Phase Two Environmental Site Assessment

89 Richmond Road, Ottawa, ON

Type of Document:
Final

Client:
Lydia Wu & George Cai
89 Richmond Road
Ottawa, Ontario K1Z 6V8

Project Number:
OTT-00240343-A0

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Date Submitted:
September 25, 2017

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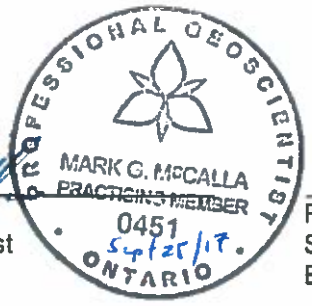

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Date Submitted:
September 25, 2017

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Executive Summary

Exp Services Inc. (**exp**) was retained by Lydia Wu and George Cai to conduct a Phase Two Environmental Site Assessment (ESA) of the property located at 89 Richmond Road in Ottawa, Ontario hereinafter referred to as the 'Site'. The objective of the Phase Two ESA was to address areas of potential environmental concern (APEC) identified in a Phase I ESA conducted at the Site by **exp** in June 2017. It is understood that this report is required as part of the permitting process with the City of Ottawa. We understand that a Record of Site Condition (RSC) is not required.

The findings of the Phase I ESA were presented in a report entitled *Phase I Environmental Site Assessment, 89 Richmond Road, Ottawa, Ontario,* **exp** Services Inc., dated June 21, 2017. The Phase I ESA identified the following APECs:

Table EX.1: Areas of Potential Environmental Concern

Area of Potential Environmental Concern (APEC)	Potentially Contaminating Activity (PCA)	Location of PCA (On-Site or Off-Site)	Contribution to APEC at the Site (Yes/No)	Media Potentially Impacted (Groundwater, Soil and/or Sediment)	Contaminants of Concern
1. Current automotive garage and former RFO (77 Richmond Road) operated between 1950s and 1980s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	30 m east	Yes	Soil and groundwater	petroleum hydrocarbons (PHC) and benzene, toluene, ethylbenzene, xylene (BTEX)
2. Former RFO located at 109/119 Richmond Road (now 101 Richmond Road) operated between the 1950s and 2000s	#28 – Gasoline and Associated Products Storage in Fixed Tanks	50 m west	Yes	Soil and groundwater	PHC and BTEX
3. Former automotive garage located at 72 Richmond Road operated between the 1950s and 2010s and spill in 1988	#27 – Garages and Maintenance	40 m east	Yes	Soil and groundwater	PHC and BTEX
4. Former RFO located at 70 Richmond Road operated between 1940s and 1960s. Also formerly operated as an automotive garage between the 1960s and 2010s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	65 m east	Yes	Soil and groundwater	PHC and BTEX

Area of Potential Environmental Concern (APEC)	Potentially Contaminating Activity (PCA)	Location of PCA (On-Site or Off-Site)	Contribution to APEC at the Site (Yes/No)	Media Potentially Impacted (Groundwater, Soil and/or Sediment)	Contaminants of Concern
5. Former dry cleaners located at 90 Richmond Road (now 98 Richmond Road) operated between 1969 and the early 1970s	#37 – Operation of Dry Cleaning Equipment	30 m southeast	Yes	Groundwater	VOCs

Based on the Phase One ESA findings, a Phase Two ESA was recommended for the Site.

The Phase Two ESA consisted advancing a total of three (3) boreholes (MW17-1 to MW17-3) at the site. Soil and groundwater samples were collected and submitted for laboratory analysis of PHC, metals, BTEX and/or volatile organic compounds (VOC).

For assessment purposes, **exp** selected the Site Condition Standards (SCS), provided in Table 3 of *Soil, Groundwater and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act*, Ministry of the Environment (MOECC), 2011 for residential use at a site with coarse textured soil conditions in accordance with Ontario Regulation 153/04 (as amended).

Based on the Phase Two ESA results, the following summary is provided:

- Below the asphalt in MW17-2 and MW17-3 crushed stone sand and gravel was encountered. Below the concrete in MW17-1 and the crushed stone in the other two monitoring wells, fill was encountered to approximately 5.5 m depth. The fill consists of sand and gravel with occasional cobbles and boulders. No odours or visual indications of impact were observed in the fill material. Below the fill in all three monitoring wells was glacial till which extended to refusal depths ranging from 6.86 m to 7.62 m on probable bedrock. The till was comprised of sand with some gravel and some silt. No odours or visual indications of impact were observed in the native material.
- On September 5, 2017, groundwater was encountered at a depth of 4.77 m bgs in MW17-3 to 6.76 m bgs in MW17-1. No petroleum sheens were observed in the monitoring wells during either sampling event. Based on the groundwater level measurements, the groundwater flow in the area of the boreholes is to the southwest.
- The concentrations of metals, PHC and VOC measured in the soil samples and blind duplicate were either less than the laboratory detection limit and or the MOECC 2011 Table 3 SCS.
- The concentrations of metals, PHC and VOC in the groundwater samples were either less the laboratory detection limit or less than the 2011 MOECC Table 3 SCS.

Based on the Phase Two ESA findings, no further work is recommended at this time. If the wells are no longer needed, they should be decommissioned in accordance with Ontario Regulation 903.

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1 Introduction

Exp Services Inc. (**exp**) was retained by Lydia Wu and George Cai to conduct a Phase Two Environmental Site Assessment (ESA) of the property located at 89 Richmond Road in Ottawa, Ontario, hereinafter referred to as the 'Site'. The objective of the Phase Two ESA was to address areas of potential environmental concern (APEC) identified in a Phase One ESA conducted at the Site by **exp** in June 2017. It is understood that this report is required as part of the permitting process with the City of Ottawa. We understand that a Record of Site Condition (RSC) is not required.

This report has been prepared in accordance with the Phase Two ESA standard as defined by Ontario Regulation 153/04 (as amended), and in accordance with generally accepted professional practices. Subject to this standard of care, **exp** makes no express or implied warranties regarding its services and no third party beneficiaries are intended. Limitation of liability, scope of report and third party reliance are outlined in Section 9 of this report.

1.1 Site Description

The Site consists of a 2-storey, mixed commercial/residential building located at 89 Richmond Road, Ottawa, Ontario. The ground floor consists of the commercial space and the second floor consists of residential space. The building has an approximate footprint of 115 m^2. The Site is rectangular in shape, covers an area of approximately 0.036 hectares and is located on the northern side of Richmond Road between Island Park Drive and Patricia Avenue. A site plan is presented as Figure. 2 in Appendix B. The property is legally described as Plan 400 Lot 83 Richmond Rd; N and the PIN is 040210110.

At the time of the investigation, the property was developed as a 2-storey mixed commercial/residential building with a gravel parking area to the north and an asphalt driveway to the east of the building. The parking area is accessed via Richmond Road to the south. The property is municipally serviced by the City of Ottawa and neighboured by a mixed residential/commercial property to the west and multi-tenant residential properties to the north and east.

Topographically, the Site is relatively flat with the northern section of the property sloping slightly northwards. The surrounding area has a slight downwards slope towards the north. The closest body of water is the Ottawa River, located approximately 1.2 kilometres northwest of the Site.

Regional groundwater flow direction is inferred to be in the northwestern direction towards the Ottawa River. The approximate Universal Transverse Mercator (UTM) coordinates for the Site centroid is NAD83, Zone 18, 441800 m E, 5027309 m N. The UTM coordinates were based on an estimate derived using Google Earth™. The accuracy of the centroid is estimated to range from 5 to 50 m.

1.2 Property Ownership

The owner contact information is provided below:

Owner Contact: Ms. Lydia Wu and Mr. George Cai
89 Richmond Road
Ottawa, Ontario K1Z 6V8

1.3 Current and Proposed Future Uses

At the time of the Phase Two ESA investigation, the Site consisted of two (2)-storey, mixed commercial/residential building. The Site is to be potentially redeveloped with a three (3)-storey mixed commercial/residential building with an underground parking garage. A site plan is included in Appendix B.

1.4 Applicable Site Condition Standards

Analytical results obtained for Site soil and groundwater samples were assessed against Site Condition Standards (SCS) as established under subsection 169.4(1) of the Environmental Protection Act, and presented in the document MOE *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, ("SGWS" Standards), (MOE, 2011a). Tabulated background SCS (Table 1) applicable to environmentally sensitive Sites and effects based generic SCS (Tables 2 to 9) applicable to non-environmentally sensitive Sites are provided in MOE (2011a). The effects based SCS (Tables 2 to 9) are protective of human health and the environment for different groundwater conditions (potable and non-potable), land use scenarios (residential, parkland, institutional, commercial, industrial, community and agricultural/other), soil texture (coarse or medium/fine) and restoration depth (full or stratified).

Tables 1 to 9 of MOE (2011a) are summarized as follows:

- Table 1 – applicable to sites where background concentrations must be met (full depth), such as sensitive sites where site-specific criteria have not been derived;
- Table 2 – applicable to sites with potable groundwater and full depth restoration;
- Table 3 – applicable to sites with non-potable groundwater and full depth restoration;
- Table 4 – applicable to sites with potable groundwater and stratified restoration;
- Table 5 – applicable to sites with non-potable groundwater and stratified restoration;
- Table 6 – applicable to sites with potable groundwater and shallow soils;
- Table 7 – applicable to sites with non-potable groundwater and shallow soils;
- Table 8 – applicable to sites with potable groundwater and that are within 30 m of a water body; and,
- Table 9 – applicable to sites with non-potable groundwater and that are within 30 m of a water body.

Application of the generic or background SCS to a specific site is based on a consideration of site conditions related to soil pH (i.e. surface and subsurface soil), thickness and extent of overburden material, (i.e. shallow soil conditions), and proximity to an area of environmental sensitivity or of natural significance. For some chemical constituents, consideration is also given to soil textural classification with SCS having been derived for both coarse and medium-fine textured soil conditions.

For assessment purposes, **exp** selected the MOE (2011) Table 3: Full Depth Generic Site Condition Standards in a non-potable groundwater condition for residential property use and coarse textured soil. The selection of this category was based on the following factors:

- The predominant soil type on the Site was considered to be coarse textured (refer to the results of the Grain Size Analysis as provided in the Certificates of Analysis presented in Appendix E); and,
- There was no intention to carry out a stratified restoration at the Site.
- More than two-thirds of the Site has an overburden thickness greater than 2 m.
- The Site is not located within 30 m of a surface water body or an area of natural significance.
- The soil at the Site has a pH value between 5 and 11 for subsurface soils.
- The property is not within an area of natural significance; does not include, nor is it adjacent to an area of natural significance, nor is it part of such an area; and, it does not include land that is within 30 m of an area of natural significance, nor is it part of such an area.

- The Site is fully serviced by the City of Ottawa water distribution system and, to the best of **exp**'s knowledge; all properties within 250 m of the Site are also serviced by the municipal water supply (i.e. there are no potable water supply wells located within the Phase One Study Area).
- The Site was commercial/residential and will be commercial/residential in the future.

2 Background Information

2.1 Past Investigations

The findings of the Phase I ESA were presented in a report entitled *Phase I Environmental Site Assessment, 89 Richmond Road, Ottawa, Ontario,* **exp** Services Inc., dated June 21, 2017. The Phase I ESA identified the following APECs:

Table 2.1: Areas of Potential Environmental Concern

Area of Potential Environmental Concern (APEC)	Potentially Contaminating Activity (PCA)	Location of PCA (On-Site or Off-Site)	Contribution to APEC at the Site (Yes/No)	Media Potentially Impacted (Groundwater, Soil and/or Sediment)	Contaminants of Concern
1. Current automotive garage and former RFO (77 Richmond Road) operated between 1950s and 1980s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	30 m east	Yes	Soil and groundwater	petroleum hydrocarbons (PHC) and benzene, toluene, ethylbenzene, xylene (BTEX)
2. Former RFO located at 109/119 Richmond Road (now 101 Richmond Road) operated between the 1950s and 2000s	#28 – Gasoline and Associated Products Storage in Fixed Tanks	50 m west	Yes	Soil and groundwater	PHC and BTEX
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4. Former RFO located at 70 Richmond Road operated between 1940s and 1960s. Also formerly operated as an automotive garage between the 1960s and 2010s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	65 m east	Yes	Soil and groundwater	PHC and BTEX
5. Former dry cleaners located at 90 Richmond Road (now 98 Richmond Road) operated between 1969 and the early 1970s	#37 – Operation of Dry Cleaning Equipment	30 m southeast	Yes	Groundwater	VOCs

Based on the Phase One ESA findings, a Phase Two ESA was recommended to assess the soil and groundwater quality at the Site from the above-noted APECs. A site plan with the APECs is provided on Figure 3.

3 Scope of the Investigation

3.1 Overview of Site Investigation

The purpose of the Phase Two ESA was to investigate the soil and groundwater quality at the Site and to obtain soil and groundwater data to further characterize conditions in the surficial fill/shallow overburden soils.

It is understood that the site is to be re-developed into a residential land use. As part of the permitting process, the City of Ottawa requires that a Phase Two ESA be completed in accordance with Ontario Regulation 153/04 (as amended).

3.2 Scope of Work

The scope of work for the Phase Two ESA was as follows:

- Request local utility locating companies (e.g., cable, telephone, gas, hydro) to mark any underground utilities present at the subject site;
- Retain a private utility locating company to mark any underground utilities present in the vicinity of the borehole locations and to clear the individual borehole locations;
- Advance a total of three (3) boreholes and complete them as groundwater monitoring wells;
- Collect representative soil samples for chemical analysis of metals, PHC, BTEX and/or volatile organic compounds (VOC);
- Collect representative groundwater samples for chemical analysis of metals, PHC, VOC;
- Measure groundwater levels in the monitoring wells;
- Complete a survey of the monitoring well locations relative to a geodetic or other permanent benchmark and in reference with the Universal Transverse Mercator (UTM) coordinate system for vertical and horizontal control; and,
- Review the analytical data and prepare a report of the findings.

Mark Devlin, B. Sc. conducted assessment work for this project and was supervised by Mark McCalla, P.Geo., QP_{ESA}. Mark McCalla is a qualified person as defined by O. Reg. 153/04.

3.3 Media Investigated

The Phase Two ESA included the investigation of on-Site soil and groundwater. As there are no water bodies on the Site, no surface water or sediment sampling was required.

The potential contaminants of concern (PCOCs) identified in the Phase One ESA were identified as target parameters for this Phase Two ESA. The areas of potential environmental concern (APEC) and PCOCs identified in the Phase One ESA are outlined in Table 3.1.

The rationale for the selection of borehole and monitoring well locations during this investigation are to place them near the west property line towards the off-site PCA and in the north part of the site to assess the former on-site heating oil tank to assess the soil and groundwater conditions. A copy of the Sampling and Analysis Plan prepared for the site is provided in Appendix A.

3.4 Deviations from Sampling and Analysis Plan

The field investigative and sampling program was carried out following the requirements of the Site Sampling and Analysis Plan (SAAP in Appendix A). No significant deviations from the Sampling and Analysis Plan were reported that affected the sampling and data quality objectives for the Site.

3.5 Impediments

No physical impediments were encountered during the field investigation. The entire property was accessible at the time of the investigation.

4 Investigation Method

4.1 General

The Site investigative activities consisted of the drilling of boreholes to facilitate the collection of soil samples for chemical analysis and the installation of monitoring wells for hydrogeological property characterization and the collection of groundwater samples for chemical analysis.

4.2 Borehole Drilling

Prior to the commencement of drilling, the locations of underground public utilities including telephone, natural gas and electrical lines were marked at the Site by locating companies. A private utility locating contractor was also retained to clear the individual borehole locations.

