Geotechnical Engineering

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Phase II Environmental Site Assessment

250 Besserer Street
Ottawa, Ontario

Prepared For

Reichmann International

April 10, 2019

Report: PE4550-3

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 250 Besserer Street, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address two (2) potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in two (2) areas of potential environmental concern (APECs) on the Phase II Property. The subsurface investigation consisted of the placement of three (3) boreholes, all of which were constructed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations. Four (4) soil samples were submitted for laboratory analysis of metals, benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons (PHCs, F1-F4), and polycyclic aromatic compounds (PAHs). No parameters were detected in excess of the MECP Table 1 or 3 Standards. The soil results are in compliance with the applicable MECP standards.

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were recovered and analyzed for BTEX, PHCs (F1-F4), and PAHs. No detectable parameter concentrations were identified in any of the samples. The groundwater results are therefore in compliance with the MECP Standards.

Recommendations

Monitoring Wells

If the monitoring wells installed on the subject site are not going to be used in the future, they should be abandoned according to Ontario Regulation 903. The wells will be registered with the MECP under this regulation.

1.0 INTRODUCTION

At the request of Mr. Kirk Mawhinney of Reichmann International, Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment of 250 Besserer Street, in the City of Ottawa, Ontario. The purpose of this Phase II ESA has been to address areas of potential environmental concern (APECs) identified on the Phase II Property, during the Phase I ESA conducted by Paterson.

1.1 Site Description

Address:	250 Besserer Street, Ottawa, Ontario.
Legal Description:	Lot 12 and Part of Lot 13, South Besserer Street, Registered Plan 6, in the City of Ottawa Property Identification
Number(s):	04211-0035
Location:	The Phase I Property is located on the southeast corner of the intersection of Besserer Street and King Edward Avenue, in Ottawa, Ontario. The subject site is shown on Figure 1 - Key Plan following the body of this report.
Latitude and Longitude:	45° 25' 41" N, 75° 41' 5.6" W
Zoning:	R5B – Residential Fifth Density
Configuration:	Rectangular
Site Area:	913 m^2 (approximate)

1.2 Property Ownership

Paterson was retained to complete this Phase II ESA by Mr. Kirk Mawhinney of Reichmann International, the property owner. The property was owned by Lauzon Group at the time of the initial site visit. Reichmann International's office is located at 22 St. Clair Avenue East, Toronto, Ontario. Mr. Mawhinney can be reached by telephone at (416) 640-9652.

1.3 Current and Proposed Future Uses

The Phase II Property is currently occupied by a partially occupied two (2) storey commercial office building and a private garage structure used for flooring materials storage. The first floor of the main building is occupied by a commercial business, while the second floor and basement levels are vacant. The exterior surface is used for vehicular parking. It is our understanding that the Phase II Property will be redeveloped with a multi-unit residential building.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 3 of the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", prepared by the Ministry of the Environment, Conservation and Parks (MECP), April 2011. The selected MECP Table 3 Standards are based on the following considerations:

- ❒ Coarse-grained soil conditions
- ❒ Surface soil and groundwater conditions
- ❒ Non-potable groundwater conditions
- ❒ Residential land use

The residential standards were selected based on the future land use of the subject site. Coarse grained soil standards were chosen as a conservative approach. Grain size analysis was not completed.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is bound by King Edward Avenue to the west, Besserer Street to the north and residential dwellings to the east and south. The site is in a downtown urban setting. The ground surface onsite is asphaltic concrete. The site is below the grade of King Edward Avenue and the properties to the south. The land in the area of the property slopes down from the south to the north, and the subject site has been regraded to be relatively flat. The regional topography slopes downwards in a northerly direction towards the Rideau River, approximately 955 m away.

2.2 Past Investigations

Paterson completed a Phase I ESA, Designated Substances Survey, and geotechnical investigation for the subject site. Based on the findings of the Phase I ESA, two (2) Potentially Contaminating Activities (PCAs) resulting in Areas of Potential Environmental Concern (APECs) were identified: fill of unknown quality, and the former presence of aboveground fuel oil tanks on the site.

The PCAs that represented APECs on the Phase I and II Property as well as the Contaminants of Potential Concern (CPCs) are presented in Table 1.

Table 1: Areas of Potential Environmental Concern

Area of Potential Environmental Concern and location	Potentially Contaminating Activity, as per Table 2 of O.Reg 153/04, as amended	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 1: Fill Material located throughout the site	Item 30: "Importation of Fill Material of Unknown Quality"	On Site – southern portion and northeast quadrant of the site	PAHs, metals	Soil (metals) and groundwater (PAHs)
APEC 2: Former presence of two (2) aboveground fuel oil storage tanks	Item 28: "Gasoline and Associated Products Storage in Fixed Tanks"	On-site – southeast corner of main building basement, central portion of the site	PHCs, BTEX	Soil and groundwater

A Phase II ESA was recommended to address the aforementioned APECs.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation was conducted on February 11, 2019 in conjunction with a Geotechnical Investigation. Three (3) boreholes were drilled at the subject site. Boreholes were drilled into overburden soils to practical refusal to augering to depths of 9.5 to 9.75 m below ground surface (bgs). Groundwater monitoring wells were installed in all three (3) boreholes.

3.2 Media Investigated

During the subsurface investigation, soil samples and groundwater samples were obtained and submitted for laboratory analysis. The rationale for sampling and analyzing this media is based on the Contaminants of Potential Concern identified in the Phase I ESA and confirmation of existing groundwater conditions.

Contaminants of potential environmental concern for soil include metals, PAHs, BTEX, and PHCs. Contaminants of potential environmental concern for groundwater include PAHs, BTEX, and PHCs.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

The Geological Survey of Canada website on the Urban Geology of the National Capital Area was consulted as part of this assessment. Based on this information, bedrock in the area of the site consists interbedded limestone and shale of the Verulam Formation. Based on the maps, the thickness of overburden ranges from 5 to 10 m. Overburden reportedly consists of alluvial sediments.

Based on the findings of the Geotechnical investigation conducted by Paterson, overburden generally consists of sandy fill material (possibly native sand), underlain by silty clay with glacial till near the bedrock surface. Inferred bedrock depth was determined to be approximately 9.5 and 10.2 m below grade, in BH1 and BH3, respectively.

The regional topography slopes down in a northerly direction. The groundwater flow beneath the Phase I Property is inferred to be in a northerly direction.

Contaminants of Potential Concern

As per Section 7.1 of the Phase I ESA report, metals, PHCs, BTEX, and PAHs were identified as contaminants of potential concern (CPCs) on the subject site.

Existing Buildings and Structures

The Phase I Property is occupied by a two (2) storey office building with basement and a detached garage that were constructed circa 1954. The main building has always been used as office space, while the garage is currently used to store flooring materials.

Water Bodies

There are no water bodies on the Phase I Property or within the Phase I study area. The closest water body is the Rideau River, located approximately 955 m to the north.

Areas of Natural Significance

No areas of natural significance were identified on the Phase I Property or in the Phase I Study Area.

Drinking Water Wells

No drinking water wells are located on the Phase I Property or within the Phase I Study Area.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area is a combination of residential, commercial and institutional. Land use is shown on Drawing PE4550-2 - Surrounding Land Use Plan in the Phase I ESA report.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per Table 5 in Section 7.1, two (2) Potentially Contaminating Activities (PCAs) were identified on the Phase I Property that resulted in Areas of Potential Environmental Concern (APECs):

- Fill material of unknown quality on the Phase I Property
- Former aboveground fuel oil storage tanks in the basement of the building on the Phase I Property.

Additional historical PCAs were identified within the Phase I Study Area, however these activities were not considered to represent APECs on the Phase I Property based on their respective separation distances and/or orientations with respect to the Phase I Property.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of the Phase I ESA is considered to be sufficient to conclude that there are areas of potential environmental concern on the subject site resulting from current and historical uses of neighbouring properties. The presence of potentially contaminating activities was confirmed by a variety of independent sources. The conclusions of the report are not affected by uncertainty which may be present with respect to the individual sources.

3.4 Deviations from Sampling and Analysis Plan

The Sampling and Analysis Plan for this project is included in Appendix 1 of this report.

3.5 Impediments

No physical impediments were encountered during the Phase II ESA program, aside from utility locates.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation conducted for this Phase II ESA consisted of drilling three (3) boreholes that were completed as groundwater monitoring wells at the subject site. Boreholes were drilled through overburden soils to a maximum depth of 9.75 m bgs to intercept groundwater. This subsurface investigation was conducted in conjunction with a Geotechnical Investigation.

Three (3) boreholes were drilled and completed as monitoring wells to intercept the groundwater table for both geotechnical purposes and environmental groundwater monitoring. The boreholes were advanced using a truck-mounted auger drill rig operated by a two-person crew. Drilling occurred under full-time supervision of Paterson personnel. The borehole locations are indicated on the attached Drawing PE4550-3 – Test Hole Location Plan.

4.2 Soil Sampling

A total of thirty-nine (39) soil samples were obtained from the boreholes by means of split spoon sampling and grab sampling from auger flights. The depths at which auger and split spoon samples were obtained from the boreholes are shown as "**AU**" and "**SS**" on the Soil Profile and Test Data Sheets, appended to this report.

Site soils generally consist of crushed stone under the asphaltic concrete and silty sand (possibly native sand), underlain by silty clay and glacial till. Sandy fill material present beneath the pavement structure extended to depths ranging from 1.52 to 1.7 m. Silty clay/clayey sand was present beneath the fill extending to depths ranging from 8.5 to 8.7 m below the existing grade, followed by glacial till to 9.5 or 9.75 m, at the inferred bedrock surface.

4.3 Field Screening Measurements

No visual or olfactory indications of potential contamination were identified in the soil samples at the time of the field program.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the subject site as part of the subsurface investigation. Monitoring well construction details are listed

below in Table 2 and are also presented on the Soil Profile and Test Data Sheets provided in Appendix 1.

Boreholes were surveyed using a benchmark consisting of the top concrete step of the subject building, at the Besserer Street entrance, as presented in Drawing PE4550-3, with a geodetic elevation of 62.37 m above sea level (m ASL).

Table 2: Monitoring Well Construction Details

Well ID	Ground Surface Elevation	Total Depth (m BGS)	Screened Interval (m BGS)	Sand Pack (m BGS)	Bentonite Seal (m BGS)	Casing Type
BH1	63.21	9.50	6.50-9.50	5.80-9.50	0-5.80	Flushmount
BH2	63.02	6.10	3.10-6.10	2.70-6.10	0-2.70	Flushmount
BH3	62.66	6.70	3.70-6.70	3.40-6.70	0-3.40	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater sampling was conducted at BH1, BH2 and BH3 on February 27, March 27, and March 28, 2019. Water levels were measured on March 27 and 28. No other field parameters were measured.

4.6 Groundwater Sampling

Groundwater sampling protocols were followed using the MECP document entitled “Guidance on Sampling and Analytical Methods for Use at Contaminated Sites in Ontario”, dated May 1996. Groundwater samples were obtained from each well, using dedicated sampling equipment. Standing water was purged from each well prior to sampling. Samples were stored in coolers to reduce analyte volatilization during transportation. Details of our standard operating procedure for groundwater sampling are provided in the Sampling and Analysis Plan in Appendix 1.

4.7 Analytical Testing

Based on the guidelines outlined in the Sampling and Analysis Plan appended to this report, the following soil and groundwater samples as well as analyzed parameters are presented in Tables 3 and 4.

Table 3: Soil Samples Submitted and Analyzed Parameters						
Sample ID	Screened Depth/ Stratigraphic Unit	Parameters Analyzed				Rationale
		Metals	BTEX	PAHs	PHCs (F1-F4)	
February 11, 2019						
BH1-SS2	0.75-1.25 m, fill	X		X		Assess the quality of the soil/fill at the subject site.
BH2-SS2	0.75-1.25 m, fill	X		X		Assess the quality of the soil/fill at the subject site.
BH2-SS6	3.75-4.25 m, Silty clay		X		X	Assess the quality of the soil in the vicinity of the former fuel oil tanks.
BH3-SS2	0.75-1.25 m, fill	X				Assess the quality of the soil/fill at the subject site.

Table 4: Groundwater Samples Submitted and Analyzed Parameters						
Sample ID	Sample Depth / Stratigraphic Unit	Parameters Analyzed				Rationale
		Metals	BTEX	PAHs	PHCs (F1-F4)	
February 27, 2019						
BH1-GW1	6.5-9.50 m, silty clay/till		X		X	Assess the quality of the groundwater at the subject site.
BH2-GW1	3.1-6.10 m, silty clay		X		X	
March 27, 2019						
BH1-GW2	6.5-9.50 m, silty clay/till			X		Assess the quality of the groundwater at the subject site.
BH3-GW1	3.5-9.5 m, silty clay/till		X		X	
March 28, 2019						
BH3-GW1	3.7-6.7 m, silty clay			X		Assess the quality of the groundwater at the subject site.

Paracel Laboratories (Paracel), of Ottawa, Ontario, performed the laboratory analysis on the samples submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Laboratory Accreditation (SCC/CALA). Paracel is accredited and certified by SCC/CALA for specific tests registered with the association.

4.8 Residue Management

All soil cuttings, purge water and fluids from equipment cleaning were retained on-site.

4.9 Elevation Surveying

An elevation survey of all borehole locations was completed by Paterson at the time of the subsurface investigation. Elevations were surveyed relative to a geodetic benchmark (top of the step at the entrance to building off Besserer Street). The elevation of the benchmark was 62.37 metres above sea level (m ASL). The location of the site benchmark is shown on Drawing PE4550-3 – Test Hole Location Plan.

4.10 Quality Assurance and Quality Control Measures

A summary of quality assurance and quality control (QA/QC) measures, including sampling containers, preservation, labelling, handling, and custody, equipment cleaning procedures, and field quality control measurements is provided in the Sampling and Analysis Plan in Appendix 1.

