ug/L	0.065	85.4	70-131			

EPA 1311 - TCLP Leachate Organics

Benzo [a] pyrene	0.0336	0.0001	mg/L		67.2	39-123			
Surrogate: Terphenyl-d14	0.21		mg/L		107	37.1-155.6			

EPA 1311 - TCLP Leachate Volatiles

Benzene	0.040	0.005	mg/L		100	55-141			
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Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Qualifier Notes:

Login Qualifiers :

Container(s) - Bottle and COC sample ID don't match -
Applies to samples: 19-02 SA2

Sample Qualifiers :

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.



Client Name: Golden Associates	Project Reference: 19120465	Turnaround Time: <input type="checkbox"/> 1 Day <input type="checkbox"/> 3 Day <input type="checkbox"/> 2 Day <input checked="" type="checkbox"/> Regular Date Required:
Contact Name: Alyson Whiteluck / Keith Holmes	Quote #: City of Ottawa	
Address: 1931 Robertson Road Ottawa	PO #	
Telephone: 613-542-9600	Email Address: awh.technical@golden.com kholmes@golden.com	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 7 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Parcel Order Number: 1932561-TCIP 1932562-Bulk		Matrix	Air Volume	# of Containers	Sample Taken		PHCS F1-F4-BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (UWS)	B29153 A11-methyl 558 Bulk	558 mols	558 mols	Ignorability	+Vial	
Sample ID/Location Name					Date	Time													
1	19-02 S/A2 BGM 100	✓		3	Aug. 8/19		✓	✓	✓					✓	✓	✓	✓	✓	2x 250ml
2	19-02 S/A3			3			✓		✓					✓					
3	19-02 S/A3 Dup			3			✓		✓					✓					✓
4	19-03 S/A2 ✓			2 ✓			✓		✓					/			250ml		
5	19-04 S/A1			3			✓		✓					✓			2x 250ml + 1 vial		
6	19-05 S/A1			3			✓		✓					✓					
7	19-06 S/A2	✓		2	✓		✓		✓					✓			250ml + 1 vial		
8																			
9																			
10																			

Comments: - Sample ID on jars + vials the All sets read = BH.
Ignore BH on jar

Method of Delivery:

Paracel

Relinquished By (Sign): Alyson Whiteluck	Received by Driver/Depot: J. Koush	Received at Lab: June 2019	Verified By: mch
Relinquished By (Print): Alyson Whiteluck	Date/Time: 09/08/19 12:00	Date/Time: AUG 09, 2019 04:64	Date/Time: 8-9-19 19:10
Date/Time: Aug 9, 2019 11:30	Temperature: °C 17	Temperature: 21.0 °C	pH Verified [] By:

Certificate of Analysis

Golder Associates Ltd. (Ottawa)

1931 Robertson Rd.
Ottawa, ON K2H 5B7
Attn: Alyssa Whiteduck

Client PO:
Project: 19120465/159 Forward Avenue
Custody:

Report Date: 19-Aug-2019
Order Date: 9-Aug-2019

Order #: 1932562

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1932562-01	19-02 SA2
1932562-02	19-02 SA3
1932562-03	19-02 SA3 DUP
1932562-04	19-03 SA2
1932562-05	19-04 SA1
1932562-06	19-05 SA1
1932562-07	19-06 SA2

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Boron, available	MOE (HWE), EPA 200.7 - ICP-OES	14-Aug-19	14-Aug-19
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	17-Aug-19	17-Aug-19
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	14-Aug-19	16-Aug-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	14-Aug-19	14-Aug-19
PHC F1	CWS Tier 1 - P&T GC-FID	17-Aug-19	17-Aug-19
PHC F4G (gravimetric)	CWS Tier 1 - Extraction Gravimetric	15-Aug-19	15-Aug-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	10-Aug-19	14-Aug-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	14-Aug-19	15-Aug-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	14-Aug-19	15-Aug-19
Solids, %	Gravimetric, calculation	15-Aug-19	15-Aug-19

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: **19120465/159 Forward Avenue**