On August 29, 2017, three (3) boreholes (MW17-1 to MW17-3) were advanced at the Site by Strata Drilling Group, a licensed well contractor, under the full-time supervision of **exp** staff. Strata used a direct push probe with acetate liners to drill the borehole and collect the soil samples. The locations of the boreholes and monitoring wells are presented on Figure 3 in Appendix B.

No petroleum-based greases or solvents were used during drilling activities. **Exp** staff continuously monitored the drilling activities and recorded the depth of soil sample collection and total depth of boring. Field observations are summarized on the borehole logs provided in Appendix C.

4.3 Soil Sampling

The soil sampling during the completion of this Phase Two ESA was undertaken in general accordance with the SAAP presented in Appendix A.

Soil samples for geologic characterization were collected on a continuous basis in the overburden materials using 5 cm diameter, 61 cm long, lined tube samplers advanced into the subsurface using a jack hammer. The soil cores were removed from the samplers upon retrieval by drilling personnel. Geologic details of the recovered cores were logged by **exp** field staff. **Exp** staff continuously monitored the drilling activities to log the stratigraphy observed from the recovered soil cores, to record the depth of soil sample collection, to record total depths of borings, and to record visual or olfactory observations of potential impacts. Field observations are summarized on the borehole logs provided in Appendix C.

Soil samples identified for possible laboratory analysis were collected from the lined tube sampler and placed directly into pre-cleaned, laboratory-supplied glass sample jars/vials. Samples to be analysed for PHC fraction F1 and VOC were collected using a soil core sampler and placed in to vials containing methanol as a preservative. The jars and vials were sealed with Teflon-lined lids to minimize head-space and reduce the potential for induced volatilization during storage/transport prior to analysis. All soil samples were placed in clean coolers containing ice prior to and during transportation to the subcontract laboratory, Paracel Laboratories Limited (Paracel) of Ottawa, Ontario. The samples were transported/submitted within 24 hours of collection to Paracel following chain of custody protocols for chemical analysis.

The dedicated acetate liners were disposed of between sampling intervals by the drilling contractor and the sample tubes were washed using a potable water/phosphate-free detergent solution followed by rinses with potable water.

4.4 Field Screening Measurements

The remaining portion of each soil sample was placed in a sealed Ziploc plastic bag and allowed to reach ambient temperature prior to field screening with a combustible vapour meter calibrated to hexane gas prior to use. The field screening measurements were made by inserting the instrument's probe into the plastic

bag while manipulating the sample to ensure volatilization of the soil gases. These 'headspace' readings provide a real-time indication of the relative concentration of combustible vapours encountered in the subsurface during drilling and are used to aid in the assessment of the vertical and horizontal extent of potential impacts and the selection of soil samples for analysis. The field screening measurements, in parts per million (ppm) hexane equivalents, are presented with the borehole logs provided in Appendix C.

4.5 Soil Sample Submission

Soil samples were selected for laboratory analysis based on combustible vapour measurements and visual and olfactory evidence of impacts, where observed. One worst case soil sample from each borehole was submitted for laboratory analysis of metals, PHC, BTEX and VOC. One soil sample was also submitted for grain size analysis and pH.

4.6 Groundwater: Monitoring Well Installation

Groundwater monitoring wells were installed in boreholes MW17-1, MW17-2, and MW17-3. The monitoring wells were installed in general accordance with the Ontario Water Resources Act - R.R.O. 1990, Regulation 903 (as-amended) and were installed by Marathon Drilling, a licensed well contractor.

The monitoring wells consisted of a 3.0 m length of 31 mm diameter Schedule 40 PVC screen and an appropriate length of PVC riser pipe. The annular space around the wells was backfilled with sand to an average height of 0.3 m above the top of the screen. A bentonite seal was added from the top of the sand pack to approximately 0.3 m below ground surface. The monitoring wells were completed with flush mount protector at the asphalt surface. Details of the monitoring well installations are shown on the Borehole Logs provided in Appendix C.

The installation details of the installed monitoring wells are summarized in Table 4.1.

Table 4.1: Monitoring Well Installation Details

Monitoring Well/Piezometer	TOC Elevation (m)	Top of Sand Elevation (m)	Top of Screen Elevation (m)	Bottom of Screen Elevation (m)	Bottom of Borehole Elevation (m)	Depth of Borehole (mbgs)
MW17-1	67.42	63.70	63.40	60.40	60.40	7.16
MW17-2	67.39	63.20	62.90	59.90	59.90	7.60
MW17-3	67.01	63.50	63.20	60.20	60.20	6.85

Note: Elevations were collected using a level survey and a topographic survey of the property. A geodetic datum was established at the site (catch basin cover in front of 87 Richmond Road) with a known elevation of 67.36 m above sea level).

mbgs – metres below ground surface

TOC - top of plastic well casing

When the monitoring wells are no longer required, they must be decommissioned in accordance with the procedure outlined in the Ontario Water Resources Act - R.R.O. 1990, Regulation 903 - Amended to O. Reg. 128/03.

Measures taken to minimize the potential for cross contamination or the introduction of contaminants during well construction included:

- The use of well pipe components (e.g. riser pipe and well screens) with factory machined threaded flush coupling joints;
- Construction of wells without the use of glues or adhesives;
- Removing the protective plastic wraps from well components at the time of borehole insertion to prevent contact with the ground and other surfaces;
- Cleaning of drilling equipment between sampling locations; and,
- The use of hollow stem augers to prevent loose and potentially contaminated material in overlying layers from sloughing into the boreholes and coming into contact with groundwater.

4.7 Groundwater: Field Measurement of Water Quality Parameters

The static water level was measured, the depth of each well was recorded and the well sampled. **Exp** used an interface probe to measure the possible presence of light non-aqueous phase liquid (LNAPL) in each monitoring well. During development of the wells, pH, conductivity, temperature, and salinity were measured at regular intervals using a YSI 550 multi probe water quality meter that was calibrated using in-house pH and conductivity reference standards.

4.8 Groundwater: Sampling

Groundwater samples were collected from the monitoring wells on September 5, 2017. The monitoring activities consisted of measuring the depth to groundwater in each monitoring well so that groundwater flow and direction below the Site could be assessed. The water level measurements were recorded on water level log sheets. The water level meter probe was decontaminated between monitoring well locations with a spray bottle of water and alconox solution, paper towel, then potable water.

The wells were then sampled using a “low flow” technique whereby the wells were continuously purged using an electric pump (equipped with dedicated tubing) and parameters within the purged water were monitored using a groundwater chemistry multi-meter at 3 minute intervals. These parameters include: pH, conductivity, temperature, and salinity. Once these parameters were found to deviate less than 10% over three testing events, equilibrium was deemed to have occurred and a sample of the groundwater was collected.

The purge water was also continuously monitored for visual and olfactory evidence of petroleum and solvent impact (sheen and odour).

The groundwater samples and a blind duplicate were collected in laboratory provided sample bottles and submitted to Paracel for analysis of PHC, BTEX and/or VOC. The groundwater samples were placed in clean coolers containing ice prior to and during transportation to the subcontract laboratory.

4.9 Sediment: Sampling

As no water body was present at the Site, sediment sampling was not part of the Phase Two ESA.

4.10 Analytical Testing

The contracted laboratory selected to perform chemical analysis on all soil and water samples was Paracel Laboratories Limited. Paracel is an accredited laboratory under the Standards Council of Canada/Canadian Association for Laboratory Accreditation in accordance with ISO/IEC 17025:1999- *General Requirements for the Competence of Testing and Calibration Laboratories*.

4.11 Elevation Survey

An elevation survey was conducted to obtain vertical control of the monitoring well locations. The top of casing and ground surface elevation of each monitoring well location was surveyed using a level and a topographic survey of the property. A geodetic datum was established at the site (catch basin cover at 87 Richmond Road) with a known elevation of 67.36 m above sea level).

4.12 Residue Management

Due to the type of drilling, minimal drill cuttings were generated. The drill cuttings were disposed of on the site.

Due to the low flow sampling method, purged water from groundwater sampling was stored in a pail. Since there were no visual or olfactory evidence of impact, the water was disposed of on the grass at the Site.

4.13 Quality Assurance and Quality Control Measures

A QA/QC program was also implemented to ensure that the analytical results received are accurate and dependable. A QA/QC program is a system of documented checks that validate the reliability of the data collected regarding any given Site. Quality Assurance is a system that ensures that quality control procedures are correctly performed and documented. Quality Control refers to the established procedures observed both in the field and in the laboratory, designed to ensure that the resulting end data meet intended quality objectives. The QA/QC program implemented by **exp** incorporated the following components:

- Collection and analysis of blind duplicate soil and groundwater samples to ensure analytical precision;
- Using dedicated and/or disposal sampling equipment;
- Following proper decontamination protocols to minimize cross-contamination;
- Maintaining field notes and completing field forms to document on-Site activities; and,
- Using only laboratory supplied sample containers and following prescribed sample protocols, including proper preservation, meeting sample hold times, proper chain of custody documentation, to ensure integrity of the samples.

Paracel's QA/QC program involved the systematic analysis of control standards for the purpose of optimizing the measuring system as well as establishing system precision and accuracy and included calibration standards, method blanks, reference standards, spiked samples, surrogates and duplicates.

5 Review and Evaluation

5.1 Geology

The detailed soil profiles encountered in the borehole are provided on the attached borehole logs (Appendix C). Boundaries of soils indicated on the logs are intended to reflect transition zones for the purpose of environmental assessment and should not be interpreted as exact planes of geological change. A brief description of the soil stratigraphy at the Site, in order of depth, is summarized in the following sections. The interpreted Site geology is shown on the enclosed cross section (Figure 4, Appendix B).

5.1.1 Asphalt/Concrete

A layer of 80 mm-thick concrete paving stones were found at MW17-1 and the other two monitoring wells had 25 mm thick asphalt at the ground surface.

5.1.2 Fill Material

Below the asphalt in MW17-2 and MW17-3 was crushed stone sand and gravel. Below the concrete in MW17-1 and the crushed stone in the other two monitoring wells, fill was encountered to approximately 5.5 m depth. The fill consists of sand and gravel with occasional cobbles and boulders. No odours or visual indications of impact were observed in the fill material.

Based on field observations of soil texture and the grain size analysis conducted on S9 of MW17-1, the soil at the Site is coarse grained.

5.1.3 Native Material

Below the fill in all three monitoring wells was glacial till which extended to refusal depths ranging from 6.86 m to 7.62 m. The till was comprised of sand with some gravel and some silt. No odours or visual indications of impact were observed in the native material.

5.1.4 Bedrock

Drilling refusals were encountered at 6.86 m to 7.62 m depth below ground surface. These refusals are likely have been met on bedrock.

5.2 Groundwater: Elevations and Flow Direction

The monitoring well network advanced as part of this Phase Two ESA consists of four (4) monitoring wells screened within the geologic overburden at the Site.

Groundwater elevations and water levels were measured at the Site on September 5, 2017. Groundwater was encountered at a depth of 4.77 m bgs in MW17-3 to 6.76 m bgs in MW17-1. No petroleum sheens were observed in the monitoring wells during either sampling event.

A summary of the elevation survey and groundwater levels for each well are shown on Table 5.1.

Table 5.1: Groundwater Elevations

Monitoring Well ID	Top of Well Casing (m)	September 5, 2017	
		Water Level (mbtoc)	Water Level (MASL)
MW17-1	67.42	6.65	60.77
MW17-2	67.39	5.11	62.28
MW17-3	67.01	4.65	62.36

Note: **m**btoc – metres below top of plastic well casing
mASL – metres above sea level
NA – not applicable

Based on the groundwater level measurements, the groundwater flow in the area of the boreholes is to the southwest as shown on Figure 3 in Appendix B. **Exp** notes that groundwater flow direction and level can be influenced by utility trenches and other subsurface structures and may migrate in the bedding stone of nearby subsurface utility trenches.

5.3 Groundwater: Hydraulic Gradients

Horizontal hydraulic gradients were estimated for the groundwater flow components identified in the overburden aquifer (i.e. southwest flow) based on the September 5, 2017 groundwater elevations.

The horizontal hydraulic gradient, between each monitoring well pair, is calculated using the following equation:

$$i = \Delta h/\Delta s$$

Where,
i = horizontal hydraulic gradient;
Δh (m) = groundwater elevation difference; and,
Δs (m) = separation distance.

Since there are three wells on the Site that were used to generate the groundwater flow direction. The horizontal hydraulic gradient, based on the groundwater elevations, is estimated at 0.143.

5.4 Groundwater: Hydraulic Conductivity

The horizontal hydraulic conductivity in the overburden unit was assumed using typical values for the type of soil/fill found at the Site. The hydraulic conductivity is assumed to range from 1×10^{-3} m/s. 3×10^{-11} m/s.

5.5 Soil Texture

Based on field observations, the grain size of the soil at the site at the water table at the Site was assessed to be coarse textured. Therefore, the soil texture is coarse grained.

5.6 Soil: Field Screening

Field screening involved using the combustible vapour meter to measure vapour concentrations, in parts per million (ppm) hexane equivalents, in the collected soil samples in order to assess the presence of soil gases which would imply potential petroleum hydrocarbon impact. The vapour readings obtained during the drilling activities are presented on the borehole logs in Appendix C. As indicated, all boreholes have

vapour readings ranging from 0 ppm to 35 ppm. These results do not indicate any significant petroleum impact to soil.

Inspection of the soil cores retrieved from the boreholes did not indicate the presence of sheen, the presence of a separate organic phase, or other evidence of a non-aqueous phase liquid (NAPL) either in the surficial fill or overburden soil materials. No petroleum staining or odours were observed in any of the soil samples).

5.7 Soil Quality

In accordance with the scope of work, chemical analyses were performed on selected soil samples recovered from the boreholes. The selection of representative "worst case" soil samples from each borehole was based on field visual or olfactory evidence of impacts and/or presence of potential water bearing zones. Summaries of the soil analytical results from June 2017 are found in Appendix D. Copies of the laboratory Certificates of Analysis for the tested soil samples are provided in Appendix E.

The MOECC Table 3 SCS are applicable if soil pH is in the range of 5 to 11 for subsurface soil (greater than 1.5 m below soil surface). The Certificates of Analysis includes a pH measurement taken from the subsurface. One soil sample was submitted for pH analysis with results of 7.97. The pH value was within the acceptable range for the application of MOECC Table 3 SCS.

5.7.1 Petroleum Hydrocarbons and Volatile Organic Compounds

The concentrations of PHC and VOC measured in the four (4) analysed soil samples were less than the laboratory detection limits and the MOECC 2011 Table 3 SCS. The PHC and VOC results are shown in Table 1 in Appendix D. The concentrations of PHC and VOC also were less than the MOECC Table 1 background concentrations.

5.7.2 Metals

The concentrations of metals measured in the three (3) analysed soil samples were less than the MOECC 2011 Table 3 SCS. The metals results are shown in Table 2 in Appendix D. In addition, the metals concentrations were less than the Table 1 background concentrations in the three samples.

5.7.3 Chemical Transformation and Soil Contaminant Sources

There are no soil contaminant sources on the Phase Two property. All parameters met the applicable Table 3 SCS and as such chemical transformations are not a significant concern at the Site.

5.7.4 Evidence of Non-Aqueous Phase Liquid

Inspection of the soil cores retrieved from the boreholes did not indicate the presence of non-aqueous phase liquid (NAPL), staining or sheen. Odours were not observed during soil sampling activities. NAPLs are not expected to be present at the Phase Two property.

5.8 Groundwater Quality

Representative groundwater samples were collected from the monitoring wells to assess groundwater quality at the Site. Evidence of free product (i.e. visible film or sheen), and odour was not noted during well development or purging.