5.0 REVIEW AND EVALUATION

5.1 Geology

Site soils consist of an asphaltic concrete pavement layer, underlain by crushed stone (engineered fill), overlying a layer of silty clay, followed by glacial till and inferred bedrock.

Groundwater was encountered within the overburden at depths ranging from approximately 2.3 to 4.6 m BGS.

Site geology details are provided in the Soil Profile and Test Data Sheets provided in Appendix 1.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling events on March 27 and 28, 2019 using an electronic water level meter. Groundwater levels are summarized below in Table 5.

Table 5: Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH1	63.21	4.60	58.61	March 27, 2019
BH2	63.02	2.34	60.68	March 28, 2019
BH3	62.66	2.60	60.06	March 28, 2019

Based on the groundwater elevations measured during the March 2019 sampling events, groundwater contour mapping was completed. Groundwater contours are shown on Drawing PE4550-3. Based on the contour mapping, groundwater flow at the subject site appears to be in a southeasterly direction. A horizontal hydraulic gradient of approximately 0.5 m/m was calculated.

5.3 Fine-Coarse Soil Texture

No grain size analysis was completed for the subject site. Coarse grained standards were chosen as a conservative approach.

5.4 Soil: Field Screening

Field screening of the soil samples collected during drilling resulted in a zero-vapour reading. No obvious visual or olfactory indications of potential environmental concerns were identified in the soil samples. The field screening results of each individual soil sample are provided on the Soil Profile and Test Data Sheets appended to this report.

5.5 Soil Quality

Three (3) soil samples were submitted for metals analysis. The results of the analytical testing are presented below in Table 6. The laboratory certificate of analysis is provided in Appendix 1.

Table 6: Analytical Test Results - Soil – Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MECP Table 3 Residential Standards (µg/g)
		February 11, 2019			
		BH1-SS2	BH2-SS2	BH3-SS2	
Antimony	1.0	nd	nd	nd	7.5
Arsenic	1.0	1.1	1.1	1.5	18
Barium	1.0	32.7	10.7	35.4	390
Beryllium	0.5	nd	nd	nd	4
Boron	5.0	nd	nd	nd	120
Cadmium	0.5	nd	nd	nd	1.2
Chromium	5.0	19.2	12.1	12.4	160
Chromium (VI)	0.2	nd	nd	nd	8
Cobalt	1.0	3.7	2.8	1.8	22
Copper	5.0	9.8	nd	nd	140
Lead	1.0	1.9	2.0	18.9	120
Mercury	0.1	nd	nd	nd	0.27
Molybdenum	1.0	nd	nd	nd	6.9
Nickel	5.0	11.7	7.3	nd	100
Selenium	1.0	nd	nd	nd	2.4
Silver	0.3	nd	nd	nd	20
Thallium	1.0	nd	nd	nd	1
Uranium	1.0	nd	nd	nd	23
Vanadium	10.0	20.7	18.2	21.4	86
Zinc	20.0	nd	nd	22.2	340

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards
- NA – Parameter not tested

Several metal parameters were detected in the soil samples; however, the concentrations were below the allowable limits. All parameter concentrations are in compliance of the selected MECP standards.

One (1) soil sample was submitted for analysis of BTEX parameters. The results of the analytical testing are presented below in Table 7. The laboratory certificate of analysis is provided in Appendix 1.

Table 7: Analytical Test Results - Soil – BTEX

Parameter	MDL (µg/g)	Soil Sample (µg/g)	MECP Table 3 Residential Standards (µg/g)
		February 11, 2019	
		BH2-SS6	
Benzene	0.02	nd	0.21
Toluene	0.05	nd	2
Ethylbenzene	0.05	nd	2.3
Xylenes, total	0.05	nd	3.1

No detectable concentrations of BTEX parameters were identified in the sample analysed. The soil sample is in compliance with the MECP Table 3 Standards.

One (1) soil sample was submitted for analysis of PHC (F1-F4) parameters. The results of the analytical testing are presented below in Table 8. The laboratory certificate of analysis is provided in Appendix 1.

Table 8: Analytical Test Results - Soil – PHCs (F1-F4)

Parameter	MDL (µg/g)	Soil Sample (µg/g)	MECP Table 3 Residential Standards (µg/g)
		February 11, 2019	
		BH2-SS6	
PHC (F1)	7	nd	55
PHC (F2)	4	nd	98
PHC (F3)	8	nd	300
PHC (F4)	6	nd	2800

No detectable concentrations of PHC parameters were identified in the sample analysed. The soil sample is in compliance with the MECP Table 3 Standards.

Two (2) soil samples were submitted for analysis of PAH parameters. The results of the analytical testing are presented below in Table 9. The laboratory certificate of analysis is provided in Appendix 1.

Table 9: Analytical Test Results - Soil – PAHs				
Parameter	MDL (µg/g)	Soil Samples (µg/g)		MECP Table 3 Residential Standards (µg/g)
		February 11, 2019		
		BH1-SS2	BH2-SS2	
Acenaphthene	0.02	nd	nd	7.9
Acenaphthylene	0.02	nd	nd	0.15
Anthracene	0.02	nd	nd	0.67
Benzo[a]anthracene	0.02	nd	nd	0.5
Benzo[a]pyrene	0.02	nd	nd	0.3
Benzo[b]fluoranthene	0.02	nd	nd	0.78
Benzo[g,h,i]perylene	0.02	nd	nd	6.6
Benzo[k]fluoranthene	0.02	nd	nd	0.78
Chrysene	0.02	nd	nd	7
Dibenzo[a,h]anthracene	0.02	nd	nd	0.1
Fluoranthene	0.02	nd	nd	0.69
Fluorene	0.02	nd	nd	62
Indeno[1,2,3-cd]pyrene	0.02	nd	nd	0.38
1-Methylnaphthalene	0.02	nd	nd	0.99
2-Methylnaphthalene	0.02	nd	nd	0.99
Methylnaphthalene (1&2)	0.04	nd	nd	0.99
Naphthalene	0.01	nd	nd	0.6
Phenanthrene	0.02	nd	nd	6.2
Pyrene	0.02	nd	nd	78

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds selected MECP Standards
- NA – Parameter not tested

No detectable concentrations of PAH parameters were identified in the samples analysed. The soil samples are in compliance with the MECP Table 3 Standards.

Analytical results for all parameters tested (metals, BTEX, PAHs, and PHCs) with respect to borehole locations are shown on Drawing PE4550-4 – Analytical Testing Plan – Soils.

The maximum concentrations of analyzed metals parameters in the soil at the site are summarized below in Table 10.

Table 10: Maximum Concentrations – Soil			
Parameter	Maximum Concentration (µg/g)	Borehole	Depth Interval (m BGS)
Arsenic	1.5	BH3-SS2	0.75-1.25 m, fill
Barium	35.4		
Chromium	19.2	BH1-SS2	0.75-1.25 m, fill
Cobalt	3.7		
Copper	9.8		
Lead	18.9	BH3-SS2	0.75-1.25 m, fill
Molybdenum	2.5	BH2-SS2	0.75-1.25 m, fill
Nickel	11.7	BH1-SS2	0.75-1.25 m, fill
Vanadium	21.4	BH3-SS2	0.75-1.25 m, fill
Zinc	22.2		

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were submitted for laboratory analysis of BTEX, PHC, and PAH parameters. The groundwater samples were obtained from the screened intervals noted in Table 2. The laboratory certificates of analysis are provided in Appendix 1.

No parameters were identified at detectable concentrations in the groundwater samples analyzed. Analytical results of groundwater sampled with respect to borehole locations are shown on Drawing PE4550-5 – Analytical Testing Plan – Groundwater.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the February and March 2019 sampling events were handled in accordance with the Analytical Protocol with respect to preservation method, storage requirement, and container type. Based on the field screening results and the non-detect soil results, the samples are considered to be representative of the soil quality.

As per Subsection 47(3) of O.Reg. 153/04, as amended, under the Environmental Protection Act, a Certificate of Analysis has been received for each sample submitted for analysis and all Certificates of Analysis are appended to this report.

Overall, the quality of the field data collected during this Phase II ESA is considered to be sufficient to meet the overall objectives of this assessment.

5.8 Phase II Conceptual Site Model

The following section has been prepared in accordance with the requirements of O.Reg. 269/11 amended by the Environmental Protection Act. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As indicated in the Phase I-ESA report and Section 2.2 of this report, the following PCAs, as per Table 2, O.Reg. 153/04, as amended, under the Environmental Protection Act, are considered to result in APECs on the Phase I and Phase II Property:

- Item 28: "Gasoline and Associated Products Storage in Fixed Tanks"
- Item 30: "Importation of Fill Material of Unknown Quality"

Off-site PCAs in the area are not considered to result in APECs, based on their location relative to the subject site.

Contaminants of Potential Concern

The CPCs for the Phase II Property include metals (soil only), PHCs, BTEX, and PAHs present in the fill material and groundwater.

Subsurface Structures and Utilities

The subject site is located in a municipally serviced area. The site is currently occupied by a commercial office building and a private garage. The property is municipally serviced with water, sewer, and natural gas utilities.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is provided in the Soil Profile and Test Data Sheets in Appendix 1 and depicted in Drawing PE4550-6 – Cross-Section A-A' - Soil. The stratigraphy of the subject site generally consists of:

- Paved asphalt/concrete, approximately 0.1 m below grade;
- Engineered fill material (crushed stone), extending to 0.61 m below grade;
- Fill material (possibly native sand), extending to depths ranging from approximately 1.52 to 1.7 m below grade;
- Silty clay/clayey silt extending to depths ranging from approximately 8.43 to 8.69 m below grade;
- Glacial till (grey silty sand and gravel with clay, cobbles and boulders), extending to depths ranging from 9.5 to 9.75 m below grade;
- Inferred bedrock encountered at 9.5 to 10.19 m below grade (practical refusal to augering and dynamic cone penetration test).

Hydrogeological Characteristics

Groundwater at the Phase II Property was encountered in the overburden.

Water levels were measured at the subject site on March 27 and 28, 2019, at depths ranging from 2.34 to 4.60 m BGS. Based on the groundwater elevations measured, a groundwater contour map was completed. Groundwater contours are shown on Drawing PE4550-3. Based on the contour mapping, groundwater flow at the subject site appears to be in a southeasterly direction. A horizontal hydraulic gradient of approximately 0.5 m/m was calculated. However, the water levels may not have stabilised at the time the groundwater level measurements were taken.

Approximate Depth to Bedrock

Bedrock is present at approximately 9.5 to 10.2 m below the existing grade, as determined by practical refusal to auguring and a dynamic cone penetration test at the subject site.

Approximate Depth to Water Table

Depth to water table at the subject site varies between approximately 2.20 to 4.37 m below the existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation does not apply to the subject site as there are no areas of natural significance or bodies of water located on the subject site or within 30 m of the subject site. The subject site is not considered to be environmentally sensitive.

Section 43.1 of the Regulation does not apply to the subject site as bedrock is located more than 2 m below ground surface and thus, not considered a Shallow Soil Property.

Fill Placement

Fill placement may have occurred at the subject site; the sandy material may also be native. The potential fill material consists of silty sand throughout the property. Analytical results indicate that the material is not impacted. Soil results are shown in Drawing PE4550-4 – Analytical Testing Plan – Soil.

Existing Buildings and Structures

The Phase I Property is occupied by a commercial two (2) storey office building that was constructed circa 1954. The building has been used as offices since its construction. A retaining wall (> 2 m) is present along the southern side of the property.

Proposed Buildings and Other Structures

It is our understanding that a multi-unit residential building is proposed for the site. The footprint of the development will cover the majority of the site.

Areas of Natural Significance and Water Bodies

No areas of natural significance or water bodies are present on or within the vicinity of the Phase II Property. The closest water body is the Rideau River, located approximately 955 m to the north/northeast.

Environmental Condition

Areas Where Contaminants are Present

There are no areas where contaminants are present on the Phase II Property. Analytical test results for soil and groundwater are shown on Drawings PE4550-4 and PE4550-5 – Analytical Testing Plan, respectively.

Types of Contaminants

Based on the analytical testing conducted, there are no contaminants of concern in the soil or groundwater.

Contaminated Media

Based on the results of the Phase II ESA, the soil/fill material and groundwater on the subject site are not impacted.

What Is Known About Areas Where Contaminants Are Present

Analytical test results did not identify any parameters in excess of the MECP Table 3 Standards.

Distribution and Migration of Contaminants

As previously noted, impacted soil and groundwater were not identified on the subject site.

Discharge of Contaminants

No contaminants were identified on the subject property. No activities currently taking place on the subject site are expected to discharge contaminants.

Climatic and Meteorological Conditions

In general, climatic and meteorological conditions have the potential to affect contaminant distribution. Two (2) ways by which climatic and meteorological conditions may affect contaminant distribution include the downward leaching of contaminants by means of the infiltration of precipitation, and the migration of contaminants via groundwater levels and/or flow, which may fluctuate seasonally.

Leaching and infiltration are not concerns on the Phase II Property since contaminants were not identified above the MECP Table 3 standards.

Potential for Vapour Intrusion

Based on the soil and groundwater results, vapour intrusion is not considered to be a concern at the Phase II-ESA Property.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 250 Besserer Street, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address two (2) potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in two (2) areas of potential environmental concern (APECs) on the Phase II Property. The subsurface investigation consisted of the placement of three (3) boreholes, all of which were constructed with groundwater monitoring wells.

Soil samples were obtained from the boreholes and screened using visual observations. Four (4) soil samples were submitted for laboratory analysis of metals, benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons (PHCs, F1-F4), and polycyclic aromatic compounds (PAHs). No parameters were detected in excess of the MECP Table 1 or 3 Standards. The soil results are in compliance with the applicable MECP standards.