	Client ID:	19-02 SA2	19-02 SA3	19-02 SA3 DUP	19-03 SA2
	Sample Date:	08-Aug-19 09:00	08-Aug-19 09:00	08-Aug-19 09:00	08-Aug-19 09:00
	Sample ID:	1932562-01	1932562-02	1932562-03	1932562-04
	MDL/Units	Soil	Soil	Soil	Soil

Physical Characteristics

% Solids	0.1 % by Wt.	92.5	74.0	78.0	90.5
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Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	1.4	1.0
Arsenic	1.0 ug/g dry	5.4	5.1	6.9	12.1
Barium	1.0 ug/g dry	173	112	143	157
Beryllium	0.5 ug/g dry	0.6	0.6	0.7	0.9
Boron	5.0 ug/g dry	5.6	<5.0	<5.0	<5.0
Boron, available	0.5 ug/g dry	<0.5	<0.5	0.6	<0.5
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	5.0 ug/g dry	35.0	15.9	17.7	18.5
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	<0.2
Cobalt	1.0 ug/g dry	10.2	6.9	8.6	9.6
Copper	5.0 ug/g dry	29.2	26.3	53.2	29.6
Lead	1.0 ug/g dry	84.4	66.1	93.0	284
Mercury	0.1 ug/g dry	<0.1	<0.1	<0.1	0.1
Molybdenum	1.0 ug/g dry	1.3	1.1	1.8	2.4
Nickel	5.0 ug/g dry	26.1	17.5	21.1	25.0
Selenium	1.0 ug/g dry	<1.0	<1.0	1.2	1.7
Silver	0.3 ug/g dry	<0.3	<0.3	<0.3	<0.3
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Vanadium	10.0 ug/g dry	35.6	25.0	29.4	26.8
Zinc	20.0 ug/g dry	110	104	107	88.4

Volatiles

Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	<0.05
Toluene-d8	Surrogate	90.1%	87.2%	89.6%	96.9%

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	<7
F2 PHCs (C10-C16)	4 ug/g dry	73	61	83	<4
F3 PHCs (C16-C34)	8 ug/g dry	141	185	275	34

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

	Client ID: Sample Date: Sample ID:	19-02 SA2 08-Aug-19 09:00 1932562-01 Soil	19-02 SA3 08-Aug-19 09:00 1932562-02 Soil	19-02 SA3 DUP 08-Aug-19 09:00 1932562-03 Soil	19-03 SA2 08-Aug-19 09:00 1932562-04 Soil
	MDL/Units				
F4 PHCs (C34-C50)	6 ug/g dry	82	178 [1]	218 [1]	29
F4G PHCs (gravimetric)	50 ug/g dry	-	690	795	-

Semi-Volatiles

Acenaphthene	0.02 ug/g dry	1.57	0.08	0.08	0.04
Acenaphthylene	0.02 ug/g dry	0.28	0.54	0.30	0.03
Anthracene	0.02 ug/g dry	2.69	0.52	0.33	0.10
Benzo [a] anthracene	0.02 ug/g dry	3.60	1.05	0.88	0.26
Benzo [a] pyrene	0.02 ug/g dry	3.08	1.36	0.87	0.24
Benzo [b] fluoranthene	0.02 ug/g dry	4.28	2.12	1.30	0.39
Benzo [g,h,i] perylene	0.02 ug/g dry	1.88	1.19	0.65	0.17
Benzo [k] fluoranthene	0.02 ug/g dry	2.49	1.08	0.67	0.21
Chrysene	0.02 ug/g dry	3.98	1.07	1.04	0.27
Dibenzo [a,h] anthracene	0.02 ug/g dry	0.52	0.33	0.19	0.05
Fluoranthene	0.02 ug/g dry	11.1	2.19	1.87	0.63
Fluorene	0.02 ug/g dry	1.35	0.10	0.09	0.03
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	1.77	1.09	0.61	0.16
1-Methylnaphthalene	0.02 ug/g dry	0.18	0.05	0.04	<0.02
2-Methylnaphthalene	0.02 ug/g dry	0.26	0.08	0.05	<0.02
Methylnaphthalene (1&2)	0.04 ug/g dry	0.44	0.14	0.09	<0.04
Naphthalene	0.01 ug/g dry	0.33	0.14	0.09	0.01
Phenanthrene	0.02 ug/g dry	9.81	0.99	0.76	0.38
Pyrene	0.02 ug/g dry	8.45	2.01	1.64	0.54
2-Fluorobiphenyl	Surrogate	95.6%	51.5%	59.6%	52.2%
Terphenyl-d14	Surrogate	113%	61.9%	77.2%	86.2%