The groundwater analytical results are summarized on Table 3 and 4 in Appendix D and the Certificates of Analysis are enclosed in Appendix E.

5.8.1 Petroleum Hydrocarbons and Volatile Organic Compounds

Three (3) groundwater samples and a blind duplicate were submitted for the chemical analysis of PHC and/or VOC. As shown in Table 3 in Appendix D, the concentrations of PHC and VOC parameters in all of the groundwater samples were non-detect and therefore below the MOECC Table 3 SCS. The laboratory RDLs were also below the MOECC Table 3 SCS, with the exception of the PHC F2 concentration measured in the sample collected from MW17-1. The detection limit was 477 ug/L and the MOECC Table 3 SCS is 150 ug/L. This was due to limited sample availability and the resulting slightly turbid groundwater.

5.8.2 Metals

One (1) groundwater sample and a blind duplicate were submitted for the chemical analysis of metals. As shown in Table 4 in Appendix D, the concentrations of metals parameters in the groundwater samples were less than the MOECC Table 3 SCS. The laboratory RDLs were also below the MOECC Table 3 SCS.

5.8.3 Chemical Transformation and Contaminant Sources

There are no groundwater contaminant sources on the Phase Two property. All parameters met the applicable Table 3 SCS and as such chemical transformations are not a significant concern at the Site.

5.8.4 Evidence of Non-Aqueous Phase Liquid

Inspection of the groundwater monitoring wells did not indicate the presence of non-aqueous phase liquid (NAPL), staining or sheen. Odours were not observed during groundwater sampling activities. NAPLs are not expected to be present at the Phase Two property.

5.9 Sediment Quality

As there were no water bodies on-Site, surface water and sediment sampling was not required.

5.10 Quality Assurance and Quality Control Results

Quality assurance and quality control measures were taken during the field activities to meet the objectives of the sampling and quality assurance plan to collect unbiased and representative samples to characterize existing conditions in the fill/upper overburden materials and groundwater at the Site. QA/QC measures, as described in Section 4.13, included:

- Using dedicated and/or disposal sampling equipment;
- Following proper decontamination protocols to minimize cross-contamination;
- Maintaining field notes and completing field forms to document on-Site activities; and,
- Using only laboratory supplied sample containers and following prescribed sample protocols, including proper preservation, meeting sample hold times, proper chain of custody documentation, to ensure integrity of the samples.

Review of field activity documentation indicated that recommended sample volumes were collected from groundwater for each analytical test group into appropriate containers and preserved with proper chemical reagents in accordance with the protocols set out in the *Protocol for Analytical Methods used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act* (MOE, 2004). Samples were preserved at the required temperatures in insulated coolers and met applicable holding time requirements, when relinquished to the receiving laboratory.

Duplicate soil sample pair MW17-1 S5 (MW4 S6) were submitted for chemical analysis of metals. For QA/QC purposes, the analytical sample results are quantitatively evaluated by calculating the relative

percent difference (RPD) between the samples and their duplicates. The average RPD for the metals parameters was 9.0 which is less than the recommended limit of 30 for metals.

Duplicate groundwater samples MW17-2 (MW4) were submitted for chemical analysis metals. The average RPD for the metals parameters was 1.1 which is less than the recommended limit of 20 for metals in groundwater.

Certificates of Analysis were received from Paracel reporting the results of all the chemical analyses performed on the submitted soil and groundwater samples. Copies of the Paracel Certificates of Analysis are provided in Appendix E. A review of the Certificates of Analysis prepared by Paracel indicates that they were in compliance with the requirements set out under subsection 47(3) of O.Reg. 511/09.

The analytical program conducted by Paracel included analytical test group specific QA/QC measures to evaluate the accuracy and precision of the analytical results and the efficiency of analyte recovery during solute extraction procedures. The Paracel laboratory QA/QC program consisted of the preparation and analysis of laboratory duplicate samples to assess precision and sample homogeneity, method blanks to assess analytical bias, spiked blanks and QC standards to evaluate analyte recovery, matrix spikes to evaluate matrix interferences and surrogate compound recoveries (VOCs only) to evaluate extraction efficiency. The laboratory QA/QC results are presented in the Quality Assurance Report provided in the Certificate of Analysis prepared by Paracel. The QA/QC results are reported as percent recoveries for matrix spikes, spike blanks and QC standards, relative percent difference for laboratory duplicates and analyte concentrations for method blanks.

The Paracel QA/QC results were assessed against test group control limits in the case of spiked blanks, matrix spikes and surrogate recoveries and alert criteria in the case of method blanks and laboratory duplicates. Review of the laboratory QA/QC results reported by Paracel indicated that they were within acceptable control limits or below applicable alert criteria for the sampled media and analytical test groups. Based on the assessment of the QA/QC, the analytical results reported by Paracel are of acceptable quality and data qualifications are not required.

5.11 Phase Two Conceptual Site Model

This section presents a Conceptual Site Model (CSM) providing a narrative, graphical and tabulated description integrating information related to the Site's geologic and hydrogeological conditions, areas of potential environmental concern/potential contaminating activities, the presence and distribution of contaminants of concern, contaminant fate and transport, and potential exposure pathways.

For the purposes of this Phase Two CSM, the information relied upon was taken from all current and previous environmental reports conducted for the Site. However, the data relied upon was limited to the most recent information to convey the current Site conditions.

5.11.1 Introduction

The Site consists of a 2-storey, mixed commercial/residential building located at 89 Richmond Road, Ottawa, Ontario as shown on Figure 2 in Appendix B. The ground floor consists of the commercial space and the second floor consists of residential space. The building has an approximate footprint of 115 m^2. The surrounding properties are residential and commercial in nature.

Refer to the following table for the Site identification information.

Civic Address	89 Richmond Road, Ottawa, ON
Current Land Use	Commercial/Residential
Proposed Land Use	Commercial/Residential
Property Identification Number	040210110
UTM Coordinates	441800 m E, 5027309 m N
Site Area	0.036 ha
Property Owner	Ms. Lydia Wu and Mr. George Cai
Owner Contact	Ms. Lydia Wu and Mr. George Cai
Owner Address	89 Richmond Road, Ottawa, Ontario K1Z 6V8

5.11.2 Physical Site Description

The Phase Two CSM provides a narrative and graphical interpretation of the Site surface features, near surface geologic and hydrogeologic conditions, PCOCs, contaminant fate and transport mechanisms, and relevant receptors and exposure pathways. These components are discussed in the following sections and summarized in Table 1 in the Tables appendix.

The Site is located in a developed commercial and residential area of Ottawa where potable water is supplied by the City of Ottawa and therefore the MOECC Table 3 Site Condition Standard (SCS) is applied to the Site. The City of Ottawa obtains its water from the Ottawa River, located approximately 4.5 km west of the Site.

In accordance with Section 41 of the Ontario Regulation 153/04 (as amended), the Site is not an environmentally sensitive area. The Site is not located within an area of natural significance and it does not include land that is within 30 metres of an area of natural significance.

Based on the Phase Two ESA investigation, the Site is not a shallow soil property as defined in Section 43.1 of the regulation. The Site does not include all or part of a water body or is adjacent to a water body or includes land that is within 30 metres of a water body.

5.11.3 Geological and Hydrogeological Setting

Based on the Phase Two ESA, below the asphalt in MW17-2 and MW17-3 crushed stone sand and gravel were encountered. Below the concrete in MW17-1 and the crushed stone in the other two monitoring wells, fill was encountered to approximately 5.5 m depth. The fill consists of sand and gravel with occasional cobbles and boulders. No odours or visual indications of impact were observed in the fill material.

Below the fill in all three monitoring wells was glacial till which extended to refusal depths ranging from 6.86 m to 7.62 m on probable bedrock. The till was comprised of sand with some gravel and some silt. No odours or visual indications of impact were observed in the native material.

The geologic cross-sections prepared from Site boreholes are presented on Figure 4 in Appendix B.

Based on the groundwater level measurements, the groundwater flow in the area of the boreholes is to the southwest.

5.11.4 Underground Utilities

The Site is serviced by underground utilities such as bell, gas, water and sewer. The groundwater flow pattern at the site is unlikely to be influenced by buried services since the groundwater was found at a minimum depth of 4.77 m below ground.

5.11.5 Potentially Contaminating Activities

The Phase One ESA conducted by **exp** in 2017 identified one on-site PCA and six off-site PCAs:

- PCA1 – Current off-site automotive garage and former retail fuel outlet (RFO) located at 77 Richmond Road (30 m east) operated between the 1950s and 1980s (PCA#27 - Garages and Maintenance and PCA#28 – Gasoline and Associated Products Stored in Fixed Tanks).
- PCA2 – Former off-site RFO located at 109/119 Richmond Road (now 101 Richmond Road - 50 m west) operated between the 1950s and 2000s (PCA#28 - Gasoline and Associated Products Stored in Fixed Tanks).
- PCA3 – Former off-site automotive garage located at 72 Richmond Road (40 m east) operated between the 1950s and 2010s (PCA#27 - Garages and Maintenance). A significant furnace oil spill also occurred on this property in 1988.
- PCA4 – Former off-site retail fuel outlet located at 70 Richmond Road (65 m east) operated between 1940s and 1960s (PCA#28 – Gasoline and Associated Products Stored in Fixed Tanks). This property was also formerly operated as an automotive garage between the 1960s and 2010s (PCA#27 - Garages and Maintenance).
- PCA5 – Former off-site RFO located at 1451 Wellington Street West (130 m northeast) operated between the 1950s and 1960s. This property was also formerly operated as an automotive garage between the 1970s and 2010s (PCA#27 - Garages and Maintenance and PCA#28 – Gasoline and Associated Products Stored in Fixed Tanks).
- PCA6 – Current off-site RFO located at 369 Island Park Drive (130 m east) operated between the 1950s to present (PCA#28 – Gasoline and Associated Products Stored in Fixed Tanks).
- PCA7 – Former off-site dry cleaners located at 90 Richmond Road (now 98 Richmond Road – 30 m southeast) operated between 1969 and the early 1970s (PCA#37 – Operation of Dry Cleaning Equipment).
- PCA8 – Current commercial printing company (Canadian Bank Note Company) located at 145 Richmond Road (100 m west) operated between the 1950 and present (PCA#31 – Ink Manufacturing, Processing and Bulk Storage).

5.11.6 Areas of Potential Environmental Concern/Potential Contaminants of Concern

As per Ontario Regulation 153/04 (as amended), Potential Contaminating Activity (PCA) is defined as one of the 59 industrial operations set out in Table 2 of Schedule D that occurs or has occurred on the Site or within the Phase I ESA study area. Based on Phase I ESA, the identified areas of potential environmental concern (APEC) and potential contaminants of concern (PCOC) are summarized in the table below and are shown on Figure 2 in Appendix B.

Area of Potential Environmental Concern (APEC)	Potentially Contaminating Activity (PCA)	Location of PCA (On-Site or Off-Site)	Contribution to APEC at the Site (Yes/No)	Media Potentially Impacted (Groundwater, Soil and/or Sediment)	Contaminants of Concern
1. Current automotive garage and former RFO (77 Richmond Road) operated between 1950s and 1980s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	30 m east	Yes	Soil and groundwater	petroleum hydrocarbons (PHC) and benzene, toluene, ethylbenzene, xylene (BTEX)
2. Former RFO located at 109/119 Richmond Road (now 101 Richmond Road) operated between the 1950s and 2000s	#28 – Gasoline and Associated Products Storage in Fixed Tanks	50 m west	Yes	Soil and groundwater	PHC and BTEX
3. Former automotive garage located at 72 Richmond Road operated between the 1950s and 2010s and spill in 1988	#27 – Garages and Maintenance	40 m east	Yes	Soil and groundwater	PHC and BTEX
4. Former RFO located at 70 Richmond Road operated between 1940s and 1960s. Also formerly operated as an automotive garage between the 1960s and 2010s	#27 – Garages and Maintenance #28 – Gasoline and Associated Products Storage in Fixed Tanks	65 m east	Yes	Soil and groundwater	PHC and BTEX
5. Former dry cleaners located at 90 Richmond Road (now 98 Richmond Road) operated between 1969 and the early 1970s	#37 – Operation of Dry Cleaning Equipment	30 m southeast	Yes	Groundwater	VOCs

5.11.7 Investigation and Remediation

The Phase Two ESA was conducted to assess the soil and groundwater quality at the Site. As indicated in the APEC and PCOC Table (above), the analytical program of the Phase Two ESA included testing of soil and groundwater for PHC, VOC, and/or metals from the monitoring wells installed on the Site. The borehole and monitoring well locations are shown on Figure 3 in Appendix B.

5.11.8 Contaminants of Concern (COC)

Based on the results of the investigation, all of the soil and groundwater samples had concentrations of PHC, VOC, and metals that were less than the 2011 MOECC Table 3 SCS. Therefore, there are no COC on the Site.

5.11.9 Contaminant Fate and Transport

Soil COCs

No impacts were observed in the soil at the Site and therefore, there are no contaminants of concern in soil at the subject Site.

Groundwater COCs

No impacts were observed in the groundwater at the Site and therefore, there are no contaminants of concern in groundwater at the subject Site.

6 Conclusions

Based on the Phase Two ESA results, the following summary is provided:

- Below the asphalt in MW17-2 and MW17-3 crushed stone sand and gravel were encountered. Below the concrete in MW17-1 and the crushed stone in the other two monitoring wells, fill was encountered to approximately 5.5 m depth. The fill consists of sand and gravel with occasional cobbles and boulders. No odours or visual indications of impact were observed in the fill material. Below the fill in all three monitoring wells was glacial till which extended to refusal depths ranging from 6.86 m to 7.62 m on probable bedrock. The till was comprised of sand with some gravel and some silt. No odours or visual indications of impact were observed in the native material.
- On September 5, 2017, groundwater was encountered at a depth of 4.77 m bgs in MW17-3 to 6.76 m bgs in MW17-1. No petroleum sheens were observed in the monitoring wells during either sampling event. Based on the groundwater level measurements, the groundwater flow in the area of the boreholes is to the southwest.
- The concentrations of metals, PHC and VOC measured in the soil samples and blind duplicate were either less than the laboratory detection limit and or the MOECC 2011 Table 3 SCS.
- The concentrations of metals, PHC and VOC in the groundwater samples were either less the laboratory detection limit or less than the 2011 MOECC Table 3 SCS.

Based on the Phase Two ESA findings, no further work is recommended at this time. If the wells are no longer needed, they should be decommissioned in accordance with Ontario Regulation 903.

7 General Limitations

The information presented in this report is based on a limited investigation designed to provide information to support an assessment of the current environmental conditions within the subject property. The conclusions and recommendations presented in this report reflect Site conditions existing at the time of the investigation.

More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during any such excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent. Should this occur, **exp** Services Inc. should be contacted to assess the situation, and the need for additional testing and reporting. **Exp** has qualified personnel to provide assistance in regards to any future geotechnical and environmental issues related to this property.

The environmental investigation was carried out to address the intent of applicable provincial Regulations, Guidelines, Policies, Standards, Protocols and Objectives administered by the Ministry of Environment. It should also be noted that current environmental Regulations, Guidelines, Policies, Standards, Protocols and Objectives are subject to change, and such changes, when put into effect, could alter the conclusions and recommendations noted throughout this report. Achieving the study objectives stated in this report has required us to arrive at conclusions based upon the best information presently known to us. No investigative method can completely eliminate the possibility of obtaining partially imprecise or incomplete information; it can only reduce the possibility to an acceptable level. Professional judgment was exercised in gathering and analyzing the information obtained and in the formulation of the conclusions. Like all professional persons rendering advice we do not act as absolute insurers of the conclusions we reach, but we commit ourselves to care and competence in reaching those conclusions.