Groundwater samples from monitoring wells installed in BH1, BH2 and BH3 were recovered and analyzed for BTEX, PHCs (F1-F4), and PAHs. No detectable parameter concentrations were identified in any of the samples. The groundwater results are therefore in compliance with the MECP Standards.

Recommendations

Monitoring Wells

If the monitoring wells installed on the subject site are not going to be used in the future, they should be abandoned according to Ontario Regulation 903. The wells will be registered with the MECP under this regulation.

7.0 STATEMENT OF LIMITATIONS

This Phase II - Environmental Site Assessment report has been prepared in general accordance with O.Reg. 153/04, as amended, and meets the requirements of CSA Z769-00. The conclusions presented herein are based on information gathered from a limited sampling and testing program. The test results represent conditions at specific test locations at the time of the field program.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes themselves.

Should any conditions be encountered at the subject site and/or historical information that differ from our findings, we request that we be notified immediately in order to allow for a reassessment.

This report was prepared for the sole use of Reichmann International. Notification from Reichmann International and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Anna Graham, M.E.S.

Mark S. D'Arcy, P.Eng.

Report Distribution:

- Reichmann International
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

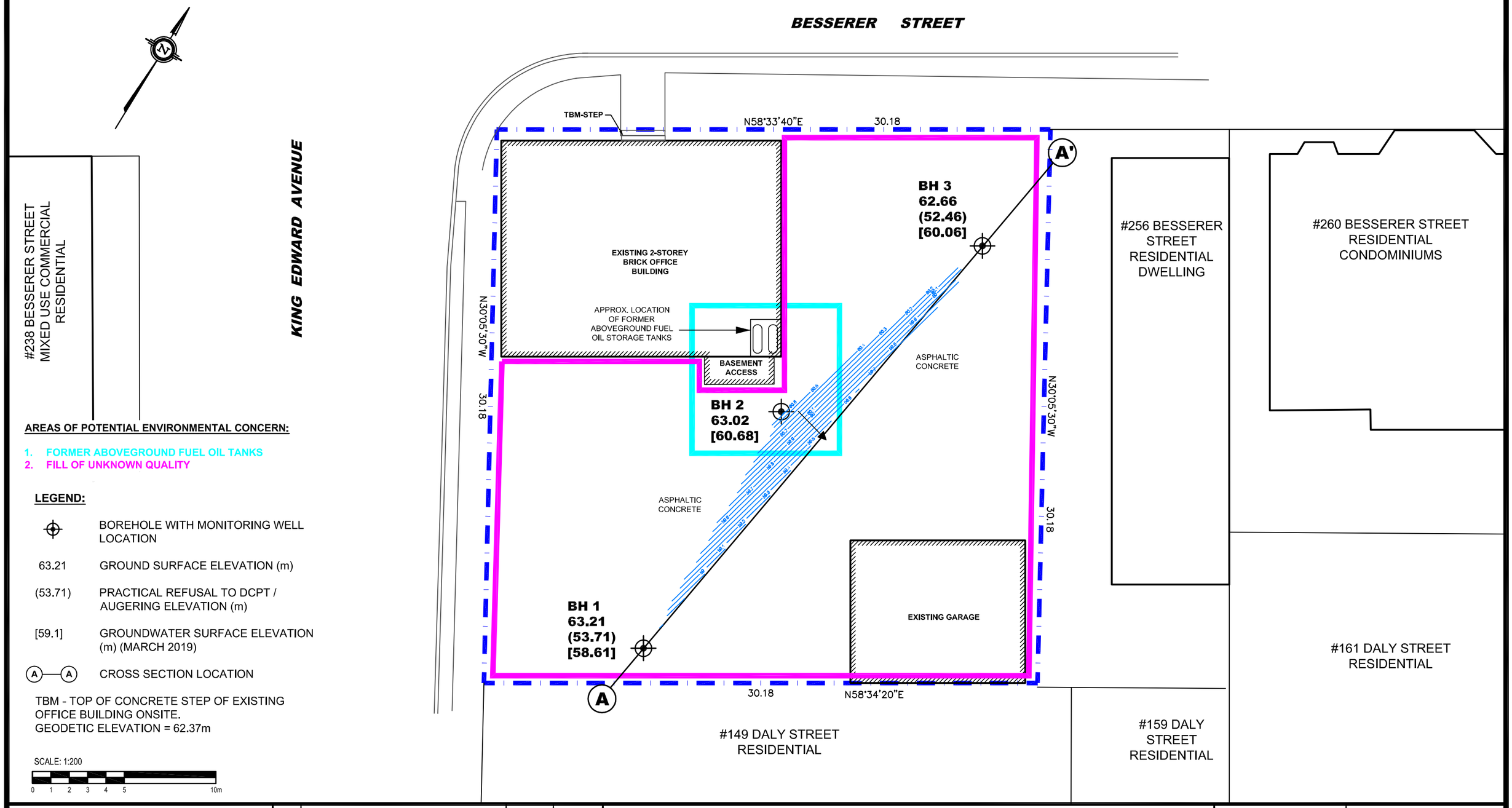
DRAWING PE4550-3 – TEST HOLE LOCATION PLAN

DRAWING PE4550-4 – ANALYTICAL TESTING PLAN – SOIL

DRAWING PE4550-5 – ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4550-6 – CROSS-SECTION A – A' – SOIL

DRAWING PE4550-7 – CROSS-SECTION A – A' – GROUNDWATER



AREAS OF POTENTIAL ENVIRONMENTAL CONCERN:

1. FORMER ABOVEGROUND FUEL OIL TANKS
2. FILL OF UNKNOWN QUALITY

LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
63.21	GROUND SURFACE ELEVATION (m)
(53.71)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)
[59.1]	GROUNDWATER SURFACE ELEVATION (m) (MARCH 2019)
A—A	CROSS SECTION LOCATION

TBM - TOP OF CONCRETE STEP OF EXISTING OFFICE BUILDING ONSITE.
GEODETIC ELEVATION = 62.37m

SCALE: 1:200

0 1 2 3 4 5 10m

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NO.	REVISIONS	DATE	INITIAL

REICHMANN INTERNATIONAL

PHASE II ENVIRONMENTAL SITE ASSESSMENT
250 BESSERER STREET
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:200	Date: 04/2019
Drawn by: AG	Report No.: PE4550-3
Checked by: MD	PE4550-3
Approved by: MD	Revision No.:

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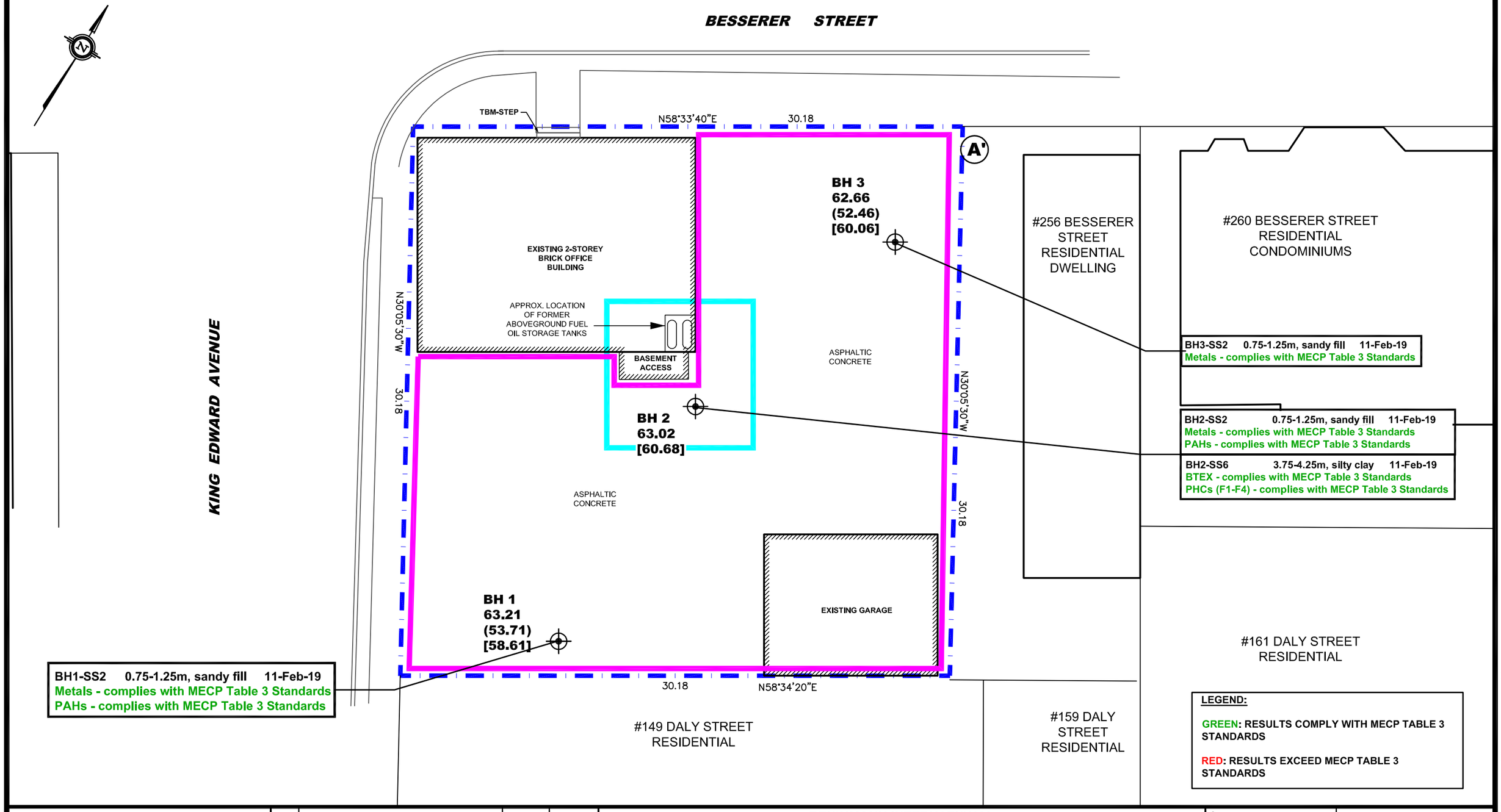

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NO.	REVISIONS	DATE	INITIAL

REICHMANN INTERNATIONAL

PHASE II ENVIRONMENTAL SITE ASSESSMENT
250 BESSERER STREET
OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL

Scale: 1:200	Date: 04/2019
Drawn by: RCG	Report No.: PE4550-3
Checked by: MD	**PE4550-4**
Approved by: MD	Revision No.:

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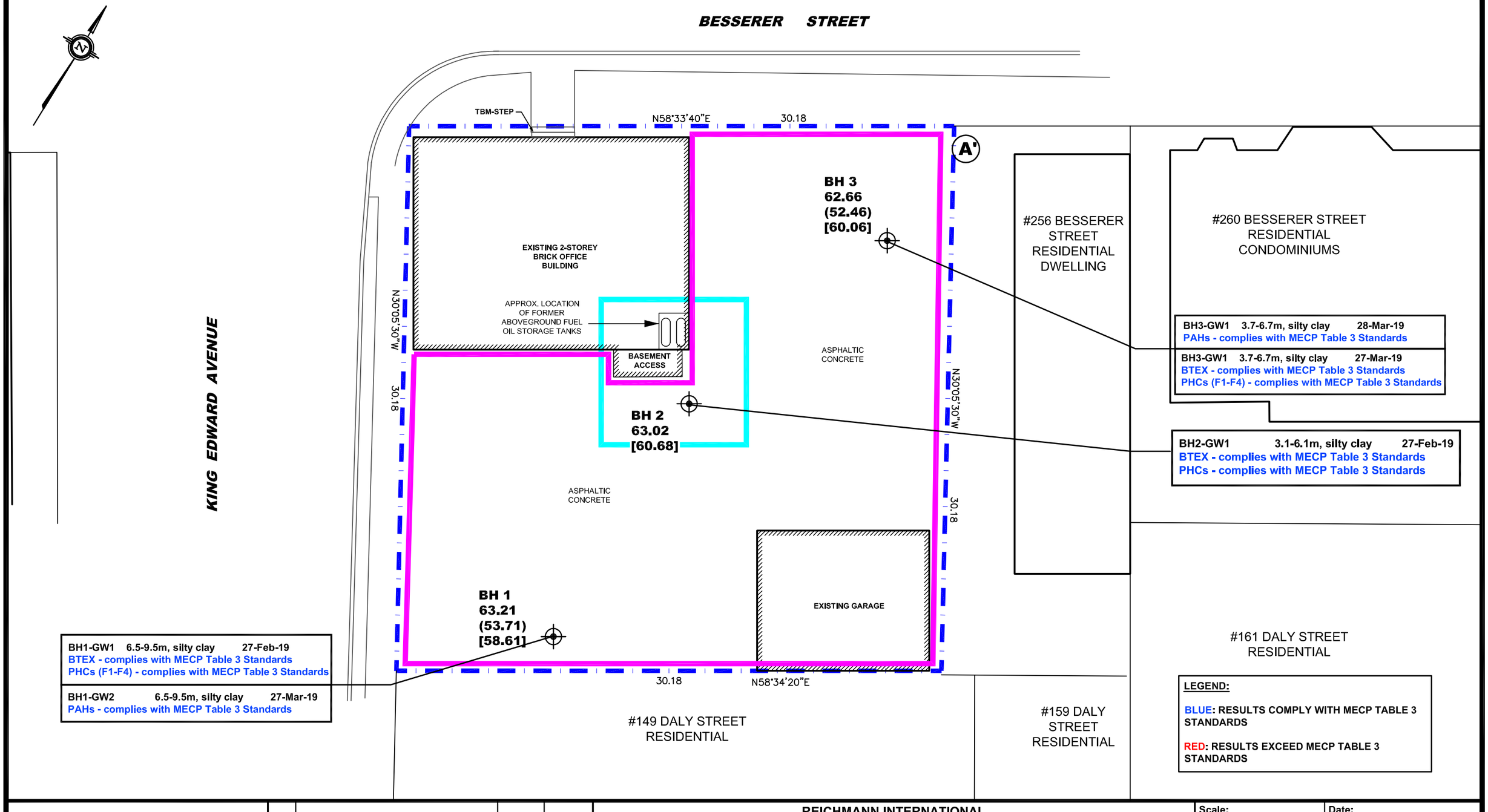