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: **19120465/159 Forward Avenue**

Client ID:	19-04 SA1	19-05 SA1	19-06 SA2	-
Sample Date:	08-Aug-19 09:00	08-Aug-19 09:00	08-Aug-19 09:00	-
Sample ID:	1932562-05	1932562-06	1932562-07	-
MDL/Units	Soil	Soil	Soil	-

Physical Characteristics

% Solids	0.1 % by Wt.	82.3	94.8	84.9	-
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Metals

Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	7.4	7.5	14.7	-
Barium	1.0 ug/g dry	101	137	203	-
Beryllium	0.5 ug/g dry	0.5	0.7	0.7	-
Boron	5.0 ug/g dry	<5.0	8.7	5.4	-
Boron, available	0.5 ug/g dry	0.6	0.6	<0.5	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Chromium	5.0 ug/g dry	13.8	22.8	21.0	-
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	-
Cobalt	1.0 ug/g dry	7.0	7.1	8.8	-
Copper	5.0 ug/g dry	25.8	19.7	42.2	-
Lead	1.0 ug/g dry	80.0	69.8	199	-
Mercury	0.1 ug/g dry	<0.1	<0.1	0.2	-
Molybdenum	1.0 ug/g dry	1.4	2.3	1.8	-
Nickel	5.0 ug/g dry	18.3	18.4	23.2	-
Selenium	1.0 ug/g dry	1.0	1.2	1.2	-
Silver	0.3 ug/g dry	<0.3	<0.3	<0.3	-
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Uranium	1.0 ug/g dry	<1.0	<1.0	1.1	-
Vanadium	10.0 ug/g dry	22.0	25.8	33.3	-
Zinc	20.0 ug/g dry	70.9	210	181	-

Volatiles

Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	-
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene-d8	Surrogate	92.7%	110%	89.8%	-

Hydrocarbons

F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	-
F3 PHCs (C16-C34)	8 ug/g dry	59	35	56	-

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

	Client ID:	19-04 SA1	19-05 SA1	19-06 SA2	
	Sample Date:	08-Aug-19 09:00	08-Aug-19 09:00	08-Aug-19 09:00	-
	Sample ID:	1932562-05	1932562-06	1932562-07	-
	MDL/Units	Soil	Soil	Soil	-
F4 PHCs (C34-C50)	6 ug/g dry	27	19	30	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	0.05	<0.02	0.05	-
Acenaphthylene	0.02 ug/g dry	0.04	0.05	0.11	-
Anthracene	0.02 ug/g dry	0.15	0.08	0.20	-
Benzo [a] anthracene	0.02 ug/g dry	0.29	0.22	0.76	-
Benzo [a] pyrene	0.02 ug/g dry	0.24	0.20	0.83	-
Benzo [b] fluoranthene	0.02 ug/g dry	0.35	0.27	1.17	-
Benzo [g,h,i] perylene	0.02 ug/g dry	0.16	0.13	0.55	-
Benzo [k] fluoranthene	0.02 ug/g dry	0.19	0.14	0.59	-
Chrysene	0.02 ug/g dry	0.30	0.23	0.86	-
Dibenzo [a,h] anthracene	0.02 ug/g dry	0.05	0.04	0.16	-
Fluoranthene	0.02 ug/g dry	0.67	0.42	1.61	-
Fluorene	0.02 ug/g dry	0.06	0.02	0.07	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	0.15	0.12	0.52	-
1-Methylnaphthalene	0.02 ug/g dry	0.02	<0.02	0.06	-
2-Methylnaphthalene	0.02 ug/g dry	0.03	<0.02	0.06	-
Methylnaphthalene (1&2)	0.04 ug/g dry	0.05	<0.04	0.12	-
Naphthalene	0.01 ug/g dry	0.04	0.02	0.08	-
Phenanthrene	0.02 ug/g dry	0.57	0.24	0.97	-
Pyrene	0.02 ug/g dry	0.53	0.38	1.41	-
2-Fluorobiphenyl	Surrogate	59.5%	54.9%	59.2%	-
Terphenyl-d14	Surrogate	96.6%	79.9%	85.1%	-