Our undertaking at **exp**, therefore, is to perform our work within limits prescribed by our clients, with the usual thoroughness and competence of the engineering profession. It is intended that the outcome of this investigation assist in reducing the client's risk associated with environmental impairment. Our work should not be considered 'risk mitigation'. No other warranty or representation, either expressed or implied, is included or intended in this report.

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8 References

This study was conducted in general accordance with the applicable Regulations, Guidelines, Policies, Standards, Protocols and Objectives administered by the Ministry of the Environment. Specific reference is made to the following:

- Environmental Protection Act, R.S.O. 1990, Chapter E.19, as amended, September 2004.
- Ministry of the Environment [MOE] (1996) Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario. Ontario Ministry of the Environment, December 1996.
- MOE (2011) Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. Ontario Ministry of the Environment, April 15, 2011.
- MOE (2011) Guide for Completing Phase Two Environmental Site Assessments under Ontario Regulation 153/04. Ontario Ministry of the Environment, June 2011.
- MOE (2011) Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. Ontario Ministry of the Environment, March 2004, amended as of July 1, 2011.
- Ontario Regulation 153/04, made under the Environmental Protection Act, May 2004, last amended to O.Reg.333/13.
- Ontario Water Resources Act – R.R.O. 1990, Regulation 903, amended to O.Reg. 128/03, August 2003.
- Groundwater, Freeze and Cheery 1979. Prentice Hall.

Tables

Table 1

Characteristic	Description
Minimum Depth to Bedrock	6.86 m
Minimum Depth to Overburden Groundwater	4.77 m September 6, 2017
Shallow Soil Property	No, greater than 2.0 m
Proximity to water body or ANSI	1.2 km
Soil pH	7.97
Soil Texture	Coarse
Current Property Use	Commercial/Residential
Future Property Use	Commercial/Residential
Proposed Future Building	Central part of the site
Areas where soil has been brought to the Site	None identified

Appendix A – Sampling and Analysis Plan

1 Introduction

This appendix presents the Sampling and Analysis Plan (SAAP) that was developed in support of the Phase Two Environmental Site Assessment (ESA) for the property located at 89 Richmond Road in Ottawa, Ontario (hereinafter referred to as the 'site'). The SAAP presents the procedures and measures that will be undertaken during field investigative activities to characterize the site conditions and meet the data quality objectives of the Phase Two ESA.

The SAAP presents the sampling program proposed for the site, the recommended procedures and protocols for sampling and related field activities, the data quality objectives, and the quality assurance/ quality control measures that will be undertaken to provide for the collection of accurate, reproducible and representative data. These components are described in further detail below.

2 Field Sampling Program

The field sampling program was developed to provide for the collection of samples of the soil and groundwater for chemical analysis of petroleum hydrocarbons (PHC), benzene, toluene, ethylbenzene and xylenes (collectively known as 'BTEX'), volatile organic compounds (VOC), and metals. The soil sampling media is to consist of the overburden materials (depths up to 6 m of overburden beneath site). The soil sampling will be location-specific to assess for the potential presence of PHC, VOC, and metals based on the identification of potential areas of potential environmental concern identified in a Phase One ESA completed by **others** in 2014. Vapour readings will also be taken in the field to determine samples to be submitted for VOC/BTEX and PHC F1-F2 analysis. The soil sample intervals will extend from the surface up to a maximum depth of approximately 7.5 m below grade.

Each of the groundwater samples will be submitted for analysis of PHC, BTEX, and/or VOC. The monitoring well network is to comprise of three newly installed wells.

Vertical control of the boreholes and monitoring wells will be obtained through the completion of an elevation survey with reference to a geodetic benchmark. Groundwater flow and direction in the overburden aquifer will also be determined through groundwater level measurements and the elevations established in the site elevation survey.

3 Field Methods

To meet the requirements of the field sampling program, the following field investigative methods will be undertaken:

- Borehole Drilling;
- Soil Sampling;
- Monitoring Well Installation;
- Groundwater Level Measurements;
- Elevation Survey; and,
- Groundwater Sampling.

The field investigative methods will be performed following the procedures and protocols set out in **exp's** standard operating procedures and are outlined below:

3.1 Borehole Drilling

Boreholes will be advanced at the site to facilitate the collection of soil samples for chemical analysis and geologic characterization; and, for the installation of groundwater monitoring wells. A total of three (3) boreholes are proposed to be advanced at the site, up to a maximum overburden depth of approximately 7.5 m below grade, to provide for the collection of samples of the surficial and overburden materials beneath the site. The borehole locations will be selected to delineate the extent and magnitude of PCOC related impacts to the soils and the groundwater.

Prior to borehole drilling, utility clearances will be obtained from public and private locators, as required. The borehole drilling program will be conducted by a licensed driller under the oversight of **exp** field staff. All drilling equipment will be cleaned prior to the commencement of drilling at each borehole location.

3.2 Soil Sampling

Soil samples will be collected for chemical analysis and geologic property characterization. The soil samples will be collected using 5 cm diameter, 152 cm long, stainless steel split-spoon sampling devices advanced ahead of the direct push drilling equipment at continuous intervals. The split spoon sampling devices will be attached to drill rods and advanced into the soil by means of a direct push hammer. Upon retrieval from the boreholes, the split-spoon samplers will be placed on a flat surface and disassembled by drilling personnel to provide access of the recovered cores. Geologic and sampling details of the recovered cores will be logged and the samples will be assessed for the potential presence of non-aqueous phase liquids. Samples for chemical analysis will be selected on the basis of visual and olfactory evidence of impacts and at specific intervals to define the lateral and vertical extent of known impacts.

Recommended volumes of soil samples selected for chemical analysis will be collected into pre-cleaned, laboratory supplied, analytical test group specific containers. The samples will be placed into clean insulated coolers chilled with ice for storage and transport. Samples intended for analysis of BTEX and PHC F1-F2 will be collected into 40 ml vials. The samples will be assigned unique identification numbers, and the date, time, location, and requested analyses for each sample will be documented in a bound field note book. The samples will be submitted to the contract laboratory within analytical test group holding times under Chain of Custody (COC) protocols. New disposable chemical resistant gloves will be used for each soil core to prevent sample cross-contamination.

3.3 Monitoring Well Installation

It is proposed that three (3) boreholes will be instrumented as groundwater monitoring wells installed with slotted screens intercepting either the native overburden material or the shallow bedrock, where the water table aquifer is expected, extending to depths of approximately 3 to 5 m below grade. The monitoring wells will be constructed using 31 mm diameter, Schedule 40, PVC riser pipe and number 10 slot size (0.25 mm) well screens. The base of the well screens will be sealed with threaded flush PVC end caps. All well pipe connections will be factory machined threaded flush couplings. The annular space around the well screens will be backfilled with silica sand, to an average height of 0.3 m above the top of the screen. Granular bentonite will be placed in the borehole annulus from the top of the sand pack to approximately 0.3 m below grade. The monitoring wells will be completed with either a flush-mounted protective steel casing or above ground protective casings cemented into place.

3.4 Monitoring Well Development

The newly installed monitoring wells will be developed to remove fine sediment particles potentially lodged in the sand pack and well screen to enhance hydraulic communication with the surrounding formation waters.

Standing water volumes will be determined by means of an electronic water level meter. Approximately 1 wetted well volume will be removed. Well development details will be documented on a well development log sheet or in a bound hard cover notebook. All development waters will be collected and stored in labeled, sealed containers.

3.5 Groundwater Level Measurements

Groundwater level measurements will be recorded for all monitoring wells to determine groundwater flow and direction in the water table aquifer beneath the site. Water levels will be measured with respect to the top of the casing by means of an electronic water level meter. The water levels will be recorded on water level log sheets. The water level meter probe will be decontaminated between monitoring well locations.

3.6 Elevation Survey

An elevation survey will be conducted to obtain vertical control of all monitoring well locations. The top of casing and ground surface elevation of each monitoring well location will be surveyed against a known geodetic benchmark, or if unavailable, against a suitable arbitrary benchmark. Elevations measured against using a high precision GPS unit and a benchmark with an assigned elevation will be recorded as meters above mean sea level (m AMSL. The elevation survey will be accurate to within ± 0.5 cm.

3.7 Groundwater Sampling

Groundwater samples will be collected from all monitoring wells for chemical analysis. The wells will be sampled using a “low flow” technique whereby the wells are continuously purged using an electric pump (equipped with dedicated tubing) and parameters within the purged water are monitored using a groundwater chemistry multi-meter at 3 minute intervals. These parameters include: pH, conductivity, temperature, and salinity. Once these parameters are found to deviate less than 10% over three testing events, equilibrium is deemed to have occurred and a sample of the groundwater will be collected. The water sample collected from the deep monitoring well will be collected using a foot valve and plastic tubing. The purge water will also be continuously monitored for visual and olfactory evidence of petroleum and solvent impact (sheen and odour).

Recommended groundwater sample volumes will be collected into pre-clean laboratory-supplied vials or bottles provided with analytical test group specific preservatives, as required. The samples will be placed in an insulated cooler chilled with ice for storage and transport. Each VOC/BTEX vial will be inverted and inspected for gas bubbles prior to being placed in the cooler to ensure that no head-space is present. All groundwater samples will be assigned unique identification numbers, and the date, time, project number, company name, location and requested analyses for each sample will be documented in a bound hard cover notebook. The samples will be submitted to the contractual laboratory within analytical test group holding times under COC protocols. New disposable chemical resistant gloves will be used for each sampling location to prevent sample cross-contamination.

4 Field Quality Assurance/Quality Control Program

The objective of the field quality assurance/quality control (QA/QC) program is to obtain soil and groundwater samples and other field measurements that provide data of acceptable quality that meets the objectives of the Phase Two ESA. The objectives of the QA/QC program will be achieved through the implementation of procedures for the collection of unbiased (i.e. non-contaminated) samples, sample documentation and the collection of appropriate QC samples to provide a measure of sample reproducibility and accuracy. The field QA/QC measures will comprise:

- Decontamination Protocols;
- Equipment Calibration;
- Sample Preservation;
- Sample Documentation; and,
- Field Quality Control Samples.

Details on the field QA/QC measures are provided below.

4.1 Decontamination Protocols

Decontamination protocols will be followed during field sampling where non-dedicated sampling equipment is used to prevent sample cross contamination. The split spoon soil sampling device will be cleaned/decontaminated between sampling intervals in according with SOP requirements. For the monitoring well installation, well components are not to come into contact with the ground surface prior to insertion into boreholes. Electronic water level meters will be decontaminated between monitoring well locations during well development, and purging activities. For hydraulic conductivity tests, the electronic water level meters will be decontaminated between sampling locations. All decontamination fluids will be collected and stored in sealed, labeled containers.

4.2 Equipment Calibration

All equipment requiring calibration will be calibrated in the field according to manufacturer's requirements using analytical grade reagents, or by the supplier prior to conducting field activities, and subsequently checked in the field. The calibration of all pre-calibrated instruments will be checked in the field using analytical grade reagents and re-calibrated as required. For multiple day sampling events, equipment calibration will be checked prior to the beginning of sampling activities. All calibration data will be documented in a bound hard cover notebook.

4.3 Sample Preservation

All samples will be preserved using appropriate analytical test group specific reagents, as required, and upon collection placed in pre-chilled insulated coolers packed with ice for storage and transport.

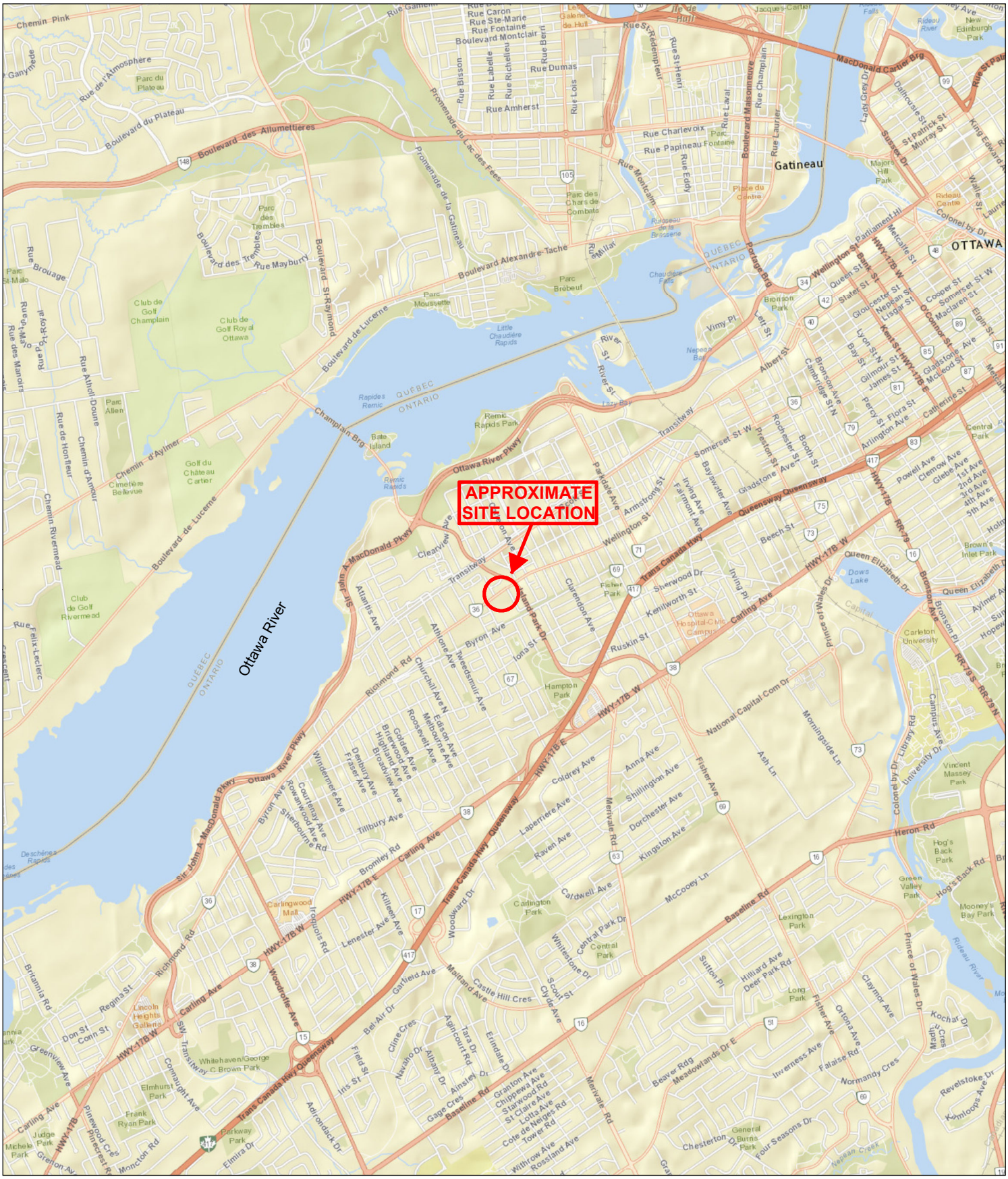
4.4 Sample Documentation

All samples will be assigned a unique identification number, which is to be recorded along with the date, time, project number, company name, location and requested analysis in a bound field notebook. All samples will be handled and transported following COC protocols.

4.5 Field Quality Control

Field quality controls samples will be collected to evaluate the accuracy and reproducibility of the field sampling procedures. For soil and groundwater sampling, one (1) field duplicate is to be collected for every ten (10) samples submitted for chemical analysis. The field duplicate samples will be assessed by calculating the relative percent difference and comparing to the analytical test group specific acceptance criteria.