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NO.	REVISIONS	DATE	INITIAL

REICHMANN INTERNATIONAL

PHASE II ENVIRONMENTAL SITE ASSESSMENT
250 BESSERER STREET
OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - GROUNDWATER

Scale: 1:200	Date: 04/2019
Drawn by: RCG	Report No.: PE4550-3
Checked by: MD	PE4550-5
Approved by: MD	Revision No.:

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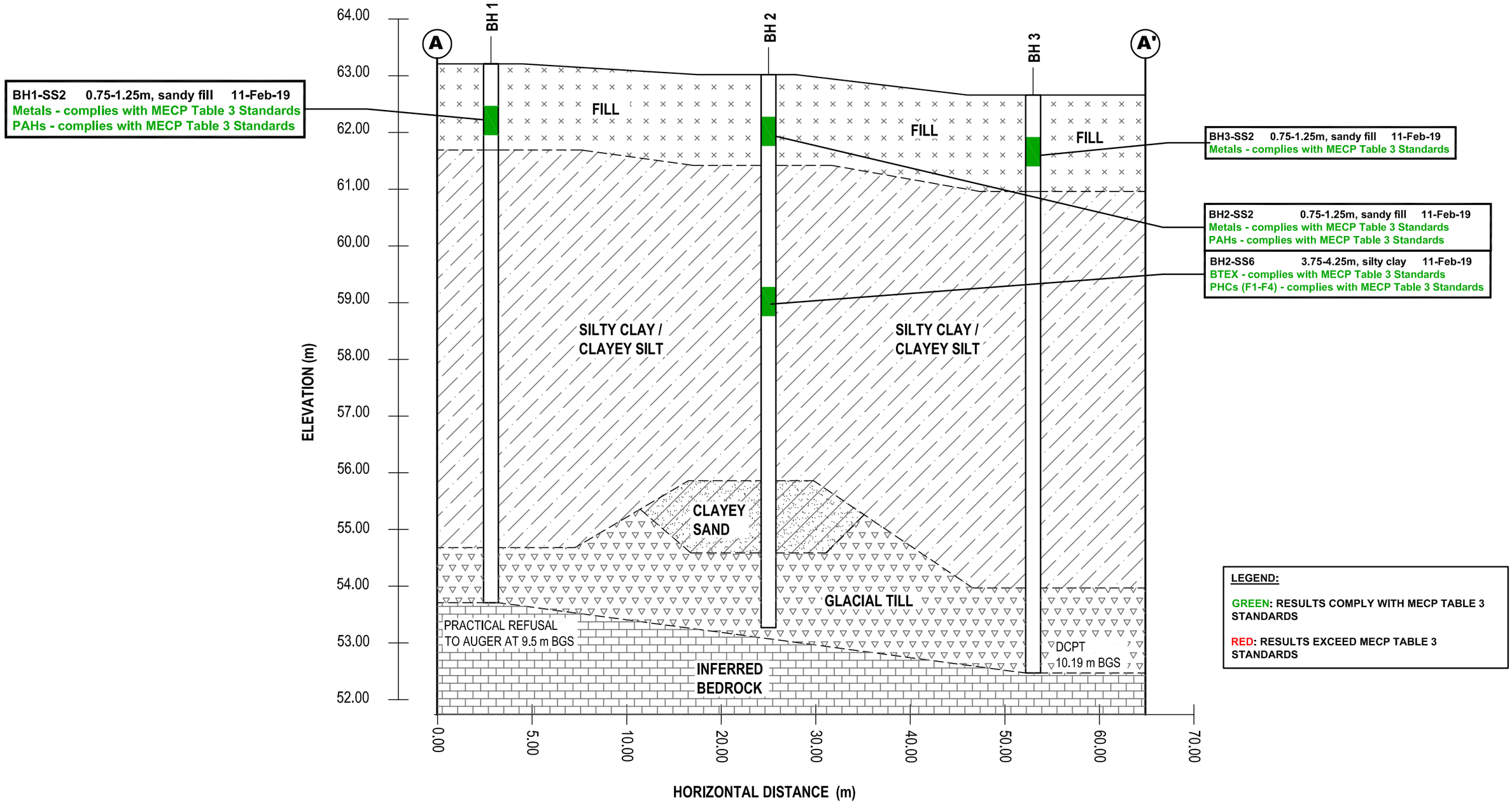

LEGEND:

GREEN: RESULTS COMPLY WITH MECP TABLE 3 STANDARDS

RED: RESULTS EXCEED MECP TABLE 3 STANDARDS

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NO.	REVISIONS	DATE	INITIAL

REICHMANN INTERNATIONAL

PHASE II ENVIRONMENTAL SITE ASSESSMENT
250 BESSERER STREET
OTTAWA, ONTARIO

Title: **CROSS SECTION A-A' SOIL**

Scale: AS SHOWN	Date: 04/2019
Drawn by: RCG	Report No.: PE4550-3
Checked by: MD	**PE4550-6**
Approved by: MD	Revision No.:

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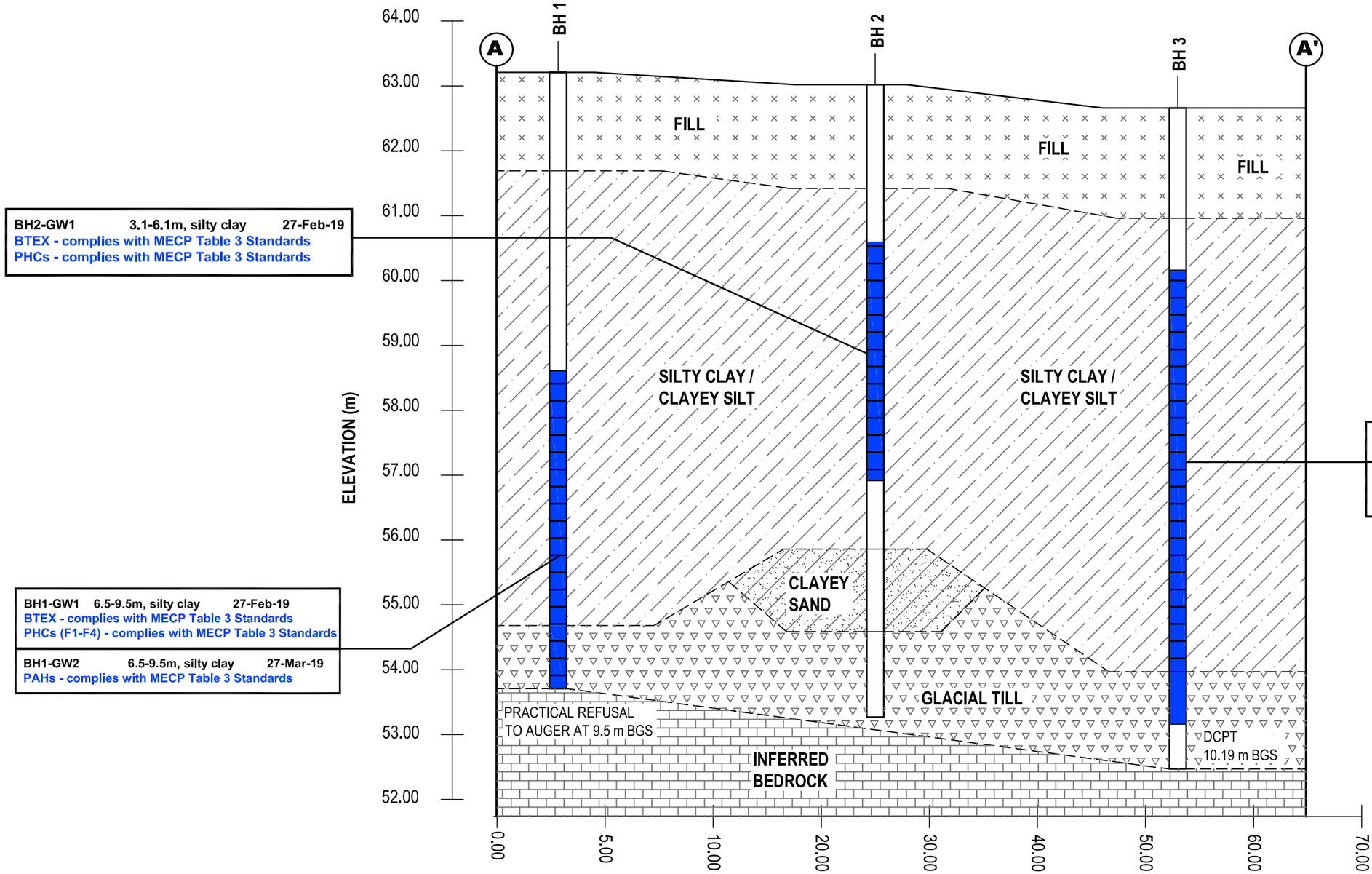

BH2-GW1 3.1-6.1m, silty clay 27-Feb-19
BTEX - complies with MECP Table 3 Standards
PHCs - complies with MECP Table 3 Standards

BH1-GW1 6.5-9.5m, silty clay 27-Feb-19
BTEX - complies with MECP Table 3 Standards
PHCs (F1-F4) - complies with MECP Table 3 Standards

BH1-GW2 6.5-9.5m, silty clay 27-Mar-19
PAHs - complies with MECP Table 3 Standards

BH3-GW1 3.7-6.7m, silty clay 28-Mar-19
PAHs - complies with MECP Table 3 Standards

BH3-GW1 3.7-6.7m, silty clay 27-Mar-19
BTEX - complies with MECP Table 3 Standards
PHCs (F1-F4) - complies with MECP Table 3 Standards

LEGEND:

BLUE: RESULTS COMPLY WITH MECP TABLE 3 STANDARDS

RED: RESULTS EXCEED MECP TABLE 3 STANDARDS

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NO.	REVISIONS	DATE	INITIAL

REICHMANN INTERNATIONAL

PHASE II ENVIRONMENTAL SITE ASSESSMENT
250 BESSERER STREET

OTTAWA, ONTARIO

Title: **CROSS SECTION A-A' GROUNDWATER**

Scale: AS SHOWN	Date: 04/2019
Drawn by: RCG	Report No.: PE4550-3
Checked by: MD	**PE4550-7**
Approved by: MD	Revision No.:

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

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patersongroup

Sampling & Analysis Plan

Phase II Environmental Site Assessment
250 Besserer Street
Ottawa, Ontario

Prepared For

Reichmann International

February 2019

Report: PE4550-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Reichmann International to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 250 Besserer Street, in the City of Ottawa, Ontario

The Phase II ESA was carried out to address the APECs identified in the Paterson Phase I ESA. The following subsurface investigation program was developed to identify and delineate the potential concerns. A geotechnical investigation was conducted concurrently with the environmental subsurface investigation.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Assess fill material of unknown quality.	Boreholes to be advanced to intercept water table to facilitate installation of groundwater monitoring wells.
BH2	Assess potential impacts resulting from former aboveground fuel oil storage tanks.	
BH3	Assess fill material of unknown quality.	

At each borehole, split-spoon samples of overburden soils will be obtained at 0.76 m (2'6") intervals until practical refusal to augering. All soil samples will be retained, and samples will be selected for submission following a preliminary screening analysis.

Following borehole drilling, monitoring wells will be installed in selected boreholes (as above) for the measurement of water levels and the collection of groundwater samples. Borehole locations are shown on the Test Hole Location Plan appended to the main report.

2.0 ANALYTICAL TESTING PROGRAM

The analytical testing program for soil at the subject site is based on the following general considerations:

- ❒ At least one sample from each borehole should be submitted, in order to delineate the horizontal extent of contamination across the site.
- ❒ At least one sample from each stratigraphic unit should be submitted, in order to delineate the vertical extent of contamination at the site.
- ❒ In boreholes where there is visual or olfactory evidence of contamination, or where organic vapour meter or photoionization detector readings indicate the presence of contamination, the 'worst-case' sample from each borehole should be submitted for comparison with MECP site condition standards.
- ❒ In boreholes with evidence of contamination as described above, a sample should be submitted from the stratigraphic unit below the 'worst-case' sample to determine whether the contaminant(s) have migrated downward.
- ❒ Parameters analyzed should be consistent with the Contaminants of Potential Concern identified in the Phase I ESA.

The analytical testing program for groundwater at the subject site is based on the following general considerations:

- ❒ Groundwater monitoring wells should be installed in all boreholes with visual or olfactory evidence of soil contamination, in stratigraphic units where soil contamination was encountered, where those stratigraphic units are at or below the water table (i.e. a water sample can be obtained).
- ❒ Groundwater monitoring well screens should straddle the water table at sites where the contaminants of concern are suspected to be LNAPLs.
- ❒ At least one groundwater monitoring well should be installed in a stratigraphic unit below the suspected contamination, where said stratigraphic unit is water-bearing.
- ❒ Parameters analyzed should be consistent with the Contaminants of Concern identified in the Phase I ESA and with the contaminants identified in the soil samples.

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

The purpose of environmental boreholes is to identify and/or delineate contamination within the soil and/or to install groundwater monitoring wells in order to identify contamination within the groundwater.