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
F4G PHCs (gravimetric)	ND	50	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	0.5	ug/g						
Boron, available	ND	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	1.26		ug/g		94.7	50-140			
Surrogate: Terphenyl-d14	1.58		ug/g		118	50-140			
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	3.07		ug/g		95.9	50-140			

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
F4G PHCs (gravimetric)	10100	83	ug/g dry	10100			0.0	30	PHC01
Metals									
Antimony	2.1	1.0	ug/g dry	ND			0.0	30	
Arsenic	3.1	1.0	ug/g dry	2.9			4.4	30	
Barium	345	1.0	ug/g dry	326			5.8	30	
Beryllium	0.8	0.5	ug/g dry	0.7			0.8	30	
Boron, available	ND	0.5	ug/g dry	ND			0.0	35	
Boron	6.3	5.0	ug/g dry	5.8			9.6	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	103	5.0	ug/g dry	99.8			3.3	30	
Cobalt	20.4	1.0	ug/g dry	20.0			2.1	30	
Copper	47.2	5.0	ug/g dry	45.7			3.1	30	
Lead	11.3	1.0	ug/g dry	10.7			5.7	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	57.8	5.0	ug/g dry	56.2			2.9	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	97.5	10.0	ug/g dry	93.8			3.9	30	
Zinc	125	20.0	ug/g dry	120			4.0	30	
Physical Characteristics									
% Solids	31.1	0.1	% by Wt.	31.4			0.8	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND				40	
Acenaphthylene	ND	0.02	ug/g dry	ND			0.0	40	
Anthracene	0.026	0.02	ug/g dry	0.037			34.8	40	
Benzo [a] anthracene	0.126	0.02	ug/g dry	0.134			5.7	40	
Benzo [a] pyrene	0.150	0.02	ug/g dry	0.150			0.1	40	
Benzo [b] fluoranthene	0.308	0.02	ug/g dry	0.327			5.7	40	
Benzo [g,h,i] perylene	0.195	0.02	ug/g dry	0.194			0.6	40	
Benzo [k] fluoranthene	0.128	0.02	ug/g dry	0.112			13.0	40	
Chrysene	0.219	0.02	ug/g dry	0.230			4.6	40	
Dibenzo [a,h] anthracene	0.035	0.02	ug/g dry	0.032			8.4	40	
Fluoranthene	0.531	0.02	ug/g dry	0.487			8.7	40	
Fluorene	ND	0.02	ug/g dry	ND			0.0	40	
Indeno [1,2,3-cd] pyrene	0.144	0.02	ug/g dry	0.143			0.3	40	
1-Methylnaphthalene	0.033	0.02	ug/g dry	0.028			15.8	40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND			0.0	40	
Naphthalene	0.037	0.01	ug/g dry	0.038			4.1	40	
Phenanthrene	0.184	0.02	ug/g dry	0.185			0.7	40	
Pyrene	0.441	0.02	ug/g dry	0.449			1.7	40	
Surrogate: 2-Fluorobiphenyl	3.22		ug/g dry		87.9	50-140			
Surrogate: Terphenyl-d14	4.68		ug/g dry		127	50-140			
Volatiles									
Benzene	ND	0.02	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
m,p-Xylenes	ND	0.05	ug/g dry	ND				50	
o-Xylene	ND	0.05	ug/g dry	ND				50	

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Toluene-d8	3.13		ug/g dry		90.3	50-140			