Appendix B – Figures



exp Services Inc.
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Ottawa, Ontario
K2B 8H6
T - (613) - 688-1899
F - (613) - 225-7337

PROJECT TITLE:
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
89 Richmond Road
Ottawa, Ontario

DRAWING TITLE:
SITE LOCATION PLAN

PROJECT No.: OTT-00240343-A0	DWN: SL
SCALE: AS SHOWN	CHKD: SD
DATE: SEPT. 2017	FIG. No.: 1

LEGEND

PCA Potentially Contaminating Activity

0 12.5 25 50 75 100 125 Metres

N

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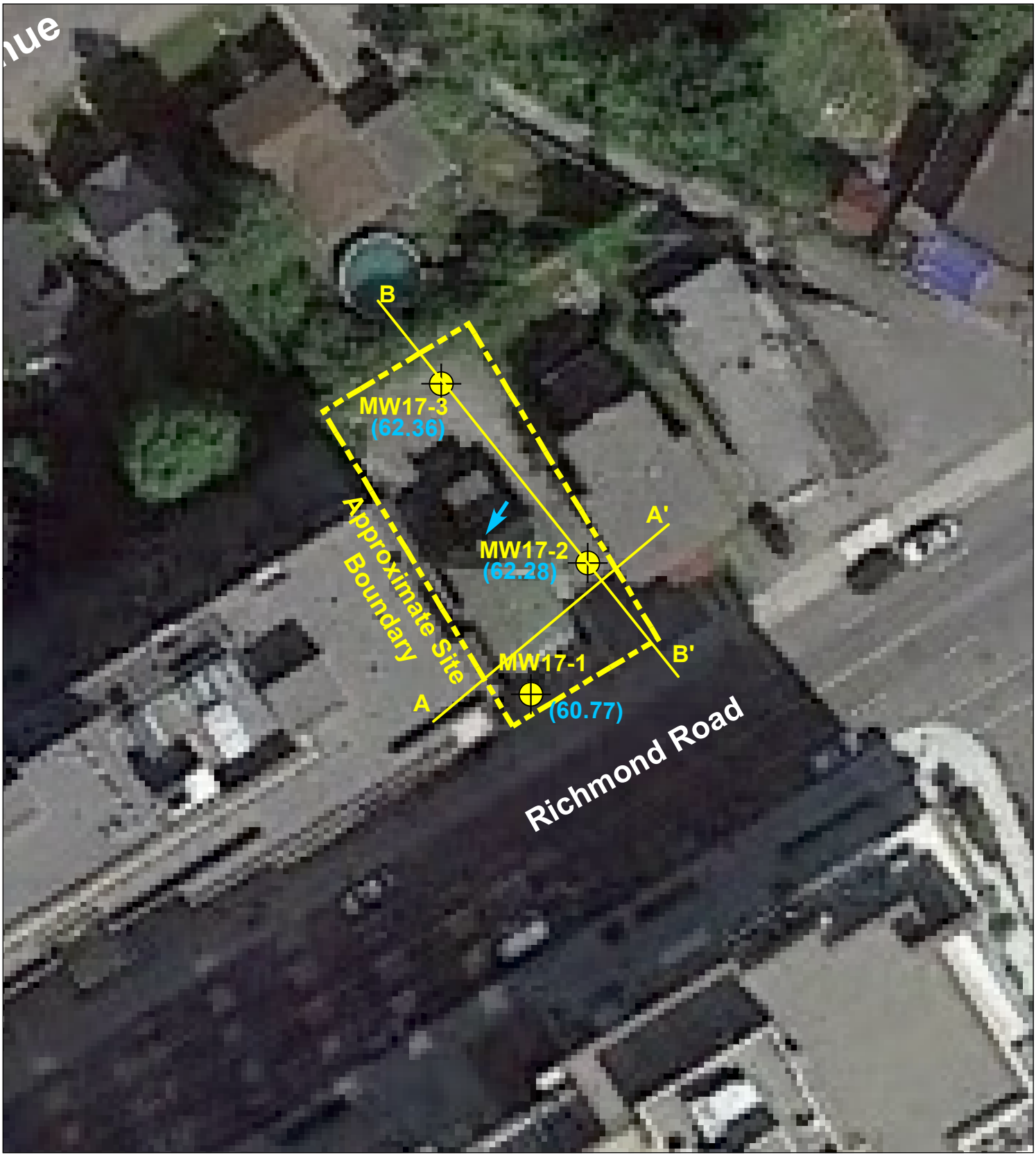
PROJECT TITLE:
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
89 Richmond Road
Ottawa, Ontario

DRAWING TITLE:
PCA LOCATION PLAN

PROJECT No.:	DWN:
OTT-00240343-A0	SL
SCALE:	CHKD:
AS SHOWN	SD
DATE:	FIG. No.:
SEPT. 2017	2



LEGEND

Monitoring well location and number

(60.77) Groundwater elevation September 5, 2017

Groundwater flow direction

0 3 6 12 18 24 30 Metres

N

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PROJECT TITLE:
PHASE TWO ENVIRONMENTAL SITE ASSESSMENT
89 Richmond Road
Ottawa, Ontario

DRAWING TITLE:
BOREHOLE LOCATION PLAN

PROJECT No.: OTT-00240343-A0	DWN: SL
SCALE: AS SHOWN	CHKD: SD
DATE: SEPT. 2017	FIG. No.: 3

Appendix C: Borehole Logs

Explanation of Terms Used on Borehole Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

Topsoil: mixture of soil and humus capable of supporting good vegetative growth.

Peat: fibrous fragments of visible and invisible decayed organic matter.

Fill: where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc.; none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

Till: the term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Terminology describing soil structure:

Desiccated: having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.

Stratified: alternating layers of varying material or color with the layers greater than 6 mm thick.

Laminated: alternating layers of varying material or color with the layers less than 6 mm thick.

Fissured: material breaks along plane of fracture.

Varved: composed of regular alternating layers of silt and clay.

Slickensided: fracture planes appear polished or glossy, sometimes striated.

Blocky: cohesive soil that can be broken down into small angular lumps which resist further breakdown.

Lensed: inclusion of small pockets of different soil, such as small lenses of sand scattered through a mass of clay; not thickness.

Seam: a thin, confined layer of soil having different particle size, texture, or color from materials above and below.

Homogeneous: same color and appearance throughout.

Well Graded: having wide range in grain sized and substantial amounts of all predominantly on grain size.

Uniformly Graded: predominantly on grain size.

All soil sample descriptions included in this report follow the ASTM D2487-11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System). The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. The system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification. The classification excludes particles larger than 76 mm. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually in accordance with ASTM D2488-09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems. Others may use different classification systems; one such system is the ISSMFE Soil Classification.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present and as described below in accordance with Note 16 in ASTM D2488-09a:

Table a: Percent or Proportion of Soil, Pp

	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5≤Pp≤10%
Little	15≤Pp≤25%
Some	30≤Pp≤45%
Mostly	50≤Pp≤100%

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test 'N' value:

Table b: Apparent Density of Cohesionless Soil

	'N' Value (blows/0.3 m)
Very Loose	N<5
Loose	5≤N<10
Compact	10≤N<30
Dense	30≤N<50
Very Dense	50≤N

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by insitu vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis, Standard Penetration Test 'N' values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils:

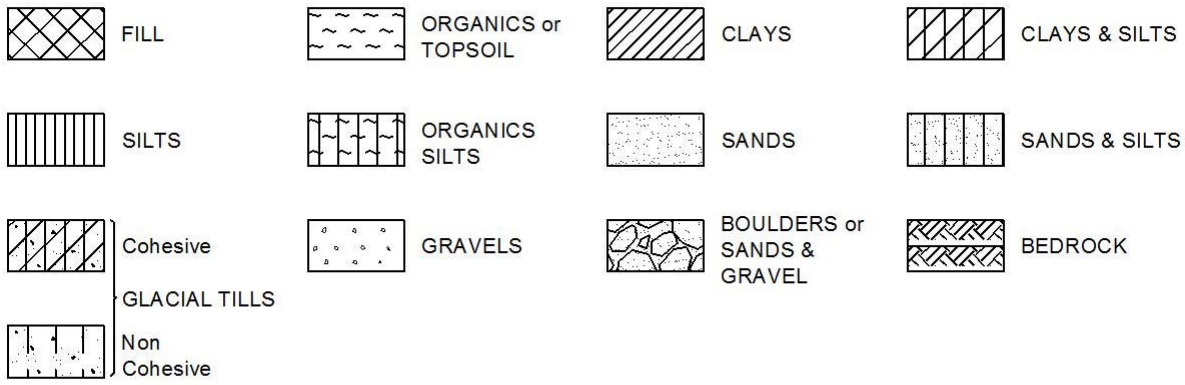
Table c: Consistency of Cohesive Soil

Consistency	Vane Shear Measurement (kPa)	'N' Value
Very Soft	<12.5	<2
Soft	12.5-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

Note: 'N' Value - The Standard Penetration Test records the number of blows of a 140 pound (64kg) hammer falling 30 inches (760mm), required to drive a 2 inch (50.8mm) O.D. split spoon sampler 1 foot (305mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in meters (e.g. 50/0.15).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT

Log of Borehole MW17-1

Project No: OTT-00240343-A0
Project: Phase Two ESA
Location: 89 Richmond Road, Ottawa, ON
Date Drilled: 'August 29, 2017
Drill Type: Track GM100
Datum: Geodetic
Logged by: MAD Checked by: MGM

Figure No. 3
Page. 1 of 1

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
		CONCRETE PAVING STONES ~80 mm	67.54	0
		FILL Sand and gravel, some silt to silty, grey to brown, moist to wet, (loose), occasional cobbles and boulders	67.5	
			61.9	
		TILL Sand, with some gravel to gravelly, some silt, grey, wet.	60.78	
			60.4	7
		Drilling Refusal at 7.16 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60
SAMPLES
Natural Unit Wt. kN/m³

0 10 0 10 5 5 5 0 10

LOG OF BOREHOLE BH LOGS - 240343-A0 89 RICHMOND.GPJ TROW OTTAWA.GDT 9/12/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 37-mm diameter slotted standpipe was installed in the borehole
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00240343-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	
7 days	6.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole MW17-2

Project No: OTT-00240343-A0
Project: Phase Two ESA
Location: 89 Richmond Road, Ottawa, ON
Date Drilled: 'August 29, 2017
Drill Type: Track GM100
Datum: Geodetic
Logged by: MAD Checked by: MGM

Figure No. 4
Page. 1 of 1

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
		ASPHALT ~25 mm	67.5	0
		FILL Grey crushed stone, sand and gravel	67.4	
		FILL Sand and gravel, some silt to silty, grey to brown, moist to wet, (loose), occasional cobbles and boulders		1
				2
				3
				4
			62.32	5
		TILL Sand, with some gravel to gravelly, some silt, grey, wet.	62.0	6
				7
			59.9	
		Drilling Refusal at 7.62 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

N Value: 20, 25, 10, 20, 15, 25, 25, 25

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 37-mm diameter slotted standpipe was installed in the borehole
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00240343-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	5.7	
7 days	5.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 240343-A0 89 RICHMOND.GPJ TROW OTTAWA.GDT 9/12/17

Log of Borehole MW17-3

Project No: OTT-00240343-A0
Project: Phase Two ESA
Location: 89 Richmond Road, Ottawa, ON
Date Drilled: 'August 29, 2017
Drill Type: Track GM100
Datum: Geodetic
Logged by: MAD Checked by: MGM

Figure No. 5
Page. 1 of 1

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)
Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
		ASPHALT ~25 mm	67.09	0
		FILL Grey crushed stone, sand and gravel	67.1	
		FILL Sand and gravel, some silt to silty, grey to brown, moist to wet, (loose), occasional cobbles and boulders	66.9	
			62.32	5
		TILL Sand, with some gravel to gravelly, some silt, grey, wet.	61.6	
		Drilling Refusal at 6.86 m Depth	60.2	6

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

35 (1) 20 (2) 30 (3) 15 (4) 15 (5) 15 (6) 15

SAMPLES | Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 37-mm diameter slotted standpipe was installed in the borehole
3. Field work supervised by an **exp** representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00240343-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	4.5	
7 days	4.8	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 240343-A0 89 RICHMOND.GPJ TROW OTTAWA.GDT 9/12/17

Appendix D - Analytical Summary Tables

TABLE 1 SOIL ANALYTICAL RESULTS *(µg/g)*
VOLATILE ORGANIC COMPOUNDS AND PETROLEUM HYDROCARBONS
89 Richmond Road, Ottawa, Ontario

(µg/g)

Parameter	**MOECC Table 1[1]**	**MOECC Table 3[2]**	MW17-1 S8	MW17-1 S9	MW17-2 S7	MW17-3 S5
Sample Date (d/m/y)	**Background**	**Residential**	26/6/2017	08/11/17	08/11/17	08/11/17
Sample Depth (mbsg)			5.3 - 6.15	6.15 - 6.9	4.1 - 5.0	3.05 - 3.80
Acetone	0.5	16	NA	<0.50	NA	NA
Benzene	0.02	0.21	<0.02	<0.02	<0.02	<0.02
Bromodichloromethane	0.05	13	NA	<0.05	NA	NA
Bromoform	0.05	0.27	NA	<0.05	NA	NA
Bromomethane	0.05	0.05	NA	<0.05	NA	NA
Carbon Tetrachloride	0.05	0.05	NA	<0.05	NA	NA
Chlorobenzene	0.05	2.4	NA	<0.05	NA	NA
Chloroform	0.05	0.05	NA	<0.05	NA	NA
Dibromochloromethane	0.05	9.4	NA	<0.05	NA	NA
Dibromodifluoromethane	0.05	16	NA	<0.05	NA	NA
1,2-Dichlorobenzene	0.05	3.4	NA	<0.05	NA	NA
1,3-Dichlorobenzene	0.05	4.8	NA	<0.05	NA	NA
1,4-Dichlorobenzene	0.05	0.083	NA	<0.05	NA	NA
1,1-Dichloroethane	0.05	3.5	NA	<0.05	NA	NA
1,2-Dichloroethane	0.05	0.05	NA	<0.05	NA	NA
1,1-Dichloroethylene	0.05	0.05	NA	<0.05	NA	NA
Cis-1,2-Dichloroethylene	0.05	3.4	NA	<0.05	NA	NA
Trans-1,2-Dichloroethylene	0.05	0.084	NA	<0.05	NA	NA
1,2-Dichloropropane	0.05	0.05	NA	<0.05	NA	NA
Cis-1,3-Dichloropropylene	0.05	0.05	NA	<0.05	NA	NA
Trans-1,3-Dichloropropylene	0.05		NA		NA	NA
Ethylbenzene	0.05	2	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	0.05	0.05	NA	<0.05	NA	NA
Hexane	0.05	2.8	NA	<0.05	NA	NA
Methyl Ethyl Ketone	0.5	16	NA	<0.50	NA	NA
Methyl Isobutyl Ketone	0.5	1.7	NA	<0.50	NA	NA
Methyl-t-Butyl Ether	0.05	0.75	NA	<0.05	NA	NA
Methylene Chloride	0.05	0.1	NA	<0.05	NA	NA
Styrene	0.05	0.7	NA	<0.05	NA	NA
1,1,1,2-Tetrachloroethane	0.05	0.058	NA	<0.05	NA	NA
1,1,2,2-Tetrachloroethane	0.05	0.05	NA	<0.05	NA	NA
Tetrachloroethylene	0.2	0.28	NA	<0.05	NA	NA
Toluene	0.05	2.3	<0.05	<0.05	<0.05	<0.05
1,1,1-Trichloroethane	0.05	0.38	NA	<0.05	NA	NA
1,1,2-Trichloroethane	0.05	0.05	NA	<0.05	NA	NA
Trichloroethylene	0.05	0.061	NA	<0.05	NA	NA
Trichlorofluoromethane	0.25	4	NA	<0.05	NA	NA
Vinyl Chloride	0.02	0.02	NA	<0.02	NA	NA
Total Xylenes	0.05	3.1	<0.05	<0.05	<0.05	<0.05
PHC F1	25	55	<7	NA	<7	<7
PHC F2	10	98	<4	NA	<4	<4
PHC F3	240	300	<8	NA	<8	<8
PHC F4	120	2800	<6	NA	<6	<6

NOTES:

1 MOECC *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the EPA, April 2011, Table 1 background concentrations.*

2 MOECC *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the EPA, April 2011, Table 3 non potable residential standards, coarse grained soil.*

Bold Concentration exceeds MOECC Table 1 background concentrations.