Equipment

The following is a list of equipment that is in addition to regular drilling equipment stated in the geotechnical drilling SOP:

- ❒ glass soil sample jars
- ❒ two buckets
- ❒ cleaning brush (toilet brush works well)
- ❒ dish detergent
- ❒ methyl hydrate
- ❒ water (if not available on site - water jugs available in trailer)
- ❒ latex or nitrile gloves (depending on suspected contaminant)
- ❒ RKI Eagle organic vapour meter or MiniRae photoionization detector (depending on contamination suspected)

Determining Borehole Locations

If conditions on site are not as suspected, and planned borehole locations cannot be drilled, **call the office to discuss**. Alternative borehole locations will be determined in conversation with the field technician and supervising engineer.

After drilling is completed a plan with the borehole locations must be provided. Distances should be measured using a measuring tape or wheel rather than paced off. Elevations were surveyed relative to a geodetic benchmark (concrete step at entrance to the building on site, facing Besserer Street). The elevation of the benchmark was 62.37 metres above sea level.

Drilling Procedure

The actual drilling procedure for environmental boreholes is the same as geotechnical boreholes (see SOP for drilling and sampling) with a few exceptions as follows:

- ❒ Continuous split spoon samples (every 0.6 m or 2') or semi-continuous (every 0.76 m or 2'6") are required.
- ❒ Make sure samples are well sealed in plastic bags with no holes prior to screening and are kept cool but unfrozen.
- ❒ If sampling for VOCs, BTEX, or PHCs F1, a soil core from each soil sample which may be analyzed must be taken and placed in the laboratory-provided methanol vial.
- ❒ Note all and any odours or discolouration of samples.
- ❒ Split spoon samplers must be washed between samples.
- ❒ If obvious contamination is encountered, continue sampling until vertical extent of contamination is delineated.
- ❒ As a general rule, environmental boreholes should be deep enough to intercept the groundwater table (unless this is impossible/impractical - call project manager to discuss).
- ❒ If at all possible, soil samples should be submitted to a preliminary screening procedure on site, either using a RKI Eagle, PID, etc. depending on type of suspected contamination.

Spoon Washing Procedure

All sampling equipment (spilt spoons, etc.) must be washed between samples in order to prevent cross contamination of soil samples.

- ❒ Obtain two buckets of water (preferably hot if available)
- ❒ Add a small amount of dish soap to one bucket
- ❒ Scrub spoons with brush in soapy water, inside and out, including tip
- ❒ Rinse in clean water
- ❒ Apply a small amount of methyl hydrate to the inside of the spoon. (A spray bottle or water bottle with a small hole in the cap works well)
- ❒ Allow to dry (takes seconds)
- ❒ Rinse with distilled water, a spray bottle works well.

The methyl hydrate eliminates any soap residue that may be on the spoon, and is especially important when dealing with suspected VOCs.

Screening Procedure

The RKI Eagle is used to screen most soil samples, particularly where petroleum hydrocarbon contamination is suspected. The MiniRae is used when VOCs are suspected, however it also can be useful for detecting petroleum. These tools are for screening purposes only and cannot be used in place of laboratory testing. Vapour results obtained from the RKI Eagle and the PID are relative and must be interpreted.

Screening equipment should be calibrated on an approximately monthly basis, more frequently if heavily used.

- ❒ Samples should be brought to room temperature; this is specifically important in colder weather. Soil must not be frozen.
- ❒ Turn instrument on and allow to come to zero - calibrate if necessary
- ❒ If using RKI Eagle, ensure instrument is in methane elimination mode unless otherwise directed.
- ❒ Ensure measurement units are ppm (parts per million) initially. RKI Eagle will automatically switch to %LEL (lower explosive limit) if higher concentrations are encountered.
- ❒ Break up large lumps of soil in the sample bag, taking care not to puncture bag.
- ❒ Insert probe into soil bag, creating a seal with your hand around the opening.
- ❒ Gently manipulate soil in bag while observing instrument readings.
- ❒ Record the highest value obtained in the first 15 to 25 seconds
- ❒ Make sure to indicate scale (ppm or LEL); also note which instrument was used (RKI Eagle 1 or 2, or MiniRae).
- ❒ Jar samples and refrigerate as per Sampling and Analysis Plan.

3.2 Monitoring Well Installation Procedure

Equipment

- ❒ 5' x 2" [1.52 m x 50 mm] threaded sections of Schedule 40 PVC slotted well screen (5' x 1 ¼" [1.52 m x 32 mm] if installing in cored hole in bedrock)
- ❒ 5' x 2" [1.52 m x 50 mm] threaded sections of Schedule 40 PVC riser pipe (5' x 1 ¼" [1.52 m x 32 mm] if installing in cored hole in bedrock)
- ❒ Threaded end-cap
- ❒ Slip-cap or J-plug
- ❒ Asphalt cold patch or concrete
- ❒ Silica Sand
- ❒ Bentonite chips (Holeplug)
- ❒ Steel flushmount casing

Procedure

- ❒ Drill borehole to required depth, using drilling and sampling procedures described above.
- ❒ If borehole is deeper than required monitoring well, backfill with bentonite chips to required depth. This should only be done on wells where contamination is not suspected, in order to prevent downward migration of contamination.
- ❒ Only one monitoring well should be installed per borehole.
- ❒ Monitoring wells should not be screened across more than one stratigraphic unit to prevent potential migration of contaminants between units.
- ❒ Where LNAPLs are the suspected contaminants of concern, monitoring wells should be screened straddling the water table in order to capture any free product floating on top of the water table.
- ❒ Thread the end cap onto a section of screen. Thread second section of screen if required. Thread risers onto screen. Lower into borehole to required depth. Ensure slip-cap or J-plug is inserted to prevent backfill materials entering well.
- ❒ As drillers remove augers, backfill borehole annulus with silica sand until the level of sand is approximately 0.3 m above the top of the screen.
- ❒ Backfill with holeplug until at least 0.3 m of holeplug is present above the top of the silica sand.
- ❒ Backfill remainder of borehole with holeplug or with auger cuttings (if contamination is not suspected).
- ❒ Install flushmount casing. Seal space between flushmount and borehole annulus with concrete, cold patch, or holeplug to match surrounding ground surface.

3.3 Monitoring Well Sampling Procedure

Equipment

- ❒ Water level metre or interface probe on hydrocarbon/LNAPL sites
- ❒ Spray bottles containing water and methanol to clean water level tape or interface probe
- ❒ Peristaltic pump
- ❒ Polyethylene tubing for peristaltic pump
- ❒ Flexible tubing for peristaltic pump
- ❒ Latex or nitrile gloves (depending on suspected contaminant)
- ❒ Allen keys and/or 9/16" socket wrench to remove well caps
- ❒ Graduated bucket with volume measurements
- ❒ pH/Temperature/Conductivity combo pen
- ❒ Laboratory-supplied sample bottles

Sampling Procedure

- ❒ Locate well and use socket wrench or Allan key to open metal flush mount protector cap. Remove plastic well cap.
- ❒ Measure water level, with respect to existing ground surface, using water level meter or interface probe. If using interface probe on suspected NAPL site, measure the thickness of free product.
- ❒ Measure total depth of well.
- ❒ Clean water level tape or interface probe using methanol and water. Change gloves between wells.
- ❒ Calculate volume of standing water within well and record.
- ❒ Insert polyethylene tubing into well and attach to peristaltic pump. Turn on peristaltic pump and purge into graduated bucket. Purge at least three well volumes of water from the well. Measure and record field chemistry. Continue to purge, measuring field chemistry after every well volume purged, until appearance or field chemistry stabilizes.
- ❒ Note appearance of purge water, including colour, opacity (clear, cloudy, silty), sheen, presence of LNAPL, and odour. Note any other unusual features (particulate matter, effervescence (bubbling) of dissolved gas, etc.).
- ❒ Fill required sample bottles. If sampling for metals, attach 75-micron filter to discharge tube and filter metals sample. If sampling for VOCs, use low flow rate to ensure continuous stream of non-turbulent flow into sample bottles. Ensure no headspace is present in VOC vials.
- ❒ Replace well cap and flushmount casing cap.

4.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The QA/QC program for this Phase II ESA is as follows:

- ❒ All non-dedicated sampling equipment (split spoons) will be decontaminated according to the SOPs listed above.
- ❒ All groundwater sampling equipment is dedicated (polyethylene and flexible peristaltic tubing is replaced for each well).
- ❒ Where groundwater samples are to be analyzed for VOCs, one laboratory-provided trip blank will be submitted for analysis with every laboratory submission.
- ❒ Approximately one (1) field duplicate will be submitted for every ten (10) samples submitted for laboratory analysis. A minimum of one (1) field duplicate per project will be submitted. Field duplicates will be submitted for soil and groundwater samples.
- ❒ Where combo pens are used to measure field chemistry, they will be calibrated on an approximately monthly basis, according to frequency of use.

5.0 DATA QUALITY OBJECTIVES

The purpose of setting data quality objectives (DQOs) is to ensure that the level of uncertainty in data collected during the Phase II ESA is low enough that decision-making is not affected, and that the overall objectives of the investigation are met.

The quality of data is assessed by comparing field duplicates with original samples. If the relative percent difference (RPD) between the duplicate and the sample is within 20%, the data are considered to be of sufficient quality so as not to affect decision-making. The RPD is calculated as follows:

$$RPD = \left| \frac{x_1 - x_2}{(x_1 + x_2)/2} \right| \times 100\%$$

Where x_1 is the concentration of a given parameter in an original sample and x_2 is the concentration of that same parameter in the field duplicate sample.

For the purpose of calculating the RPD, it is desirable to select field duplicates from samples for which parameters are present in concentrations above laboratory detection limits, i.e. samples which are expected to be contaminated. If parameters are below laboratory detection limits for selected samples or duplicates, the RPD may be calculated using a concentration equal to one half (0.5 x) the laboratory detection limit.

It is also important to consider data quality in the overall context of the project. For example, if the DQOs are not met for a given sample, yet the concentrations of contaminants in both the sample and the duplicate exceed the MOE site remediation standards by a large margin, the decision-making usefulness of the sample may not be considered to be impaired. The proximity of other samples which meet the DQOs must also be considered in developing the Phase II Conceptual Site Model; often there are enough data available to produce a reliable Phase II Conceptual Site Model even if DQOs are not met for certain individual samples.

These considerations are discussed in the body of the report.

6.0 PHYSICAL IMPEDIMENTS TO SAMPLING & ANALYSIS PLAN

Physical impediments to the Sampling and Analysis plan may include:

- ❒ The location of underground utilities
- ❒ Poor recovery of split-spoon soil samples
- ❒ Insufficient groundwater volume for groundwater samples
- ❒ Breakage of sampling containers following sampling or while in transit to the laboratory
- ❒ Elevated detection limits due to matrix interference (generally related to soil colour or presence of organic material)
- ❒ Elevated detection limits due to high concentrations of certain parameters, necessitating dilution of samples in laboratory
- ❒ Drill rig breakdowns
- ❒ Winter conditions
- ❒ Other site-specific impediments

Site-specific impediments to the Sampling and Analysis plan are discussed in the body of the Phase II ESA report.

patersongroup Consulting Engineers

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SOIL PROFILE AND TEST DATA

Environmental Site Assessment
250 Besserer Street
Ottawa, Ontario

DATUM Top concrete step of existing building onsite, with geodetic elevation = 62.37m

FILE NO. PE4550

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** 2019 February 11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.21
Asphaltic concrete 0.10		AU	1				
FILL: Crushed stone with brown sand and gravel 0.61							
FILL: Brown silty sand		SS	2	79	52	1	62.21
1.52							
Brown **SILTY CLAY** 1.83		SS	3	96	3	2	61.21
		SS	4	96	P		
		SS	5	96	P	3	60.21
		SS	6	96	P	4	59.21
Grey **SILTY CLAY**		SS	7	96	P		
		SS	8	79	P	5	58.21
		SS	9	96	P	6	57.21
		SS	10	96	P	7	56.21
7.62							
Grey **CLAYEY SILT**		SS	11	63	P	8	55.21
8.53							
GLACIAL TILL: Grey silty sand and gravel, with clay, cobbles and boulders		SS	12	58	P	9	54.21
9.50		SS	13	42	50+		
End of Borehole							
Practical refusal to augering @ 9.50m depth							
(GWL @ 4.60m - Mar. 27, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Environmental Site Assessment
250 Besserer Street
Ottawa, Ontario

DATUM Top concrete step of existing building onsite, with geodetic elevation = 62.37m

FILE NO. PE4550

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** 2019 February 11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	63.02
Asphaltic concrete 0.10		AU	1				
FILL: Crushed stone with gravel and sand 0.61							
FILL: Brown silty sand		SS	2	63	19	1	62.02
1.60							
Brown **SILTY CLAY**		SS	3	33	7	2	61.02
2.29							
Grey/brown **SILTY CLAY** 2.59		SS	4	96	P		
		SS	5	96	P	3	60.02
		SS	6	96	P	4	59.02
Grey **SILTY CLAY** trace gravel		SS	7	96	P	5	58.02
		SS	8	96	P		
		SS	9	96	P	6	57.02
6.96							
Grey **CLAYEY SAND** with silt 7.16		SS	10	96	P	7	56.02
Grey **CLAYEY SILT** to **SILTY CLAY**		SS	11	63	P	8	55.02
8.43							
		SS	12	71	P		
GLACIAL TILL: Grey silty sand and gravel, with clay, cobbles and boulders		SS	13	63	11	9	54.02
9.75							
End of Borehole							
(GWL @ 2.34m - Mar. 28, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Environmental Site Assessment
250 Besserer Street
Ottawa, Ontario

DATUM Top concrete step of existing building onsite, with geodetic elevation = 62.37m