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	209	7	ug/g		105	80-120			
F2 PHCs (C10-C16)	91	4	ug/g	ND	103	60-140			
F3 PHCs (C16-C34)	258	8	ug/g	ND	119	60-140			
F4 PHCs (C34-C50)	163	6	ug/g	ND	119	60-140			
F4G PHCs (gravimetric)	860	50	ug/g		86.0	80-120			
Metals									
Antimony	43.2		ug/L	ND	86.0	70-130			
Arsenic	51.1		ug/L	1.2	99.9	70-130			
Barium	193		ug/L	130	125	70-130			
Beryllium	47.8		ug/L	ND	95.0	70-130			
Boron, available	4.17	0.5	ug/g	ND	83.5	70-122			
Boron	44.1		ug/L	ND	83.6	70-130			
Cadmium	49.1		ug/L	ND	98.1	70-130			
Chromium (VI)	0.1		mg/L	ND	64.5	70-130			QM-05
Chromium	91.1		ug/L	39.9	102	70-130			
Cobalt	56.1		ug/L	8.0	96.3	70-130			
Copper	66.5		ug/L	18.3	96.4	70-130			
Lead	51.9		ug/L	4.3	95.4	70-130			
Mercury	1.12	0.1	ug/g	ND	74.4	70-130			
Molybdenum	49.2		ug/L	ND	97.7	70-130			
Nickel	71.8		ug/L	22.5	98.7	70-130			
Selenium	47.7		ug/L	ND	95.2	70-130			
Silver	48.3		ug/L	ND	96.5	70-130			
Thallium	47.8		ug/L	ND	95.3	70-130			
Uranium	48.8		ug/L	ND	97.0	70-130			
Vanadium	92.3		ug/L	37.5	110	70-130			
Zinc	95.1		ug/L	47.9	94.5	70-130			
Semi-Volatiles									
Acenaphthene	0.497	0.02	ug/g	ND	108	50-140			
Acenaphthylene	0.479	0.02	ug/g	ND	104	50-140			
Anthracene	0.497	0.02	ug/g	0.037	100	50-140			
Benzo [a] anthracene	0.602	0.02	ug/g	0.134	102	50-140			
Benzo [a] pyrene	0.518	0.02	ug/g	0.150	80.3	50-140			
Benzo [b] fluoranthene	1.01	0.02	ug/g	0.327	150	50-140			QM-06
Benzo [g,h,i] perylene	0.541	0.02	ug/g	0.194	75.8	50-140			
Benzo [k] fluoranthene	0.782	0.02	ug/g	0.112	146	50-140			QM-06
Chrysene	0.823	0.02	ug/g	0.230	129	50-140			
Dibenzo [a,h] anthracene	0.456	0.02	ug/g	0.032	92.5	50-140			
Fluoranthene	1.17	0.02	ug/g	0.487	149	50-140			QM-06
Fluorene	0.474	0.02	ug/g	ND	103	50-140			
Indeno [1,2,3-cd] pyrene	0.547	0.02	ug/g	0.143	88.0	50-140			
1-Methylnaphthalene	0.409	0.02	ug/g	0.028	83.1	50-140			
2-Methylnaphthalene	0.445	0.02	ug/g	ND	97.1	50-140			
Naphthalene	0.556	0.01	ug/g	0.038	113	50-140			
Phenanthrene	0.621	0.02	ug/g	0.185	95.1	50-140			
Pyrene	1.09	0.02	ug/g	0.449	139	50-140			
Surrogate: 2-Fluorobiphenyl	2.82		ug/g		77.0	50-140			
Volatiles									
Benzene	3.38	0.02	ug/g		84.4	60-130			
Ethylbenzene	3.66	0.05	ug/g		91.5	60-130			

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Toluene	3.63	0.05	ug/g		90.8	60-130			
m,p-Xylenes	7.12	0.05	ug/g		89.0	60-130			
o-Xylene	3.75	0.05	ug/g		93.9	60-130			

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 19-Aug-2019

Order Date: 9-Aug-2019

Project Description: 19120465/159 Forward Avenue

Qualifier Notes:

Sample Qualifiers :

1 : GC-FID signal did not return to baseline by C50

QC Qualifiers :

PHC01 : Moisture content >50%, sample air dried prior to extraction.

QM-05 : The spike recovery was outside acceptance limits for the matrix spike due to matrix interference.

QM-06 : Due to noted non-homogeneity of the QC sample matrix, the spike recoveries were out side the accepted range. Batch data accepted based on other QC.