Shaded Concentration exceeds MOECC Table 3 residential soil quality standard.

NA not analyzed

TABLE 2 SOIL ANALYTICAL RESULTS *(µg/g)*
METALS
89 Richmond Road, Ottawa, Ontario

Parameter	**MOECC Table 1[1]**	**MOECC Table 3[2]**	MW17-1 S5	MW17-4 S6	MW17-2 S7
Sample Date (d/m/y)	**Background**	**Residential**	29/8/2017	Duplicate of	29/8/2017
Sample Depth (mbsg)			3.05 - 3.8	MW17-1 S5	4.1 - 5.0
Antimony	1.3	7.5	<1.0	<1.0	<1.0
Arsenic	18	18	<1.0	<1.0	<1.0
Barium	220	390	70.7	60.4	64.3
Beryllium	2.5	4	<1.0	<1.0	<1.0
Boron	36	120	9.1	8.1	13.3
Cadmium	1.2	1.2	<0.5	<0.5	<0.5
Chromium	70	160	15.6	13.2	15.6
Cobalt	21	22	6.3	5.6	5.7
Copper	92	140	17.0	15.9	18.0
Lead	120	120	6.5	6.1	6.4
Molybdenum	2.0	6.9	<1.0	<1.0	<1.0
Nickel	82	100	10.4	9.7	10.8
Selenium	1.5	2.4	<1.0	<1.0	<1.0
Silver	0.5	20	<0.5	<0.5	<0.5
Thallium	1	1	<1.0	<1.0	<1.0
Uranium	2.5	23	<1.0	<1.0	<1.0
Vanadium	86	86	28.9	27.9	27.2
Zinc	290	340	21.1	20.8	25.2

NOTES:

1	MOECC *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the EPA, April 2011, Table 1 background concentrations.*
2	MOECC *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the EPA, April 2011, Table 3 non potable residential standards, coarse grained soil.*
Bold	Concentration exceeds MOECC Table 1 background concentrations.
Shaded	Concentration exceeds MOECC Table 3 residential soil quality standard.
N/A	Not analyzed
NV	no value

TABLE 3 GROUNDWATER ANALYTICAL RESULTS *(µg/L)*
VOLATILE ORGANIC COMPOUNDS AND PETROLEUM HYDROCARBONS
89 Richmond Road, Ottawa, Ontario

Parameter	MOECC Table 3[1]	MW17-1	MW17-2	MW17-3
Sample Date (d/m/y)		5/9/17	5/9/17	5/9/17
Acetone	130,000	<5	NA	NA
Benzene	44	<0.5	<0.5	<0.5
Bromodichloromethane	85,000	<0.5	NA	NA
Bromoform	380	<0.5	NA	NA
Bromomethane	5.6	<0.5	NA	NA
Carbon Tetrachloride	0.79	<0.2	NA	NA
Chlorobenzene	630	<0.5	NA	NA
Chloroform	2.4	<0.5	NA	NA
Dibromochloromethane	82,000	<0.5	NA	NA
Dichlorodifluoromethane	4,400	<1	NA	NA
1,2-Dichlorobenzene	4,600	<0.5	NA	NA
1,3-Dichlorobenzene	9,600	<0.5	NA	NA
1,4-Dichlorobenzene	8	<0.5	NA	NA
1,1-Dichloroethane	320	<0.5	NA	NA
1,2-Dichloroethane	1.6	<0.5	NA	NA
1,1-Dichloroethylene	1.6	<0.5	NA	NA
Cis-1,2-Dichloroethylene	1.6	<0.5	NA	NA
Trans-1,2-Dichloroethylene	1.6	<0.5	NA	NA
1,2-Dichloropropane	16	<0.5	NA	NA
Cis-1,3-Dichloropropylene	5.2	<0.5	NA	NA
Trans-1,3-Dichloropropylene		<0.5	NA	NA
Ethylbenzene	2,300	<0.5	<0.5	<0.5
Ethylene Dibromide	0.3	<0.2	NA	NA
Hexane	51	<1	NA	NA
Methyl Ethyl Ketone	470,000	<5	NA	NA
Methylene Chloride	610	<5	NA	NA
Methyl Isobutyl Ketone	140,000	<2	NA	NA
Methyl-t-Butyl Ether	190	<5	NA	NA
Styrene	1,300	<0.5	NA	NA
1,1,1,2-Tetrachloroethane	3.3	<0.5	NA	NA
1,1,2,2-Tetrachloroethane	3.2	<0.5	NA	NA
Tetrachloroethylene	1.6	<0.5	NA	NA
Toluene	18,000	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	640	<0.5	NA	NA
1,1,2-Trichloroethane	4.7	<0.5	NA	NA
Trichloroethylene	1.6	<0.5	NA	NA
Trichlorofluoromethane	2,500	<1	NA	NA
Vinyl Chloride	0.5	<0.5	NA	NA
Total Xylenes	4,200	<0.5	<0.5	<0.5
PHC F1	750	<25	<25	<25
PHC F2	150	<446	<100	<100
PHC F3	500	<446	<100	<100
PHC F4	500	<446	<100	<100

NOTES:

1 *XV.1 of the EPA, April 2011, Table 3 non potable standards, coarse grained*

Shaded Concentration exceeds MOECC Table 3 groundwater quality standard.

NA not analyzed

TABLE 4 GROUNDWATER ANALYTICAL RESULTS *(µg/L)*
Metals
89 Richmond Road, Ottawa, Ontario

Parameter	**MOECC**	**MW17-2**	**MW17-4**
Sample Date (d/m/y)	**Table 3[1]**	5/9/17	Dup. of MW17-2
Antimony	20000	<0.5	<0.5
Arsenic	1900	<1	<1
Barium	29000	156	156
Beryllium	67	<0.5	<0.5
Boron	45000	60	60
Cadmium	2.7	<0.1	<0.1
Chromium	810	<1	<1
Cobalt	66	<0.5	<0.5
Copper	87	1.5	1.5
Lead	25	<0.1	<0.1
Molybdenum	9200	2.1	2.2
Nickel	490	1	1
Selenium	63	<1	<1
Silver	1.5	<0.1	<0.1
Sodium	2300000	230000	228000
Thallium	510	<0.1	<0.1
Uranium	420	9.2	9.5
Vanadium	250	<0.5	<0.5
Zinc	1100	7	7

NOTES:

1 *XV.1 of the EPA, April 2011, Table 3 non potable standards, coarse grained*

Shaded Concentration exceeds MOECC Table 3 groundwater quality standard.

Appendix E – Laboratory Certificates of Analysis

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Certificate of Analysis

exp Services Inc. (Ottawa)

100-2650 Queensview Dr.
Ottawa, ON K2B 8K2
Attn: Mark Devlin

Client PO:
Project: OTT00240343BO
Custody: 37572

Report Date: 6-Sep-2017
Order Date: 30-Aug-2017

Order #: 1735292

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

Paracel ID	Client ID
1735292-01	MW1-S5
1735292-02	MW4-S6
1735292-03	MW1-S8
1735292-04	MW1-S9
1735292-05	MW2-S4
1735292-06	MW2-S7
1735292-07	MW3-S5

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 06-Sep-2017
Order Date: 30-Aug-2017
Project Description: OTT00240343BO

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	1-Sep-17	4-Sep-17
PHC F1	CWS Tier 1 - P&T GC-FID	1-Sep-17	4-Sep-17
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	31-Aug-17	2-Sep-17
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	6-Sep-17	6-Sep-17
REG 153: VOCs by P&T GC/MS	EPA 8260 - P&T GC-MS	1-Sep-17	4-Sep-17
Solids, %	Gravimetric, calculation	5-Sep-17	5-Sep-17
Texture - Coarse Med/Fine	Based on ASTM D2487	31-Aug-17	1-Sep-17

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 06-Sep-2017
Order Date: 30-Aug-2017
Project Description: OTT00240343BO

	Client ID:	MW1-S5	MW4-S6	MW1-S8	MW1-S9
	Sample Date:	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17
	Sample ID:	1735292-01	1735292-02	1735292-03	1735292-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	94.9	95.2	90.7	90.9
>75 um	0.1 %	-	-	-	54.3
<75 um	0.1 %	-	-	-	45.7
Texture	0.1 %	-	-	-	Coarse
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	-	-
Arsenic	1.0 ug/g dry	<1.0	<1.0	-	-
Barium	1.0 ug/g dry	70.7	60.4	-	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	-	-
Boron	1.0 ug/g dry	9.1	8.1	-	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	-	-
Chromium	1.0 ug/g dry	15.6	13.2	-	-
Cobalt	1.0 ug/g dry	6.3	5.6	-	-
Copper	1.0 ug/g dry	17.0	15.9	-	-
Lead	1.0 ug/g dry	6.5	6.1	-	-
Molybdenum	1.0 ug/g dry	<1.0	<1.0	-	-
Nickel	1.0 ug/g dry	10.4	9.7	-	-
Selenium	1.0 ug/g dry	<1.0	<1.0	-	-
Silver	0.5 ug/g dry	<0.5	<0.5	-	-
Thallium	1.0 ug/g dry	<1.0	<1.0	-	-
Uranium	1.0 ug/g dry	<1.0	<1.0	-	-
Vanadium	1.0 ug/g dry	28.9	27.9	-	-
Zinc	1.0 ug/g dry	21.1	20.8	-	-
Volatiles					
Acetone	0.50 ug/g dry	-	-	-	<0.50
Benzene	0.02 ug/g dry	-	-	-	<0.02
Bromodichloromethane	0.05 ug/g dry	-	-	-	<0.05
Bromoform	0.05 ug/g dry	-	-	-	<0.05
Bromomethane	0.05 ug/g dry	-	-	-	<0.05
Carbon Tetrachloride	0.05 ug/g dry	-	-	-	<0.05
Chlorobenzene	0.05 ug/g dry	-	-	-	<0.05
Chloroform	0.05 ug/g dry	-	-	-	<0.05
Dibromochloromethane	0.05 ug/g dry	-	-	-	<0.05
Dichlorodifluoromethane	0.05 ug/g dry	-	-	-	<0.05
1,2-Dichlorobenzene	0.05 ug/g dry	-	-	-	<0.05

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 06-Sep-2017
Order Date: 30-Aug-2017
Project Description: OTT00240343BO

	Client ID:	MW1-S5	MW4-S6	MW1-S8	MW1-S9
	Sample Date:	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17
	Sample ID:	1735292-01	1735292-02	1735292-03	1735292-04
	MDL/Units	Soil	Soil	Soil	Soil
1,3-Dichlorobenzene	0.05 ug/g dry	-	-	-	<0.05
1,4-Dichlorobenzene	0.05 ug/g dry	-	-	-	<0.05
1,1-Dichloroethane	0.05 ug/g dry	-	-	-	<0.05
1,2-Dichloroethane	0.05 ug/g dry	-	-	-	<0.05
1,1-Dichloroethylene	0.05 ug/g dry	-	-	-	<0.05
cis-1,2-Dichloroethylene	0.05 ug/g dry	-	-	-	<0.05
trans-1,2-Dichloroethylene	0.05 ug/g dry	-	-	-	<0.05
1,2-Dichloropropane	0.05 ug/g dry	-	-	-	<0.05
cis-1,3-Dichloropropylene	0.05 ug/g dry	-	-	-	<0.05
trans-1,3-Dichloropropylene	0.05 ug/g dry	-	-	-	<0.05
1,3-Dichloropropene, total	0.05 ug/g dry	-	-	-	<0.05
Ethylbenzene	0.05 ug/g dry	-	-	-	<0.05
Ethylene dibromide (dibromoethan	0.05 ug/g dry	-	-	-	<0.05
Hexane	0.05 ug/g dry	-	-	-	<0.05
Methyl Ethyl Ketone (2-Butanone)	0.50 ug/g dry	-	-	-	<0.50
Methyl Isobutyl Ketone	0.50 ug/g dry	-	-	-	<0.50
Methyl tert-butyl ether	0.05 ug/g dry	-	-	-	<0.05
Methylene Chloride	0.05 ug/g dry	-	-	-	<0.05
Styrene	0.05 ug/g dry	-	-	-	<0.05
1,1,1,2-Tetrachloroethane	0.05 ug/g dry	-	-	-	<0.05
1,1,2,2-Tetrachloroethane	0.05 ug/g dry	-	-	-	<0.05
Tetrachloroethylene	0.05 ug/g dry	-	-	-	<0.05
Toluene	0.05 ug/g dry	-	-	-	<0.05
1,1,1-Trichloroethane	0.05 ug/g dry	-	-	-	<0.05
1,1,2-Trichloroethane	0.05 ug/g dry	-	-	-	<0.05
Trichloroethylene	0.05 ug/g dry	-	-	-	<0.05
Trichlorofluoromethane	0.05 ug/g dry	-	-	-	<0.05
Vinyl chloride	0.02 ug/g dry	-	-	-	<0.02
m,p-Xylenes	0.05 ug/g dry	-	-	-	<0.05
o-Xylene	0.05 ug/g dry	-	-	-	<0.05
Xylenes, total	0.05 ug/g dry	-	-	-	<0.05
4-Bromofluorobenzene	Surrogate	-	-	-	102%
Dibromofluoromethane	Surrogate	-	-	-	101%
Toluene-d8	Surrogate	-	-	-	106%
Benzene	0.02 ug/g dry	-	-	<0.02	-
Ethylbenzene	0.05 ug/g dry	-	-	<0.05	-

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 06-Sep-2017
Order Date: 30-Aug-2017
Project Description: OTT00240343BO

	Client ID:	MW1-S5	MW4-S6	MW1-S8	MW1-S9
	Sample Date:	29-Aug-17	29-Aug-17	29-Aug-17	29-Aug-17
	Sample ID:	1735292-01	1735292-02	1735292-03	1735292-04
	MDL/Units	Soil	Soil	Soil	Soil
Toluene	0.05 ug/g dry	-	-	<0.05	-
m,p-Xylenes	0.05 ug/g dry	-	-	<0.05	-
o-Xylene	0.05 ug/g dry	-	-	<0.05	-
Xylenes, total	0.05 ug/g dry	-	-	<0.05	-
Toluene-d8	Surrogate	-	-	107%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	-	-	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	-	-	<4	-
F3 PHCs (C16-C34)	8 ug/g dry	-	-	<8	-
F4 PHCs (C34-C50)	6 ug/g dry	-	-	<6	-

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 06-Sep-2017
Order Date: 30-Aug-2017
Project Description: OTT00240343BO