FILE NO. PE4550

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** 2019 February 11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	62.66
Asphaltic concrete 0.10		AU	1				
FILL: Crushed stone with sand and gravel 0.61							
FILL: Brown silty sand		SS	2	67	14	1	61.66
1.70		SS	3	63	P		
Brown **SILTY CLAY**		SS	4	71	P	2	60.66
3.05		SS	5	71	P	3	59.66
Grey/brown **SILTY CLAY** 3.81		SS	6	96	P	4	58.66
		SS	7	96	P		
Grey **SILTY CLAY**		SS	8	96	P	5	57.66
		SS	9	96	P		
		SS	10	96	P	6	56.66
7.92		SS	11	46	P		
Grey **CLAYEY SILT** 8.69		SS	12	42	P	7	55.66
GLACIAL TILL: Grey silty sand and gravel, with clay, cobbles and boulders 9.75		SS	13	42	35	8	54.66
Dynamic Cone Penetration Test commenced at 9.75m depth. 10.19						9	53.66
End of Borehole						10	52.66
(GWL @ 2.6m - Mar. 28, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

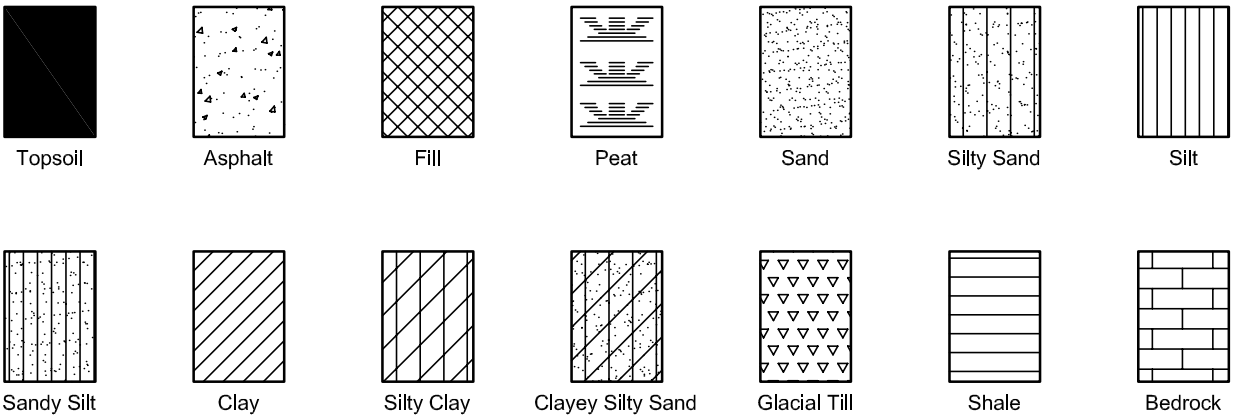
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

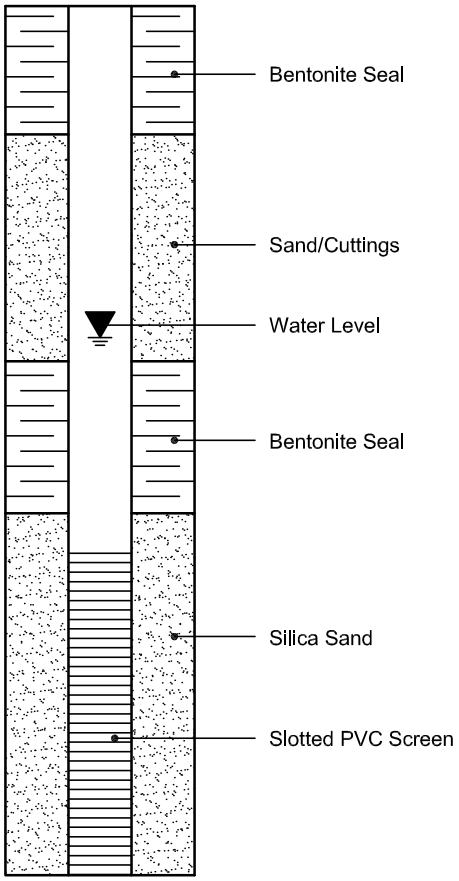
SYMBOLS AND TERMS (continued)

STRATA PLOT

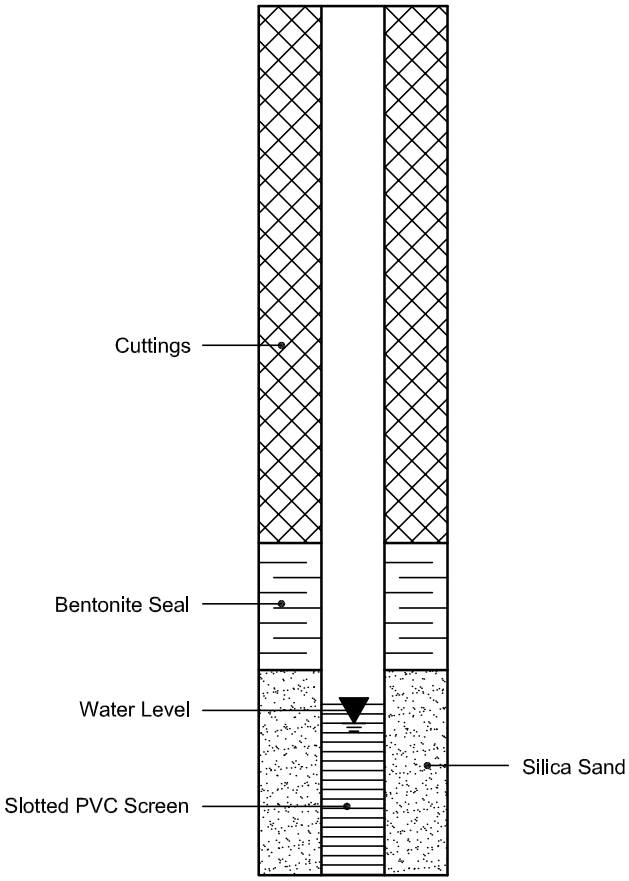


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mike Beaudoin

Client PO: 25958
Project: PE4550
Custody: 118603

Report Date: 8-Apr-2019
Order Date: 25-Feb-2019

Revised Report

Order #: 1909091

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

Paracel ID	Client ID
1909091-01	BH1-SS2
1909091-02	BH2-SS2
1909091-03	BH2-SS6
1909091-04	BH3-SS2

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 25958

Report Date: 08-Apr-2019
Order Date: 25-Feb-2019
Project Description: PE4550

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	26-Feb-19	26-Feb-19
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	1-Mar-19	4-Mar-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	4-Mar-19	5-Mar-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	19-Mar-19	20-Mar-19
PHC F1	CWS Tier 1 - P&T GC-FID	26-Feb-19	26-Feb-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	25-Feb-19	27-Feb-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	27-Feb-19	27-Feb-19
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	26-Feb-19	28-Feb-19
Solids, %	Gravimetric, calculation	28-Feb-19	28-Feb-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25958

Report Date: 08-Apr-2019

Order Date: 25-Feb-2019

Project Description: PE4550

	Client ID:	BH1-SS2	BH1-SS2	BH2-SS2	BH2-SS2
	Sample Date:	02/11/2019 09:00	02/11/2019 09:00	02/11/2019 09:00	02/11/2019 09:00
	Sample ID:	1909091-01	1909091-01RE1	1909091-02	1909091-02RE1
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	87.8	-	94.8	-
General Inorganics					
pH	0.05 pH Units	-	-	7.86 [1]	-
Metals					
Antimony	1.0 ug/g dry	<1.0	-	<1.0	-
Arsenic	1.0 ug/g dry	1.1	-	1.1	-
Barium	1.0 ug/g dry	32.7	-	10.7	-
Beryllium	0.5 ug/g dry	<0.5	-	<0.5	-
Boron	5.0 ug/g dry	<5.0	-	<5.0	-
Cadmium	0.5 ug/g dry	<0.5	-	<0.5	-
Chromium	5.0 ug/g dry	19.2	-	12.1	-
Chromium (VI)	0.2 ug/g dry	<0.2	-	<0.2	-
Cobalt	1.0 ug/g dry	3.7	-	2.8	-
Copper	5.0 ug/g dry	9.8	-	<5.0	-
Lead	1.0 ug/g dry	1.9	-	2.0	-
Mercury	0.1 ug/g dry	<0.1	-	<0.1	-
Molybdenum	1.0 ug/g dry	<1.0	-	<1.0	-
Nickel	5.0 ug/g dry	11.7	-	7.3	-
Selenium	1.0 ug/g dry	<1.0	-	<1.0	-
Silver	0.3 ug/g dry	<0.3	-	<0.3	-
Thallium	1.0 ug/g dry	<1.0	-	<1.0	-
Uranium	1.0 ug/g dry	<1.0	-	<1.0	-
Vanadium	10.0 ug/g dry	20.7	-	18.2	-
Zinc	20.0 ug/g dry	<20.0	-	<20.0	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Anthracene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Benzo [a] anthracene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Benzo [a] pyrene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Benzo [b] fluoranthene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Benzo [g,h,i] perylene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Benzo [k] fluoranthene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Chrysene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25958

Report Date: 08-Apr-2019

Order Date: 25-Feb-2019

Project Description: PE4550

	Client ID:	BH1-SS2	BH1-SS2	BH2-SS2	BH2-SS2
	Sample Date:	02/11/2019 09:00	02/11/2019 09:00	02/11/2019 09:00	02/11/2019 09:00
	Sample ID:	1909091-01	1909091-01RE1	1909091-02	1909091-02RE1
	MDL/Units	Soil	Soil	Soil	Soil
Fluoranthene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Fluorene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
1-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
2-Methylnaphthalene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Methylnaphthalene (1&2)	0.04 ug/g dry	<0.04	<0.04	<0.04	<0.04
Naphthalene	0.01 ug/g dry	<0.01	<0.01	<0.01	<0.01
Phenanthrene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
Pyrene	0.02 ug/g dry	<0.02	<0.02	<0.02	<0.02
2-Fluorobiphenyl	Surrogate	63.2%	67.5%	94.2%	81.0%
Terphenyl-d14	Surrogate	72.1%	88.3%	102%	116%

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25958

Report Date: 08-Apr-2019

Order Date: 25-Feb-2019

Project Description: PE4550

	Client ID:	BH2-SS6	BH3-SS2	-	-
	Sample Date:	02/11/2019 09:00	02/11/2019 09:00	-	-
	Sample ID:	1909091-03	1909091-04	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	79.7	84.2	-	-
General Inorganics					
pH	0.05 pH Units	7.95 [1]	-	-	-
Metals					
Antimony	1.0 ug/g dry	-	<1.0	-	-
Arsenic	1.0 ug/g dry	-	1.5	-	-
Barium	1.0 ug/g dry	-	35.4	-	-
Beryllium	0.5 ug/g dry	-	<0.5	-	-
Boron	5.0 ug/g dry	-	<5.0	-	-
Cadmium	0.5 ug/g dry	-	<0.5	-	-
Chromium	5.0 ug/g dry	-	12.4	-	-
Chromium (VI)	0.2 ug/g dry	-	<0.2	-	-
Cobalt	1.0 ug/g dry	-	1.8	-	-
Copper	5.0 ug/g dry	-	<5.0	-	-
Lead	1.0 ug/g dry	-	18.9	-	-
Mercury	0.1 ug/g dry	-	<0.1	-	-
Molybdenum	1.0 ug/g dry	-	<1.0	-	-
Nickel	5.0 ug/g dry	-	<5.0	-	-
Selenium	1.0 ug/g dry	-	<1.0	-	-
Silver	0.3 ug/g dry	-	<0.3	-	-
Thallium	1.0 ug/g dry	-	<1.0	-	-
Uranium	1.0 ug/g dry	-	<1.0	-	-
Vanadium	10.0 ug/g dry	-	21.4	-	-
Zinc	20.0 ug/g dry	-	22.2	-	-
Volatiles					
Benzene	0.02 ug/g dry	<0.02	-	-	-
Ethylbenzene	0.05 ug/g dry	<0.05	-	-	-
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	97.5%	-	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	-	-	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	-	-	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 25958