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.



LABORATORIES LTD.

Parcel ID: 1932562



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Ottawa, Ontario K1G 4J8
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E: paracel@paracellabs.com

Chain of Custody

(Lab Use Only)

No 113605

Page 1 of 1

Client Name: Golden Associates	Project Reference: 19120465	Turnaround Time: <input type="checkbox"/> 1 Day <input type="checkbox"/> 3 Day <input type="checkbox"/> 2 Day <input checked="" type="checkbox"/> Regular Date Required:
Contact Name: Alyssa Whiteluck / Keith Holmes	Quote #: City of Ottawa	
Address: 1931 Robertson Road Ottawa	PO #	
Telephone: 613-592-9600	Email Address: awhiteluck@golden.com kholmes@golden.com	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 7 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: ☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Parcel Order Number: 1932562-TCIP BGM/100 1932562-Bulk					Matrix	Air Volume	# of Containers	Sample Taken		Required Analyses												
Sample ID/Location Name								Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP			B (HWS)			As 153 All metals	SSB BODp	SSB metals	SSB benzene
1	19-02 SA2	BGM	101	S		3	Aug-8/19			X	X						X	X	X	X	X	2x250ml
2	19-02 SA3		102			3				X	X						X					
3	19-02 SA3 Dup		103			3				X	X						X					
4	19-03 SA2		✓104			2				X	X						X					
5	19-04 SA1		105			3				X	X						X					
6	19-05 SA1		106			3				X	X						X					
7	19-06 SA2		107			2				X	X						X					
8																						
9																						
10																						

Comments: Sample ID on jars + vials the All sets read = BH. ignore BHM ID's

Relinquished By (Sign): Alyssa Whiteluck	Received by Driver/Depot: J. KROUSE	Received at Lab: Sumecorn Ddk mai	Verified By: [Signature]
Relinquished By (Print): Alyssa Whiteluck	Date/Time: 09/08/19 12:26	Date/Time: AUG 09, 2019 04:54	Date/Time: 8-9-19 19:04
Date/Time: Aug. 9, 2019 11:30	Temperature: °C	Temperature: 11.0 °C	pH Verified [] By:

Certificate of Analysis

Golder Associates Ltd. (Ottawa)

1931 Robertson Rd.
Ottawa, ON K2H 5B7
Attn: Alyssa Whiteduck

Client PO:
Project: 19120465/159 Forward Avenue
Custody: 122506

Report Date: 27-Aug-2019
Order Date: 16-Aug-2019

Order #: 1933650

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1933650-01	19-01
1933650-02	19-02
1933650-03	19-03
1933650-04	DUP

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: 19120465/159 Forward Avenue

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	25-Aug-19	24-Aug-19
PCBs, total	EPA 608 - GC-ECD	21-Aug-19	21-Aug-19
PHC F1	CWS Tier 1 - P&T GC-FID	23-Aug-19	24-Aug-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	26-Aug-19	26-Aug-19

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: **19120465/159 Forward Avenue**

	Client ID:	19-01	19-02	19-03	DUP
	Sample Date:	16-Aug-19 09:28	16-Aug-19 07:40	16-Aug-19 08:25	16-Aug-19 08:30
	Sample ID:	1933650-01	1933650-02	1933650-03	1933650-04
	MDL/Units	Water	Water	Water	Water

Volatiles

Benzene	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
Toluene	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
Xylenes, total	0.5 ug/L	<0.5	<0.5	<0.5	<0.5
Toluene-d8	Surrogate	71.7%	80.0%	73.1%	80.0%

Hydrocarbons

F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	<25
F2 PHCs (C10-C16)	100 ug/L	<100	<100	<100	<100
F3 PHCs (C16-C34)	100 ug/L	<100	<100	<100	<100
F4 PHCs (C34-C50)	100 ug/L	<100	<100	<100	<100

PCBs

PCBs, total	0.05 ug/L	-	-	<0.05	<0.05
Decachlorobiphenyl	Surrogate	-	-	73.5%	68.5%