	Client ID:	MW2-S4	MW2-S7	MW3-S5	-
	Sample Date:	29-Aug-17	29-Aug-17	29-Aug-17	-
	Sample ID:	1735292-05	1735292-06	1735292-07	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	94.6	95.5	95.3	-
Metals					
Antimony	1.0 ug/g dry	<1.0	-	-	-
Arsenic	1.0 ug/g dry	<1.0	-	-	-
Barium	1.0 ug/g dry	64.3	-	-	-
Beryllium	1.0 ug/g dry	<1.0	-	-	-
Boron	1.0 ug/g dry	13.3	-	-	-
Cadmium	0.5 ug/g dry	<0.5	-	-	-
Chromium	1.0 ug/g dry	15.6	-	-	-
Cobalt	1.0 ug/g dry	5.7	-	-	-
Copper	1.0 ug/g dry	18.0	-	-	-
Lead	1.0 ug/g dry	6.4	-	-	-
Molybdenum	1.0 ug/g dry	<1.0	-	-	-
Nickel	1.0 ug/g dry	10.8	-	-	-
Selenium	1.0 ug/g dry	<1.0	-	-	-
Silver	0.5 ug/g dry	<0.5	-	-	-
Thallium	1.0 ug/g dry	<1.0	-	-	-
Uranium	1.0 ug/g dry	<1.0	-	-	-
Vanadium	1.0 ug/g dry	27.2	-	-	-
Zinc	1.0 ug/g dry	25.2	-	-	-
Volatiles					
Benzene	0.02 ug/g dry	-	<0.02	<0.02	-
Ethylbenzene	0.05 ug/g dry	-	<0.05	<0.05	-
Toluene	0.05 ug/g dry	-	<0.05	<0.05	-
m,p-Xylenes	0.05 ug/g dry	-	<0.05	<0.05	-
o-Xylene	0.05 ug/g dry	-	<0.05	<0.05	-
Xylenes, total	0.05 ug/g dry	-	<0.05	<0.05	-
Toluene-d8	Surrogate	-	103%	104%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	-	<7	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	-	<4	<4	-
F3 PHCs (C16-C34)	8 ug/g dry	-	<8	<8	-
F4 PHCs (C34-C50)	6 ug/g dry	-	<6	<6	-

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						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						
Volatiles									
Acetone	ND	0.50	ug/g						
Benzene	ND	0.02	ug/g						
Bromodichloromethane	ND	0.05	ug/g						
Bromoform	ND	0.05	ug/g						
Bromomethane	ND	0.05	ug/g						
Carbon Tetrachloride	ND	0.05	ug/g						
Chlorobenzene	ND	0.05	ug/g						
Chloroform	ND	0.05	ug/g						
Dibromochloromethane	ND	0.05	ug/g						
Dichlorodifluoromethane	ND	0.05	ug/g						
1,2-Dichlorobenzene	ND	0.05	ug/g						
1,3-Dichlorobenzene	ND	0.05	ug/g						
1,4-Dichlorobenzene	ND	0.05	ug/g						
1,1-Dichloroethane	ND	0.05	ug/g						
1,2-Dichloroethane	ND	0.05	ug/g						
1,1-Dichloroethylene	ND	0.05	ug/g						
cis-1,2-Dichloroethylene	ND	0.05	ug/g						
trans-1,2-Dichloroethylene	ND	0.05	ug/g						
1,2-Dichloropropane	ND	0.05	ug/g						
cis-1,3-Dichloropropylene	ND	0.05	ug/g						
trans-1,3-Dichloropropylene	ND	0.05	ug/g						
1,3-Dichloropropene, total	ND	0.05	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Ethylene dibromide (dibromoethane	ND	0.05	ug/g						
Hexane	ND	0.05	ug/g						
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g						
Methyl Isobutyl Ketone	ND	0.50	ug/g						
Methyl tert-butyl ether	ND	0.05	ug/g						
Methylene Chloride	ND	0.05	ug/g						
Styrene	ND	0.05	ug/g						
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g						
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g						
Tetrachloroethylene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
1,1,1-Trichloroethane	ND	0.05	ug/g						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,2-Trichloroethane	ND	0.05	ug/g						
Trichloroethylene	ND	0.05	ug/g						
Trichlorofluoromethane	ND	0.05	ug/g						
Vinyl chloride	ND	0.02	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: 4-Bromofluorobenzene	*3.50*		*ug/g*		*110*	*50-140*			
Surrogate: Dibromofluoromethane	*2.76*		*ug/g*		*86.3*	*50-140*			
Surrogate: Toluene-d8	*3.23*		*ug/g*		*101*	*50-140*			
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	*3.23*		*ug/g*		*101*	*50-140*			

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	
Physical Characteristics									
% Solids	75.5	0.1	% by Wt.	74.0			1.9	25	
Volatiles									
Acetone	ND	0.50	ug/g dry	ND				50	
Benzene	ND	0.02	ug/g dry	ND				50	
Bromodichloromethane	ND	0.05	ug/g dry	ND				50	
Bromoform	ND	0.05	ug/g dry	ND				50	
Bromomethane	ND	0.05	ug/g dry	ND				50	
Carbon Tetrachloride	ND	0.05	ug/g dry	ND				50	
Chlorobenzene	ND	0.05	ug/g dry	ND				50	
Chloroform	ND	0.05	ug/g dry	ND				50	
Dibromochloromethane	ND	0.05	ug/g dry	ND				50	
Dichlorodifluoromethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,3-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,4-Dichlorobenzene	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,2-Dichloroethane	ND	0.05	ug/g dry	ND				50	
1,1-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
cis-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
trans-1,2-Dichloroethylene	ND	0.05	ug/g dry	ND				50	
1,2-Dichloropropane	ND	0.05	ug/g dry	ND				50	
cis-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
trans-1,3-Dichloropropylene	ND	0.05	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Ethylene dibromide (dibromoethane	ND	0.05	ug/g dry	ND				50	
Hexane	ND	0.05	ug/g dry	ND				50	
Methyl Ethyl Ketone (2-Butanone)	ND	0.50	ug/g dry	ND				50	
Methyl Isobutyl Ketone	ND	0.50	ug/g dry	ND				50	
Methyl tert-butyl ether	ND	0.05	ug/g dry	ND				50	
Methylene Chloride	ND	0.05	ug/g dry	ND				50	
Styrene	ND	0.05	ug/g dry	ND				50	
1,1,1,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2,2-Tetrachloroethane	ND	0.05	ug/g dry	ND				50	
Tetrachloroethylene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
1,1,1-Trichloroethane	ND	0.05	ug/g dry	ND				50	
1,1,2-Trichloroethane	ND	0.05	ug/g dry	ND				50	
Trichloroethylene	ND	0.05	ug/g dry	ND				50	
Trichlorofluoromethane	ND	0.05	ug/g dry	ND				50	
Vinyl chloride	ND	0.02	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	
Surrogate: 4-Bromofluorobenzene	*2.06*		*ug/g dry*		*102*	*50-140*			
Surrogate: Dibromofluoromethane	*2.27*		*ug/g dry*		*112*	*50-140*			
Surrogate: Toluene-d8	*2.17*		*ug/g dry*		*107*	*50-140*			
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	
Surrogate: Toluene-d8	*2.17*		*ug/g dry*		*107*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	197	7	ug/g		98.5	80-120			
F2 PHCs (C10-C16)	85	4	ug/g		93.9	80-120			
F3 PHCs (C16-C34)	186	8	ug/g		99.9	80-120			
F4 PHCs (C34-C50)	147	6	ug/g		119	80-120			
Metals									
Antimony	216		ug/L		86.4	70-130			
Arsenic	214		ug/L		85.4	70-130			
Barium	227		ug/L		90.7	70-130			
Beryllium	215		ug/L		86.2	70-130			
Boron	222		ug/L		88.7	70-130			
Cadmium	212		ug/L		84.6	70-130			
Chromium	216		ug/L		86.2	70-130			
Cobalt	217		ug/L		86.7	70-130			
Copper	222		ug/L		88.9	70-130			
Lead	214		ug/L		85.5	70-130			
Molybdenum	208		ug/L		83.2	70-130			
Nickel	213		ug/L		85.2	70-130			
Selenium	228		ug/L		91.3	70-130			
Silver	237		ug/L		94.9	70-130			
Thallium	215		ug/L		86.2	70-130			
Uranium	224		ug/L		89.6	70-130			
Vanadium	227		ug/L		90.7	70-130			
Zinc	203		ug/L		81.3	70-130			
Volatiles									
Acetone	9.16	0.50	ug/g		91.6	50-140			
Benzene	2.95	0.02	ug/g		73.7	60-130			
Bromodichloromethane	3.41	0.05	ug/g		85.3	60-130			
Bromoform	5.16	0.05	ug/g		129	60-130			
Bromomethane	3.43	0.05	ug/g		85.7	50-140			
Carbon Tetrachloride	3.22	0.05	ug/g		80.4	60-130			
Chlorobenzene	3.70	0.05	ug/g		92.6	60-130			
Chloroform	2.80	0.05	ug/g		69.9	60-130			
Dibromochloromethane	5.05	0.05	ug/g		126	60-130			
Dichlorodifluoromethane	2.64	0.05	ug/g		66.1	50-140			
1,2-Dichlorobenzene	3.91	0.05	ug/g		97.7	60-130			
1,3-Dichlorobenzene	3.93	0.05	ug/g		98.3	60-130			
1,4-Dichlorobenzene	3.81	0.05	ug/g		95.4	60-130			
1,1-Dichloroethane	2.64	0.05	ug/g		66.1	60-130			
1,2-Dichloroethane	2.75	0.05	ug/g		68.7	60-130			
1,1-Dichloroethylene	2.91	0.05	ug/g		72.8	60-130			
cis-1,2-Dichloroethylene	2.62	0.05	ug/g		65.5	60-130			
trans-1,2-Dichloroethylene	2.62	0.05	ug/g		65.5	60-130			
1,2-Dichloropropane	2.87	0.05	ug/g		71.6	60-130			
cis-1,3-Dichloropropylene	4.31	0.05	ug/g		108	60-130			
trans-1,3-Dichloropropylene	4.97	0.05	ug/g		124	60-130			
Ethylbenzene	4.11	0.05	ug/g		103	60-130			
Ethylene dibromide (dibromoethane	3.80	0.05	ug/g		94.9	60-130			
Hexane	3.20	0.05	ug/g		80.0	60-130			
Methyl Ethyl Ketone (2-Butanone)	6.50	0.50	ug/g		65.0	50-140			
Methyl Isobutyl Ketone	7.65	0.50	ug/g		76.5	50-140			
Methyl tert-butyl ether	7.22	0.05	ug/g		72.2	50-140			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Methylene Chloride	2.70	0.05	ug/g		67.6	60-130			
Styrene	4.17	0.05	ug/g		104	60-130			
1,1,1,2-Tetrachloroethane	4.62	0.05	ug/g		116	60-130			
1,1,2,2-Tetrachloroethane	4.67	0.05	ug/g		117	60-130			
Tetrachloroethylene	3.59	0.05	ug/g		89.9	60-130			
Toluene	3.66	0.05	ug/g		91.4	60-130			
1,1,1-Trichloroethane	3.08	0.05	ug/g		77.1	60-130			
1,1,2-Trichloroethane	2.93	0.05	ug/g		73.3	60-130			
Trichloroethylene	2.76	0.05	ug/g		69.0	60-130			
Trichlorofluoromethane	3.41	0.05	ug/g		85.2	50-140			
Vinyl chloride	2.56	0.02	ug/g		64.0	50-140			
m,p-Xylenes	8.14	0.05	ug/g		102	60-130			
o-Xylene	4.15	0.05	ug/g		104	60-130			
Surrogate: 4-Bromofluorobenzene	*2.41*		*ug/g*		*75.3*	*50-140*			
Benzene	2.95	0.02	ug/g		73.7	60-130			
Ethylbenzene	4.11	0.05	ug/g		103	60-130			
Toluene	3.66	0.05	ug/g		91.4	60-130			
m,p-Xylenes	8.14	0.05	ug/g		102	60-130			
o-Xylene	4.15	0.05	ug/g		104	60-130			

Qualifier Notes:

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.

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.

Paracel ID: 1735292

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Chain of Custody
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№ 37572

Page 1 of 1

Client Name: Exp Services Inc.	Project Reference: OTT-00240343-B0	**Turnaround Time:**
Contact Name: Mark Devlin / Shawn Doherty	Quote #	☐ 1 Day ☐ 3 Day
Address: 100 - 2650 Queensview Drive. Ottawa, ON	PO #	☐ 2 Day ☒ Regular
Telephone: (613) 688 1891	Email Address:	Date Required:

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 3 ☐ 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)

	Paracel Order Number: 1735292 / Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	Required Analyses: Metals (ICP)	PHC/BTEX	VOC	Grain Size (Texture)	
1	MW1-S5	S		2	Aug 29, 2017	12:00	X				- 2x 120mL -
2	MW4-S6			2			X				↓
3	MW1-S8			2				X			- 120mL + 1 vial
4	MW1-S9			3					X	X	120mL + ZIPLOCK BAG + 1 vial
5	MW2-S4			2			X				- 2x 250mL -
6	MW2-S7			2				X			- 125mL + 1 vial
7	MW3-S5			2	↓	↓		X			↓
8											
9											
10											

Comments:

Method of Delivery: Walk in.

Relinquished By (Sign): Mark Devlin	Received by Driver/Depot:	Received at Lab: [signature]	Verified By: Rachel Subject
Relinquished By (Print): Mark Devlin	Date/Time:	Date/Time: Aug 30, 17 10:[illegible]	Date/Time: Aug 30/17.
Date/Time: Aug 30, 2017	Temperature: °C	Temperature: 9.3 °C	pH Verified ☒ By: NA 12:03

Chain of Custody (Blank) - Rev 0.4 Feb 2016

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Certificate of Analysis

exp Services Inc. (Ottawa)

100-2650 Queensview Dr.
Ottawa, ON K2B 8K2
Attn: Mark Devlin

Client PO:
Project: OTT00240343BO
Custody: 37572

Report Date: 15-Sep-2017
Order Date: 13-Sep-2017

Order #: 1737297

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

Paracel ID	Client ID
1737297-01	MW1-S9

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 15-Sep-2017
Order Date: 13-Sep-2017
Project Description: OTT00240343BO

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	14-Sep-17	14-Sep-17

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'.

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 15-Sep-2017
Order Date: 13-Sep-2017
Project Description: OTT00240343BO

Sample Results

pH

Matrix: Soil
Sample Date: 29-Aug-17

Paracel ID	Client ID	Units	MDL	Result
1737297-01	MW1-S9	pH Units	0.05	7.97

Laboratory Internal QA/QC

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Matrix Blank									
Matrix Duplicate									
pH	**7.28**	**0.05**	**pH Units**	**7.29** ND			**0.1**	**10**	

Revised sept. 13/17. - RS.

Paracel ID: 1737297

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e: paracel@paracellabs.com

Chain of Custody
(Lab Use Only)
№ 37572

Page 1 of 1

Client Name: Exp Services Inc.	Project Reference: OTT-00240343-B0
Contact Name: Mark Devlin / Shawn Doherty	Quote #
Address: 100 - 2650 Queensview Drive. Ottawa, ON	PO #
Telephone: (613) 688 1891	Email Address:

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☒ Regular
Date Required: _____

Criteria: O. Reg. 153/04 (As Amended) Table 3 ☐ 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

Paracel Order Number: 1737297. ~~1735292~~

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Metals (ICP)	PHC/BTEX	VOC	Grain Size (Texture)	pH						
1	MW1-S5	S		2	Aug 29, 2017	12:00	X					- 2x 120ml -					✓
2	MW4-S6	↓		2	↓	↓	X					↓					✓
3	MW1-S8			2				X				- 120ml + 1 vial +					✓
4	MW1-S9			3					X	X	(X)	120ml + 2 Plastic Bags + 1 vial					✓
5	MW2-S4			2			X					2x 250ml -					✓
6	MW2-S7			2				X				- 120ml + 1 vial +					✓
7	MW3-S5	↓		2	↓	↓		X				↓					✓
8																	
9																	
10																	

Comments:

Method of Delivery: Walkin.