Report Date: 08-Apr-2019
Order Date: 25-Feb-2019
Project Description: PE4550

	Client ID:	BH2-SS6	BH3-SS2	-	-
	Sample Date:	02/11/2019 09:00	02/11/2019 09:00	-	-
	Sample ID:	1909091-03	1909091-04	-	-
	MDL/Units	Soil	Soil	-	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	-	-	-
F4 PHCs (C34-C50)	6 ug/g dry	<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	0.5	ug/g						
Boron	ND	5.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	5.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.3	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	10.0	ug/g						
Zinc	ND	20.0	ug/g						
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g						
Acenaphthylene	ND	0.02	ug/g						
Anthracene	ND	0.02	ug/g						
Benzo [a] anthracene	ND	0.02	ug/g						
Benzo [a] pyrene	ND	0.02	ug/g						
Benzo [b] fluoranthene	ND	0.02	ug/g						
Benzo [g,h,i] perylene	ND	0.02	ug/g						
Benzo [k] fluoranthene	ND	0.02	ug/g						
Chrysene	ND	0.02	ug/g						
Dibenzo [a,h] anthracene	ND	0.02	ug/g						
Fluoranthene	ND	0.02	ug/g						
Fluorene	ND	0.02	ug/g						
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g						
1-Methylnaphthalene	ND	0.02	ug/g						
2-Methylnaphthalene	ND	0.02	ug/g						
Methylnaphthalene (1&2)	ND	0.04	ug/g						
Naphthalene	ND	0.01	ug/g						
Phenanthrene	ND	0.02	ug/g						
Pyrene	ND	0.02	ug/g						
Surrogate: 2-Fluorobiphenyl	*1.39*		*ug/g*		*105*	*50-140*			
Surrogate: Terphenyl-d14	*1.48*		*ug/g*		*111*	*50-140*			
Volatiles									
Benzene	ND	0.02	ug/g						
Ethylbenzene	ND	0.05	ug/g						
Toluene	ND	0.05	ug/g						
m,p-Xylenes	ND	0.05	ug/g						
o-Xylene	ND	0.05	ug/g						
Xylenes, total	ND	0.05	ug/g						
Surrogate: Toluene-d8	*3.41*		*ug/g*		*107*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
General Inorganics									
pH	8.78	0.05	pH Units	8.54			2.8	10	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	ND	4	ug/g dry	ND				30	
F3 PHCs (C16-C34)	ND	8	ug/g dry	ND				30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	1.4	1.0	ug/g dry	ND			0.0	30	
Arsenic	12.0	1.0	ug/g dry	10.2			16.1	30	
Barium	27.3	1.0	ug/g dry	23.2			16.3	30	
Beryllium	0.8	0.5	ug/g dry	ND			0.0	30	
Boron	9.0	5.0	ug/g dry	7.4			19.1	30	
Cadmium	0.6	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	13.9	5.0	ug/g dry	12.6			10.0	30	
Cobalt	6.0	1.0	ug/g dry	5.0			19.0	30	
Copper	24.1	5.0	ug/g dry	20.8			14.7	30	
Lead	11.4	1.0	ug/g dry	9.7			16.5	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	2.1	1.0	ug/g dry	1.5			32.8	30	QR-01
Nickel	13.6	5.0	ug/g dry	12.1			11.3	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	0.4	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	1.3	1.0	ug/g dry	ND			0.0	30	
Vanadium	27.3	10.0	ug/g dry	23.8			13.5	30	
Zinc	82.0	20.0	ug/g dry	65.5			22.3	30	
Physical Characteristics									
% Solids	86.1	0.1	% by Wt.	88.5			2.8	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g dry	ND				40	
Acenaphthylene	ND	0.02	ug/g dry	ND				40	
Anthracene	ND	0.02	ug/g dry	ND				40	
Benzo [a] anthracene	ND	0.02	ug/g dry	ND				40	
Benzo [a] pyrene	ND	0.02	ug/g dry	ND				40	
Benzo [b] fluoranthene	ND	0.02	ug/g dry	ND				40	
Benzo [g,h,i] perylene	ND	0.02	ug/g dry	ND				40	
Benzo [k] fluoranthene	ND	0.02	ug/g dry	ND				40	
Chrysene	ND	0.02	ug/g dry	ND				40	
Dibenzo [a,h] anthracene	ND	0.02	ug/g dry	ND				40	
Fluoranthene	ND	0.02	ug/g dry	ND				40	
Fluorene	ND	0.02	ug/g dry	ND				40	
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g dry	ND				40	
1-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
2-Methylnaphthalene	ND	0.02	ug/g dry	ND				40	
Naphthalene	ND	0.01	ug/g dry	ND				40	
Phenanthrene	ND	0.02	ug/g dry	ND				40	
Pyrene	ND	0.02	ug/g dry	ND				40	
Surrogate: 2-Fluorobiphenyl	*1.49*		*ug/g dry*		*97.9*	*50-140*			
Surrogate: Terphenyl-d14	*1.61*		*ug/g dry*		*106*	*50-140*			
Volatiles									
Benzene	ND	0.02	ug/g dry	ND				50	
Ethylbenzene	ND	0.05	ug/g dry	ND				50	
Toluene	ND	0.05	ug/g dry	ND				50	
m,p-Xylenes	ND	0.05	ug/g dry	ND				50	
o-Xylene	ND	0.05	ug/g dry	ND				50	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Surrogate: Toluene-d8	*3.94*		*ug/g dry*		*102*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 25958

Report Date: 08-Apr-2019
Order Date: 25-Feb-2019
Project Description: PE4550

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	199	7	ug/g		99.3	80-120			
F2 PHCs (C10-C16)	129	4	ug/g	ND	129	60-140			
F3 PHCs (C16-C34)	338	8	ug/g	ND	138	60-140			
F4 PHCs (C34-C50)	207	6	ug/g	ND	133	60-140			
Metals									
Antimony	118	1.0	ug/g	ND	94.8	70-130			
Arsenic	130	1.0	ug/g	10.2	95.8	70-130			
Barium	130	1.0	ug/g	23.2	85.3	70-130			
Beryllium	135	0.5	ug/g	ND	108	70-130			
Boron	116	5.0	ug/g	7.4	87.2	70-130			
Cadmium	135	0.5	ug/g	ND	108	70-130			
Chromium (VI)	3.8	0.2	ug/g		75.5	70-130			
Chromium	136	5.0	ug/g	12.6	98.8	70-130			
Cobalt	124	1.0	ug/g	5.0	95.3	70-130			
Copper	131	5.0	ug/g	20.8	88.3	70-130			
Lead	123	1.0	ug/g	9.7	90.4	70-130			
Mercury	1.61	0.1	ug/g	ND	107	70-130			
Molybdenum	123	1.0	ug/g	1.5	97.4	70-130			
Nickel	134	5.0	ug/g	12.1	97.7	70-130			
Selenium	132	1.0	ug/g	ND	105	70-130			
Silver	122	0.3	ug/g	ND	97.2	70-130			
Thallium	125	1.0	ug/g	ND	99.7	70-130			
Uranium	125	1.0	ug/g	ND	99.9	70-130			
Vanadium	138	10.0	ug/g	23.8	91.0	70-130			
Zinc	131	20.0	ug/g	65.5	52.5	70-130			QM-07
Semi-Volatiles									
Acenaphthene	0.181	0.02	ug/g	ND	95.1	50-140			
Acenaphthylene	0.164	0.02	ug/g	ND	86.3	50-140			
Anthracene	0.180	0.02	ug/g	ND	94.7	50-140			
Benzo [a] anthracene	0.163	0.02	ug/g	ND	85.9	50-140			
Benzo [a] pyrene	0.140	0.02	ug/g	ND	73.7	50-140			
Benzo [b] fluoranthene	0.218	0.02	ug/g	ND	115	50-140			
Benzo [g,h,i] perylene	0.152	0.02	ug/g	ND	80.1	50-140			
Benzo [k] fluoranthene	0.181	0.02	ug/g	ND	95.3	50-140			
Chrysene	0.189	0.02	ug/g	ND	99.4	50-140			
Dibenzo [a,h] anthracene	0.128	0.02	ug/g	ND	67.5	50-140			
Fluoranthene	0.156	0.02	ug/g	ND	82.0	50-140			
Fluorene	0.148	0.02	ug/g	ND	77.8	50-140			
Indeno [1,2,3-cd] pyrene	0.130	0.02	ug/g	ND	68.7	50-140			
1-Methylnaphthalene	0.143	0.02	ug/g	ND	75.2	50-140			
2-Methylnaphthalene	0.159	0.02	ug/g	ND	83.5	50-140			
Naphthalene	0.179	0.01	ug/g	ND	94.3	50-140			
Phenanthrene	0.166	0.02	ug/g	ND	87.7	50-140			
Pyrene	0.160	0.02	ug/g	ND	84.3	50-140			
Surrogate: 2-Fluorobiphenyl	*1.22*		*ug/g*		*80.3*	*50-140*			
Volatiles									
Benzene	4.81	0.02	ug/g		120	60-130			
Ethylbenzene	3.34	0.05	ug/g		83.5	60-130			
Toluene	3.80	0.05	ug/g		94.9	60-130			
m,p-Xylenes	8.22	0.05	ug/g		103	60-130			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
o-Xylene	4.14	0.05	ug/g		103	60-130			

Qualifier Notes:

Sample Qualifiers :

1 : This analysis was conducted after the accepted holding time had been exceeded.

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:

Revision 1 - This report includes additional Mercury and Hexavalent Chromium data.

Revision 2 - this report includes additional pH data.

Revision 3- This report includes SVOC/PAH data reanalyzed due to suspended accreditation. Reanalyzed samples are denoted by 'RE1' following the Paracel Sample number and the analysis was conducted after the suspension was lifted.

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.

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Paracel ID: 1909091

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Chain of Custody (Lab Use Only)

№ 118603

Page 1 of 1

Client Name: Paterson	Project Reference: ~~PE4821~~ PE4550	**Turnaround Time:**
Contact Name: Mike Beaudoin / Mark D'Arcy	Quote #	☐ 1 Day ☐ 3 Day
Address: 154 Colonnade Rd S.	PO # 259558	☐ 2 Day ~~☐ Regular~~
Telephone: 613-226-7381	Email Address: mbeaudoin@patersongrp.ca mdarcy@patersongrp.ca	Date Required: HOLD

Criteria: ☑ O. Reg. 153/04 (As Amended) Table _ ☐ 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: 1909091

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	HOLD
1	BH1-SS2	S		1	Feb 11/19				X	X	X	X	X	X
2	BH1-SS5	S		2	↓		X							X
3	BH2-SS2	S		1					X	X	X	X	X	X
4	BH2-SS6	S		2			X							X
5	BH3-SS2	S		1						X				X
6	BH3-SS6	S		2										X
7														
8														
9														
10	Please analyze as indicated per misc on req. TAT - Feb. 25, 19													

Comments: PLEASE HOLD ALL SAMPLES UNTIL FURTHER NOTICE MB.

Method of Delivery: Paracel Courier

Relinquished By (Sign): MikeB	Received by Driver/Depot: M. Belouse	Received at Lab:	Verified By:
Relinquished By (Print): MIKE B.	Date/Time: 12/02/19 4:30 PM	Date/Time: Feb 12/19 5:46	Date/Time: 02/25/19 4:20pm
Date/Time:	Temperature:	Temperature: 19.2 °C	pH Verified: ☑ By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Mark D'Arcy

Client PO: 24844
Project: PE4550
Custody: 121003

Report Date: 28-Feb-2019
Order Date: 27-Feb-2019

Order #: 1909321

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

Paracel ID	Client ID
1909321-01	BH1-GW1
1909321-02	BH2-GW1

Approved By:

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24844

Report Date: 28-Feb-2019
Order Date: 27-Feb-2019
Project Description: PE4550

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	28-Feb-19	28-Feb-19
PHC F1	CWS Tier 1 - P&T GC-FID	28-Feb-19	28-Feb-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	28-Feb-19	28-Feb-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24844

Report Date: 28-Feb-2019

Order Date: 27-Feb-2019

Project Description: PE4550

	Client ID:	BH1-GW1	BH2-GW1	-	-
	Sample Date:	02/27/2019 12:45	02/27/2019 10:30	-	-
	Sample ID:	1909321-01	1909321-02	-	-
	MDL/Units	Water	Water	-	-
Volatiles					
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	91.9%	104%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<25	-	-
F2 PHCs (C10-C16)	100 ug/L	<100	<100	-	-
F3 PHCs (C16-C34)	100 ug/L	<100	<100	-	-
F4 PHCs (C34-C50)	100 ug/L	<100	<100	-	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24844

Report Date: 28-Feb-2019
Order Date: 27-Feb-2019
Project Description: PE4550

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						
Volatiles									
Benzene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	*80.4*		*ug/L*		*100*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24844

Report Date: 28-Feb-2019
Order Date: 27-Feb-2019
Project Description: PE4550

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Benzene	ND	0.5	ug/L	ND				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	*77.8*		*ug/L*		*97.2*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24844

Report Date: 28-Feb-2019
Order Date: 27-Feb-2019
Project Description: PE4550

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1500	25	ug/L		75.2	68-117			
Volatiles									
Benzene	33.7	0.5	ug/L		84.3	60-130			
Ethylbenzene	32.2	0.5	ug/L		80.6	60-130			
Toluene	30.5	0.5	ug/L		76.3	60-130			
m,p-Xylenes	65.1	0.5	ug/L		81.3	60-130			
o-Xylene	33.7	0.5	ug/L		84.3	60-130			
Surrogate: Toluene-d8	*68.5*		*ug/L*		*85.6*	*50-140*			

Qualifier Notes:

None

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 ID: 1909321

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Chain of Custody
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№ 121003

Page 1 of 1

Client Name: Paterson Group.	Project Reference: PE4550
Contact Name: Mark D'Arcy	Quote #
Address:	PO # 24844
Telephone: 226-7381	Email Address:

Turnaround Time:
☑ 1 Day see note below ☐ 3 Day
☐ 2 Day ☑ Regular
Date Required:

Criteria: ☑ O. Reg. 153/04 (As Amended) Table __ ☐ 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: 1909321

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)
1	BH1-GW1	GW	-	3	Feb 27/19	12:45	✓						
2	BH2-GW1	GW	-	3	"	10:30	✓						
3													
4													
5													
6													
7													
8													
9													
10													

Comments: BH2-GW1 is more critical than BH1-GW1, if both cannot be done on 24 hour. ½

Method of Delivery: Paracel

Relinquished By (Sign): N. Sullivan	Received by Driver/Depot: A. Louise	Received at Lab: [illegible]
Relinquished By (Print): Nick Sullivan	Date/Time: 27/02/19 4:40 pm	Date/Time: Feb 27/19 5:20
Date/Time: Feb 27/19 @4:15pm	Temperature: °C	Temperature: 3.1 °C
		Verified By: DPM — 20
		Date/Time: Feb 27/19 5:20
		pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Rd South
Nepean, ON K2E 7J5
Attn: Mark St. Pierre

Client PO: 26260
Project: PE4550
Custody: 121062

Report Date: 2-Apr-2019
Order Date: 27-Mar-2019

Order #: 1913431

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

Paracel ID	Client ID
1913431-01	BH1-GW2
1913431-02	BH3-GW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26260