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
PCBs									
PCBs, total	ND	0.05	ug/L						
Surrogate: Decachlorobiphenyl	0.448		ug/L		89.6	60-140			
Volatiles									
Benzene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	56.0		ug/L		70.0	50-140			

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Benzene	ND	0.5	ug/L	ND			0.0	30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND			0.0	30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: Toluene-d8	57.4		ug/L		71.7	50-140			

Certificate of Analysis
Client: Golder Associates Ltd. (Ottawa)
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: 19120465/159 Forward Avenue

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	2030	25	ug/L		102	68-117			
F2 PHCs (C10-C16)	1530	100	ug/L		95.7	60-140			
F3 PHCs (C16-C34)	3740	100	ug/L		95.3	60-140			
F4 PHCs (C34-C50)	2680	100	ug/L		108	60-140			
PCBs									
PCBs, total	0.865	0.05	ug/L		86.5	60-140			
Surrogate: Decachlorobiphenyl	0.445		ug/L		88.9	60-140			
Volatiles									
Benzene	35.2	0.5	ug/L		88.0	60-130			
Ethylbenzene	39.2	0.5	ug/L		97.9	60-130			
Toluene	33.9	0.5	ug/L		84.7	60-130			
m,p-Xylenes	83.1	0.5	ug/L		104	60-130			
o-Xylene	38.5	0.5	ug/L		96.3	60-130			

Certificate of Analysis
Client: **Golder Associates Ltd. (Ottawa)**
Client PO:

Report Date: 27-Aug-2019

Order Date: 16-Aug-2019

Project Description: **19120465/159 Forward Avenue**

Qualifier Notes:

Login Qualifiers :

Samples received submerged in water, possibly melted ice. This condition can compromise sample integrity.

Applies to samples: 19-01, 19-02, 19-03, DUP

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.
- F1 range corrected for BTEX.
- F2 to F3 ranges corrected for appropriate PAHs where available.
- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.
- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.
- When reported, data for F4G has been processed using a silica gel cleanup.

Parcel ID: 1933650



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Chain of Custody
(Lab Use Only)

No 122506

Page 1 of 1

Client Name: <u>Golden Associates</u>	Project Reference: <u>19120465</u>	Turnaround Time: <input type="checkbox"/> 1 Day <input type="checkbox"/> 3 Day <input type="checkbox"/> 2 Day <input checked="" type="checkbox"/> Regular Date Required: _____
Contact Name: <u>Alyssa Whiteduck/Kath Holmes</u>	Quote # <u>City of Ottawa</u>	
Address: <u>1931 Robertson Rd. Ottawa</u>	PO # _____	
Telephone: <u>613 592-9600</u>	Email Address: <u>awhiteduck@golden.com</u> <u>kholmes@golden.com</u>	

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 7 ☐ RSC Filing ☐ O. Reg. 558/00 ☐ PWQO ☐ CCME ☐ SUB (Storm) ☐ SUB (Sanitary) Municipality: _____ ☐ Other: _____

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

Parcel Order Number:		Matrix	Air Volume	# of Containers	Sample Taken		PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (UWS)	PCB's						
Sample ID/Location Name					Date	Time														
1	19-01 BSM100	GW		3	20/08/16	9:28	X													
2	19-02 BSM109			3		7:40	X													
3	19-03 BSM10			4		8:25	X							X						
4	Dup BSM111			4		8:30	X							X						
5																				
6																				
7																				
8																				
9																				
10																				

Comments: Sample submerged on the water. The water in cooler too.
NO. 3 For PCB Bottle sample ID on bottle read: BH 19-03. - separate as per Walkm

Relinquished By (Sign): <u>[Signature]</u>	Received by Driver/Depot: <u>[Signature]</u>	Received at Lab: <u>Sumner Park</u>	Verified By: <u>[Signature]</u>
Relinquished By (Print): <u>J. DeRosa</u>	Date/Time: <u>Aug 16/19 10:57</u>	Date/Time: <u>Aug 16, 2019 02:55</u>	Date/Time: <u>08/17/19 11:16</u>
Date/Time: <u>2019 08/16</u>	Temperature: <u>20°C</u>	Temperature: <u>9.2 °C</u>	pH Verified [] By: <u>NA</u>



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