Relinquished By (Sign): Mark Devlin	Received by Driver/Depot:	Received at Lab:	Verified By: Rachel Subject
Relinquished By (Print): Mark Devlin	Date/Time:	Date/Time: Aug 30, 17 10:—	Date/Time: Aug 30/17
Date/Time: Aug 30, 2017	Temperature: ___ °C	Temperature: 9.3 °C	pH Verified ☒ By: NA 12:03

Chain of Custody (Blank) - Rev 0.4 Feb 2016

Rachel Subject
Sep 13/17
11:08

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Certificate of Analysis

exp Services Inc. (Ottawa)

100-2650 Queensview Dr.
Ottawa, ON K2B 8K2
Attn: Mark Devlin

Client PO:
Project: OTT00240343B0
Custody: 23202

Report Date: 11-Sep-2017
Order Date: 5-Sep-2017

Order #: 1736139

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

Paracel ID	Client ID
1736139-01	MW1
1736139-02	MW2
1736139-03	MW3
1736139-04	MW4

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 11-Sep-2017
Order Date: 5-Sep-2017
Project Description: OTT00240343B0

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	7-Sep-17	7-Sep-17
Metals, ICP-MS	EPA 200.8 - ICP-MS	6-Sep-17	6-Sep-17
PHC F1	CWS Tier 1 - P&T GC-FID	6-Sep-17	7-Sep-17
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	6-Sep-17	6-Sep-17
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	6-Sep-17	7-Sep-17

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 11-Sep-2017
Order Date: 5-Sep-2017
Project Description: OTT00240343B0

	Client ID:	MW1	MW2	MW3	MW4
	Sample Date:	05-Sep-17	05-Sep-17	05-Sep-17	05-Sep-17
	Sample ID:	1736139-01	1736139-02	1736139-03	1736139-04
	MDL/Units	Water	Water	Water	Water
Metals					
Antimony	0.5 ug/L	-	<0.5	-	<0.5
Arsenic	1 ug/L	-	<1	-	<1
Barium	1 ug/L	-	156	-	156
Beryllium	0.5 ug/L	-	<0.5	-	<0.5
Boron	10 ug/L	-	60	-	60
Cadmium	0.1 ug/L	-	<0.1	-	<0.1
Chromium	1 ug/L	-	<1	-	<1
Cobalt	0.5 ug/L	-	<0.5	-	<0.5
Copper	0.5 ug/L	-	1.5	-	1.5
Lead	0.1 ug/L	-	<0.1	-	<0.1
Molybdenum	0.5 ug/L	-	2.1	-	2.2
Nickel	1 ug/L	-	1	-	1
Selenium	1 ug/L	-	<1	-	<1
Silver	0.1 ug/L	-	<0.1	-	<0.1
Sodium	200 ug/L	-	230000	-	228000
Thallium	0.1 ug/L	-	<0.1	-	<0.1
Uranium	0.1 ug/L	-	9.2	-	9.5
Vanadium	0.5 ug/L	-	<0.5	-	<0.5
Zinc	5 ug/L	-	7	-	7
Volatiles					
Acetone	5.0 ug/L	<5.0	-	-	-
Benzene	0.5 ug/L	<0.5	-	-	-
Bromodichloromethane	0.5 ug/L	<0.5	-	-	-
Bromoform	0.5 ug/L	<0.5	-	-	-
Bromomethane	0.5 ug/L	<0.5	-	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	-	-	-
Chlorobenzene	0.5 ug/L	<0.5	-	-	-
Chloroform	0.5 ug/L	<0.5	-	-	-
Dibromochloromethane	0.5 ug/L	<0.5	-	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	-	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	-	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	-	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	-	-	-

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 11-Sep-2017
Order Date: 5-Sep-2017
Project Description: OTT00240343B0

	Client ID:	MW1	MW2	MW3	MW4
	Sample Date:	05-Sep-17	05-Sep-17	05-Sep-17	05-Sep-17
	Sample ID:	1736139-01	1736139-02	1736139-03	1736139-04
	MDL/Units	Water	Water	Water	Water
1,1-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	-	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	-	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	-	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	-	-	-
Ethylbenzene	0.5 ug/L	<0.5	-	-	-
Ethylene dibromide (dibromoethan	0.2 ug/L	<0.2	-	-	-
Hexane	1.0 ug/L	<1.0	-	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	-	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	-	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	-	-	-
Methylene Chloride	5.0 ug/L	<5.0	-	-	-
Styrene	0.5 ug/L	<0.5	-	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	-	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	-	-	-
Toluene	0.5 ug/L	<0.5	-	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	-	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	-	-	-
Trichloroethylene	0.5 ug/L	<0.5	-	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	-	-	-
Vinyl chloride	0.5 ug/L	<0.5	-	-	-
m,p-Xylenes	0.5 ug/L	<0.5	-	-	-
o-Xylene	0.5 ug/L	<0.5	-	-	-
Xylenes, total	0.5 ug/L	<0.5	-	-	-
4-Bromofluorobenzene	Surrogate	99.5%	-	-	-
Dibromofluoromethane	Surrogate	93.6%	-	-	-
Toluene-d8	Surrogate	85.3%	-	-	-
Benzene	0.5 ug/L	-	<0.5	<0.5	-
Ethylbenzene	0.5 ug/L	-	<0.5	<0.5	-
Toluene	0.5 ug/L	-	<0.5	<0.5	-
m,p-Xylenes	0.5 ug/L	-	<0.5	<0.5	-
o-Xylene	0.5 ug/L	-	<0.5	<0.5	-
Xylenes, total	0.5 ug/L	-	<0.5	<0.5	-
Toluene-d8	Surrogate	-	86.1%	87.2%	-

Certificate of Analysis
Client: exp Services Inc. (Ottawa)
Client PO:

Report Date: 11-Sep-2017
Order Date: 5-Sep-2017
Project Description: OTT00240343B0

	Client ID:	MW1	MW2	MW3	MW4
	Sample Date:	05-Sep-17	05-Sep-17	05-Sep-17	05-Sep-17
	Sample ID:	1736139-01	1736139-02	1736139-03	1736139-04
	MDL/Units	Water	Water	Water	Water
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	-
F2 PHCs (C10-C16)	100 ug/L	<446 [2]	<100	<100	-
F3 PHCs (C16-C34)	100 ug/L	<446 [2]	<100	<100	-
F4 PHCs (C34-C50)	100 ug/L	<446 [2]	<100	<100	-

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						
Metals									
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Lead	ND	0.1	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Thallium	ND	0.1	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						
Zinc	ND	5	ug/L						
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	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: 4-Bromofluorobenzene	*85.6*		*ug/L*		*107*	*50-140*			
Surrogate: Dibromofluoromethane	*74.6*		*ug/L*		*93.3*	*50-140*			
Surrogate: Toluene-d8	*71.9*		*ug/L*		*89.9*	*50-140*			
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	*71.9*		*ug/L*		*89.9*	*50-140*			

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	
Metals									
Antimony	0.80	0.5	ug/L	0.52			43.2	20	QR-01
Arsenic	4.4	1	ug/L	4.4			0.8	20	
Barium	95.2	1	ug/L	96.3			1.1	20	
Beryllium	ND	0.5	ug/L	ND			0.0	20	
Boron	105	10	ug/L	103			1.9	20	
Cadmium	ND	0.1	ug/L	ND			0.0	20	
Chromium	ND	1	ug/L	ND			0.0	20	
Cobalt	0.61	0.5	ug/L	0.59			4.2	20	
Copper	1.30	0.5	ug/L	1.28			1.4	20	
Lead	0.43	0.1	ug/L	0.40			6.9	20	
Molybdenum	57.2	0.5	ug/L	55.3			3.5	20	
Nickel	2.3	1	ug/L	2.2			3.5	20	
Selenium	ND	1	ug/L	ND			0.0	20	
Silver	ND	0.1	ug/L	ND			0.0	20	
Sodium	245000	200	ug/L	254000			3.6	20	
Thallium	ND	0.1	ug/L	ND			0.0	20	
Uranium	0.8	0.1	ug/L	0.8			3.5	20	
Vanadium	1.39	0.5	ug/L	1.37			1.8	20	
Zinc	ND	5	ug/L	ND			0.0	20	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Ethylene dibromide (dibromoethane	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*82.5*		*ug/L*		*103*	*50-140*			
Surrogate: Dibromofluoromethane	*77.6*		*ug/L*		*97.0*	*50-140*			
Surrogate: Toluene-d8	*70.2*		*ug/L*		*87.7*	*50-140*			
Benzene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: Toluene-d8	*70.2*		*ug/L*		*87.7*	*50-140*			

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)	1760	100	ug/L		97.6	60-140			
F3 PHCs (C16-C34)	3370	100	ug/L		90.7	60-140			
F4 PHCs (C34-C50)	2170	100	ug/L		87.7	60-140			
Metals									
Antimony	43.3		ug/L	0.52	85.6	80-120			
Arsenic	55.4		ug/L	4.4	102	80-120			
Barium	46.5		ug/L		93.0	80-120			
Beryllium	45.0		ug/L	ND	90.0	80-120			
Boron	144		ug/L	103	81.1	80-120			
Cadmium	44.4		ug/L	ND	88.8	80-120			
Chromium	47.2		ug/L	ND	93.8	80-120			
Cobalt	44.9		ug/L	0.59	88.7	80-120			
Copper	45.5		ug/L	1.28	88.4	80-120			
Lead	42.6		ug/L	0.40	84.5	80-120			
Molybdenum	99.8		ug/L	55.3	89.0	80-120			
Nickel	46.4		ug/L	2.2	88.3	80-120			
Selenium	50.3		ug/L	ND	99.4	80-120			
Silver	31.1		ug/L	ND	62.2	80-120			QM-07
Sodium	1030		ug/L		103	80-120			
Thallium	45.4		ug/L	ND	90.7	80-120			
Uranium	46.8		ug/L	0.8	92.0	80-120			
Vanadium	50.0		ug/L	1.37	97.2	80-120			
Zinc	51		ug/L	ND	92.5	80-120			
Volatiles									
Acetone	58.8	5.0	ug/L		58.8	50-140			
Benzene	38.7	0.5	ug/L		96.8	60-130			
Bromodichloromethane	48.9	0.5	ug/L		122	60-130			
Bromoform	50.6	0.5	ug/L		126	60-130			
Bromomethane	40.8	0.5	ug/L		102	50-140			
Carbon Tetrachloride	51.9	0.2	ug/L		130	60-130			
Chlorobenzene	38.7	0.5	ug/L		96.8	60-130			
Chloroform	41.5	0.5	ug/L		104	60-130			
Dibromochloromethane	50.7	0.5	ug/L		127	60-130			
Dichlorodifluoromethane	49.3	1.0	ug/L		123	50-140			
1,2-Dichlorobenzene	40.5	0.5	ug/L		101	60-130			
1,3-Dichlorobenzene	41.3	0.5	ug/L		103	60-130			
1,4-Dichlorobenzene	40.2	0.5	ug/L		100	60-130			
1,1-Dichloroethane	37.3	0.5	ug/L		93.3	60-130			
1,2-Dichloroethane	42.4	0.5	ug/L		106	60-130			
1,1-Dichloroethylene	43.5	0.5	ug/L		109	60-130			
cis-1,2-Dichloroethylene	40.0	0.5	ug/L		100	60-130			
trans-1,2-Dichloroethylene	43.3	0.5	ug/L		108	60-130			
1,2-Dichloropropane	39.2	0.5	ug/L		98.0	60-130			
cis-1,3-Dichloropropylene	50.0	0.5	ug/L		125	60-130			
trans-1,3-Dichloropropylene	49.6	0.5	ug/L		124	60-130			
Ethylbenzene	47.9	0.5	ug/L		120	60-130			
Ethylene dibromide (dibromoethane	38.9	0.2	ug/L		97.2	60-130			
Hexane	33.0	1.0	ug/L		82.5	60-130			
Methyl Ethyl Ketone (2-Butanone)	80.8	5.0	ug/L		80.8	50-140			
Methyl Isobutyl Ketone	107	5.0	ug/L		107	50-140			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Methyl tert-butyl ether	96.0	2.0	ug/L		96.0	50-140			
Methylene Chloride	29.1	5.0	ug/L		72.8	60-130			
Styrene	50.7	0.5	ug/L		127	60-130			
1,1,1,2-Tetrachloroethane	47.6	0.5	ug/L		119	60-130			
1,1,2,2-Tetrachloroethane	36.8	0.5	ug/L		92.0	60-130			
Tetrachloroethylene	40.7	0.5	ug/L		102	60-130			
Toluene	40.4	0.5	ug/L		101	60-130			
1,1,1-Trichloroethane	50.5	0.5	ug/L		126	60-130			
1,1,2-Trichloroethane	42.4	0.5	ug/L		106	60-130			
Trichloroethylene	46.3	0.5	ug/L		116	60-130			
Trichlorofluoromethane	50.5	1.0	ug/L		126	60-130			
Vinyl chloride	51.5	0.5	ug/L		129	50-140			
m,p-Xylenes	96.0	0.5	ug/L		120	60-130			
o-Xylene	47.5	0.5	ug/L		119	60-130			
Surrogate: 4-Bromofluorobenzene	*82.3*		*ug/L*		*103*	*50-140*			
Benzene	38.7	0.5	ug/L		96.8	60-130			
Ethylbenzene	47.9	0.5	ug/L		120	60-130			
Toluene	40.4	0.5	ug/L		101	60-130			
m,p-Xylenes	96.0	0.5	ug/L		120	60-130			
o-Xylene	47.5	0.5	ug/L		119	60-130			

Qualifier Notes:

Sample Qualifiers :

2 : Elevated Reporting Limits due to limited sample volume.

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

QR-01 : Duplicate RPD is high, however, the sample result is less than 10x the MDL.

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.

PARACEL LABORATORIES LTD. | TRUSTE RESPON RELIABL

Paracel ID: 1736139

Chain of Custody
(Lab Use Only)
№ 23202

Page 1 of 1

Client Name: exp Services Inc.	Project Reference: OTT-00240343-B0	TAT: [X] Regular [ ] 3 Day
Contact Name: Mark Devlin / Shawn Doherty	Quote #	[ ] 2 Day [ ] 1 Day
Address: 100-2650 Queensview Dr, Ottawa, ON	PO #	Date Required:
Telephone: 613 688 1899	Email Address:	

Criteria: [X] O. Reg. 153/04 (As Amended) Table 3 [ ] 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)

Paracel Order Number: 1736139

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	VOC	PHC/BTEX	metals ICP	Hold								
1	MW1	GW		3	Sept 5, 2017	10:30am	X	X				PHC bottle low volume only KW						
2	MW2	↓		4	↓	11:30am		X	X									
3	MW3			3		12:30pm		X										
4	MW4			4		1:30pm			X									
5	MW4			3				X		X								
6																		
7																		
8																		
9																		
10																		

Comments: Please hold PHC/BTEX for MW4 Sample. Run for metals. MW1 is limited in volume Run for PHC/BTEX if required. Note: Sediment may be present in MW2 & MW3, decant if necessary & proceed.

Method of Delivery: Walkin

Relinquished By (Sign):	Received by Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Mark Devlin	Date/Time:	Date/Time: Sept 5/17	Date/Time: 09/05/17 4:13pm
Date/Time: Sept 5, 2017 / 4:00pm	Temperature: ____ °C	Temperature: 17.9 °C 3:58p	pH Verified [ ] By: KW