Report Date: 02-Apr-2019
Order Date: 27-Mar-2019
Project Description: PE4550

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	31-Mar-19	31-Mar-19
PHC F1	CWS Tier 1 - P&T GC-FID	30-Mar-19	31-Mar-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	1-Apr-19	2-Apr-19
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	28-Mar-19	29-Mar-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26260

Report Date: 02-Apr-2019

Order Date: 27-Mar-2019

Project Description: PE4550

	Client ID:	BH1-GW2	BH3-GW1	-	-
	Sample Date:	03/27/2019 09:00	03/27/2019 09:00	-	-
	Sample ID:	1913431-01	1913431-02	-	-
	MDL/Units	Water	Water	-	-
Volatiles					
Benzene	0.5 ug/L	-	<0.5	-	-
Ethylbenzene	0.5 ug/L	-	<0.5	-	-
Toluene	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	-	-
Toluene-d8	Surrogate	-	114%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	-	<25	-	-
F2 PHCs (C10-C16)	100 ug/L	-	<100	-	-
F3 PHCs (C16-C34)	100 ug/L	-	<100	-	-
F4 PHCs (C34-C50)	100 ug/L	-	<100	-	-
Semi-Volatiles					
Acenaphthene	0.05 ug/L	<0.05	-	-	-
Acenaphthylene	0.05 ug/L	<0.05	-	-	-
Anthracene	0.01 ug/L	<0.01	-	-	-
Benzo [a] anthracene	0.01 ug/L	<0.01	-	-	-
Benzo [a] pyrene	0.01 ug/L	<0.01	-	-	-
Benzo [b] fluoranthene	0.05 ug/L	<0.05	-	-	-
Benzo [g,h,i] perylene	0.05 ug/L	<0.05	-	-	-
Benzo [k] fluoranthene	0.05 ug/L	<0.05	-	-	-
Chrysene	0.05 ug/L	<0.05	-	-	-
Dibenzo [a,h] anthracene	0.05 ug/L	<0.05	-	-	-
Fluoranthene	0.01 ug/L	<0.01	-	-	-
Fluorene	0.05 ug/L	<0.05	-	-	-
Indeno [1,2,3-cd] pyrene	0.05 ug/L	<0.05	-	-	-
1-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-
2-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-
Methylnaphthalene (1&2)	0.10 ug/L	<0.10	-	-	-
Naphthalene	0.05 ug/L	<0.05	-	-	-
Phenanthrene	0.05 ug/L	<0.05	-	-	-
Pyrene	0.01 ug/L	<0.01	-	-	-
2-Fluorobiphenyl	Surrogate	113%	-	-	-
Terphenyl-d14	Surrogate	113%	-	-	-

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						
Semi-Volatiles									
Acenaphthene	ND	0.05	ug/L						
Acenaphthylene	ND	0.05	ug/L						
Anthracene	ND	0.01	ug/L						
Benzo [a] anthracene	ND	0.01	ug/L						
Benzo [a] pyrene	ND	0.01	ug/L						
Benzo [b] fluoranthene	ND	0.05	ug/L						
Benzo [g,h,i] perylene	ND	0.05	ug/L						
Benzo [k] fluoranthene	ND	0.05	ug/L						
Chrysene	ND	0.05	ug/L						
Dibenzo [a,h] anthracene	ND	0.05	ug/L						
Fluoranthene	ND	0.01	ug/L						
Fluorene	ND	0.05	ug/L						
Indeno [1,2,3-cd] pyrene	ND	0.05	ug/L						
1-Methylnaphthalene	ND	0.05	ug/L						
2-Methylnaphthalene	ND	0.05	ug/L						
Methylnaphthalene (1&2)	ND	0.10	ug/L						
Naphthalene	ND	0.05	ug/L						
Phenanthrene	ND	0.05	ug/L						
Pyrene	ND	0.01	ug/L						
Surrogate: 2-Fluorobiphenyl	*16.7*		*ug/L*		*83.3*	*50-140*			
Surrogate: Terphenyl-d14	*22.4*		*ug/L*		*112*	*50-140*			
Volatiles									
Benzene	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: Toluene-d8	*90.3*		*ug/L*		*113*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26260

Report Date: 02-Apr-2019
Order Date: 27-Mar-2019
Project Description: PE4550

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Benzene	ND	0.5	ug/L	ND				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	*92.9*		*ug/L*		*116*	*50-140*			

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26260

Report Date: 02-Apr-2019
Order Date: 27-Mar-2019
Project Description: PE4550

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1950	25	ug/L		97.5	68-117			
F2 PHCs (C10-C16)	1490	100	ug/L		93.4	60-140			
F3 PHCs (C16-C34)	3860	100	ug/L		98.4	60-140			
F4 PHCs (C34-C50)	2100	100	ug/L		84.6	60-140			
Semi-Volatiles									
Acenaphthene	3.93	0.05	ug/L		78.6	50-140			
Acenaphthylene	3.58	0.05	ug/L		71.6	50-140			
Anthracene	4.26	0.01	ug/L		85.3	50-140			
Benzo [a] anthracene	4.26	0.01	ug/L		85.2	50-140			
Benzo [a] pyrene	4.04	0.01	ug/L		80.8	50-140			
Benzo [b] fluoranthene	5.54	0.05	ug/L		111	50-140			
Benzo [g,h,i] perylene	3.57	0.05	ug/L		71.5	50-140			
Benzo [k] fluoranthene	5.42	0.05	ug/L		108	50-140			
Chrysene	5.34	0.05	ug/L		107	50-140			
Dibenzo [a,h] anthracene	3.83	0.05	ug/L		76.7	50-140			
Fluoranthene	3.90	0.01	ug/L		78.0	50-140			
Fluorene	3.88	0.05	ug/L		77.6	50-140			
Indeno [1,2,3-cd] pyrene	3.99	0.05	ug/L		79.7	50-140			
1-Methylnaphthalene	5.06	0.05	ug/L		101	50-140			
2-Methylnaphthalene	5.33	0.05	ug/L		107	50-140			
Naphthalene	4.71	0.05	ug/L		94.3	50-140			
Phenanthrene	4.14	0.05	ug/L		82.8	50-140			
Pyrene	4.09	0.01	ug/L		81.7	50-140			
Surrogate: 2-Fluorobiphenyl	*18.2*		*ug/L*		*90.8*	*50-140*			
Volatiles									
Benzene	35.6	0.5	ug/L		89.0	60-130			
Ethylbenzene	34.8	0.5	ug/L		87.0	60-130			
Toluene	37.9	0.5	ug/L		94.6	60-130			
m,p-Xylenes	69.6	0.5	ug/L		87.0	60-130			
o-Xylene	35.4	0.5	ug/L		88.6	60-130			

Qualifier Notes:

None

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.

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Paracel ID: 1913431

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Page __ of __

Client Name: Paterson Group	Project Reference: PE 4550
Contact Name: Mark St Pierre	Quote #
Address: 154 Colonnade Rd.	PO # 26260
	Email Address: mstpierre@patersongroup.ca
Telephone: 613-226-7381	

Turnaround Time:
☐ 1 Day ☐ 3 Day
☐ 2 Day ☑ Regular
Date Required: ________

Criteria: ☐ O. Reg. 153/04 (As Amended) Table __ ☐ 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: 1913431

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)							
1	BH1-GW2	GW	-	1	Mar.27.19				✓											
2	BH3-GW1	GW	-	3	Mar.27.19		✓													
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): [signature]	Received by Driver/Depot: [signature]	Received at Lab: [illegible]	Verified By: [signature]
Relinquished By (Print):	Date/Time: 27/03/19 4:20 PM	Date/Time: MAR 29, 2019 08.0?	Date/Time: 28/Mar/19 7:10
Date/Time:	Temperature:	Temperature: 14.4 °C	pH Verified ☐ By: [illegible]

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Rd South
Nepean, ON K2E 7J5
Attn: Mark St. Pierre

Client PO: 26273
Project: PE4550
Custody: 121603

Report Date: 3-Apr-2019
Order Date: 28-Mar-2019

Order #: 1913548

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

Paracel ID	Client ID
1913548-01	BH3-GW1

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26273

Report Date: 03-Apr-2019
Order Date: 28-Mar-2019
Project Description: PE4550

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
REG 153: PAHs by GC-MS	EPA 625 - GC-MS, extraction	2-Apr-19	2-Apr-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26273

Report Date: 03-Apr-2019

Order Date: 28-Mar-2019

Project Description: PE4550

	Client ID:	BH3-GW1	-	-	-
	Sample Date:	03/28/2019 09:00	-	-	-
	Sample ID:	1913548-01	-	-	-
	MDL/Units	Water	-	-	-
Semi-Volatiles					
Acenaphthene	0.05 ug/L	<0.05	-	-	-
Acenaphthylene	0.05 ug/L	<0.05	-	-	-
Anthracene	0.01 ug/L	<0.01	-	-	-
Benzo [a] anthracene	0.01 ug/L	<0.01	-	-	-
Benzo [a] pyrene	0.01 ug/L	<0.01	-	-	-
Benzo [b] fluoranthene	0.05 ug/L	<0.05	-	-	-
Benzo [g,h,i] perylene	0.05 ug/L	<0.05	-	-	-
Benzo [k] fluoranthene	0.05 ug/L	<0.05	-	-	-
Chrysene	0.05 ug/L	<0.05	-	-	-
Dibenzo [a,h] anthracene	0.05 ug/L	<0.05	-	-	-
Fluoranthene	0.01 ug/L	<0.01	-	-	-
Fluorene	0.05 ug/L	<0.05	-	-	-
Indeno [1,2,3-cd] pyrene	0.05 ug/L	<0.05	-	-	-
1-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-
2-Methylnaphthalene	0.05 ug/L	<0.05	-	-	-
Methylnaphthalene (1&2)	0.10 ug/L	<0.10	-	-	-
Naphthalene	0.05 ug/L	<0.05	-	-	-
Phenanthrene	0.05 ug/L	<0.05	-	-	-
Pyrene	0.01 ug/L	<0.01	-	-	-
2-Fluorobiphenyl	Surrogate	106%	-	-	-
Terphenyl-d14	Surrogate	110%	-	-	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Semi-Volatiles									
Acenaphthene	ND	0.05	ug/L						
Acenaphthylene	ND	0.05	ug/L						
Anthracene	ND	0.01	ug/L						
Benzo [a] anthracene	ND	0.01	ug/L						
Benzo [a] pyrene	ND	0.01	ug/L						
Benzo [b] fluoranthene	ND	0.05	ug/L						
Benzo [g,h,i] perylene	ND	0.05	ug/L						
Benzo [k] fluoranthene	ND	0.05	ug/L						
Chrysene	ND	0.05	ug/L						
Dibenzo [a,h] anthracene	ND	0.05	ug/L						
Fluoranthene	ND	0.01	ug/L						
Fluorene	ND	0.05	ug/L						
Indeno [1,2,3-cd] pyrene	ND	0.05	ug/L						
1-Methylnaphthalene	ND	0.05	ug/L						
2-Methylnaphthalene	ND	0.05	ug/L						
Methylnaphthalene (1&2)	ND	0.10	ug/L						
Naphthalene	ND	0.05	ug/L						
Phenanthrene	ND	0.05	ug/L						
Pyrene	ND	0.01	ug/L						
Surrogate: 2-Fluorobiphenyl	*20.8*		*ug/L*		*104*	*50-140*			
Surrogate: Terphenyl-d14	*22.6*		*ug/L*		*113*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Semi-Volatiles									
Acenaphthene	3.91	0.05	ug/L		78.2	50-140			
Acenaphthylene	3.79	0.05	ug/L		75.9	50-140			
Anthracene	4.89	0.01	ug/L		97.7	50-140			
Benzo [a] anthracene	4.32	0.01	ug/L		86.4	50-140			
Benzo [a] pyrene	4.62	0.01	ug/L		92.5	50-140			
Benzo [b] fluoranthene	4.51	0.05	ug/L		90.3	50-140			
Benzo [g,h,i] perylene	4.65	0.05	ug/L		93.1	50-140			
Benzo [k] fluoranthene	5.03	0.05	ug/L		101	50-140			
Chrysene	5.73	0.05	ug/L		115	50-140			
Dibenzo [a,h] anthracene	3.67	0.05	ug/L		73.3	50-140			
Fluoranthene	4.41	0.01	ug/L		88.1	50-140			
Fluorene	4.17	0.05	ug/L		83.5	50-140			
Indeno [1,2,3-cd] pyrene	4.17	0.05	ug/L		83.4	50-140			
1-Methylnaphthalene	5.28	0.05	ug/L		106	50-140			
2-Methylnaphthalene	5.61	0.05	ug/L		112	50-140			
Naphthalene	4.70	0.05	ug/L		93.9	50-140			
Phenanthrene	4.49	0.05	ug/L		89.8	50-140			
Pyrene	4.65	0.01	ug/L		92.9	50-140			
Surrogate: 2-Fluorobiphenyl	*19.3*		*ug/L*		*96.3*	*50-140*			

Qualifier Notes:

None

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.

PARACEL LABORATORIES LTD

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Page 1 of 1

Client Name: Paterson Group	Project Reference: PE4550
Contact Name: Mark St Pierre	Quote #
Address: 154 Colonnade Rd South	PO # 26273
Telephone: 613-226-7381	Email Address: mstpierre@patersongroup.ca

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)

Paracel Order Number: 1913548

Required Analyses

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)							
1	BH3-GW1	GW	-	1	Mar. 28, 19	9:00am			✓											
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received by Driver/Depot: M. McLOUSE	Received at Lab: SUNBURY DONNAI	Verified By: D Gamer
Relinquished By (Print): Mark St Pierre	Date/Time: 28/03/19 3 20	Date/Time: MAR 28, 2019 04:08	Date/Time: 28/Mar/19 16:55
Date/Time:	Temperature: °C PT	Temperature: 15.9 °	pH Verified ☐ By: 12