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Paterson Group Inc.

Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

patersongroup

Phase II Environmental Site Assessment

10 McArthur Avenue
Ottawa, Ontario

Prepared For

2672915 Ontario Inc.

April 26, 2019

Report: PE4562-2

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EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 10 McArthur Avenue, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the Phase II Property. The subsurface investigation was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes, all of which were completed as 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 benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4) and metals, including chromium six and mercury. No detectable BTEX concentrations were identified in the soil samples, and thus, complied with the MECP Table 3 Standards. Several metal parameters and PHC fractions were detected in the samples, however, all metal and PHC results were in compliance with the selected MECP standards.

Groundwater samples were recovered from BH1 and BH2 and analyzed for volatile organic compounds (VOCs) and PHC parameters. Groundwater samples were in compliance with the MECP Table 3 Standards.

Conclusion

Based on the findings of the Phase II ESA, no further environmental investigation is required.

It is expected that the groundwater monitoring wells will be abandoned in accordance with O.Reg. 903, at the time of construction excavation. Further information can be provided upon request in this regard.

1.0 INTRODUCTION

At the request of 2672915 Ontario Inc., Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment for 10 McArthur Avenue, 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 in March 2019.

1.1 Site Description

Address:	10 McArthur Avenue, Ottawa, Ontario.
Legal Description:	Part 1; Part of Lot 62, Registered Plan 239, in the City of Ottawa
Location:	The site is located on the south side of McArthur Avenue, 45 m east of where McArthur Avenue transects with North River Road, in the City of Ottawa, Ontario. Refer to Figure 1 - Key Plan in the Figures section following the text.
PIN:	04249-0039
Latitude and Longitude:	45° 25' 50.24" N, 75° 40' 5.85" W

1.2 Property Ownership

The current registered property owners of 10 McArthur Avenue are Eric Patenaude and Todd Christopher. Paterson was retained to complete this Phase II ESA by Mr. Mo Sleiman with 2672915 Ontario Incorporated. The office of 2672915 Ontario Inc. is located at 2544 Bank Street, Ottawa, Ontario. Mr. Sleiman can be reached by telephone at (613) 288-1999.

1.3 Current and Proposed Future Uses

The Phase II Property is occupied by a two (2) storey building that is currently used for residential purposes. It is our understanding that the current building will be demolished, and the property will be redeveloped with a 10-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 MECP selected Table 3 Standards are based on the following considerations:

- ❒ Coarse-grained soil conditions
- ❒ Full depth generic site conditions
- ❒ Non-potable groundwater conditions
- ❒ Residential land use

Residential standards were selected based on the proposed future 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 situated in a mixed-use area that includes commercial offices and business that are located to the north, parkland to the west, and residential to the east and south. The site gently slopes downwards from south to north and is slightly above the grade of McArthur Avenue. Site drainage is primarily sheet flow to catch basins on McArthur Avenue. The regional topography slopes down in a westerly direction towards the Rideau River, approximately 170 m west of the subject site.

2.2 Past Investigations

A Phase I & II ESA was conducted by Trow in 2012, in which they identified a former retail fuel outlet (RFO) as a potentially contaminating activity (PCA) located on the property immediately west of the subject site. This former RFO represented an area of potential environmental concern (APEC) on the Phase I Property. A subsequent Phase II ESA was conducted, in which two (2) boreholes were drilled and completed as monitoring wells along the western property boundary. Soil samples were analyzed for BTEX and PHC (fraction F1-F4) parameters. All soil samples were in compliance with the selected MECP standards.

Groundwater was not tested due to insufficient water volume in the wells. Trow concluded that no further environmental work was required for the subject site.

Paterson completed a Phase I ESA in March 2019 for the subject site. Based on our findings of the Phase I ESA and untested groundwater beneath the site (2012 Phase II ESA), it was not possible to conclude that the presence of the former RFO had not impacted the subject site. Therefore, it was concluded that the presence of the former RFO located on the adjacent property, was still considered an APEC on the Phase I Property.

The PCA that represents an APEC on the Phase I 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 (APEC)	Location of APEC with respect to Phase I Property	Potentially Contaminating Activity (PCA)	Contaminants of Potential Concern (CPC)	Media Potentially Impacted
Former underground Storage Tank (UST)	Western portion of the Phase I ESA property.	Item 28 - Gasoline and Associated Products Storage in Fixed UST	BTEX, PHCs	Soil and/or groundwater

During the drilling program, a layer of fill was identified across the subject site. Although it was considered likely that the fill was just reworked native soil, it was decided that the fill would be tested for metals to ensure that if had not been impacted. 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 March 27, 2019, in conjunction with a Geotechnical Investigation. The field program consisted of drilling three (3) boreholes, all of which were completed as groundwater monitoring wells. Boreholes were drilled to depths of ranging from approximately 6.4 to 6.6 m below the existing grade.

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 these samples is based on the Contaminants of Potential Concern identified in the Phase I ESA.

Contaminants of concern for soil and groundwater include petroleum hydrocarbons (PHCs, fractions F_1-F_4) and benzene, toluene, ethylbenzene and xylenes (BTEX). The groundwater was also analyzed for the entire volatile organic compound (VOC) parameters for quality control purposes, while several fill samples were analyzed for metals.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

Based on information from the Geological Survey of Canada, the overburden thickness in the area of the subject site is estimated to be on the order of 2 to 5 m. The overburden consists of offshore marine deposits of erosional terraces. Bedrock in the area consists of shale of the Billings Formation.

Contaminants of Potential Concern

Based on the nature of the APEC identified on the subject site, the contaminants of potential concern (CPCs) are Petroleum Hydrocarbons (PHC F1-F4), Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and metals. The CPCs are expected to be present in the soil and/or groundwater of the subject site.

Existing Buildings and Structures

The subject site is occupied by a two (2) storey building constructed pre-1928 with a stone and mortar foundation. The building is currently used for residential purposes.

Water Bodies and Areas of Natural Significance

No water bodies or areas of natural significance were identified on the Phase I Property. The Rideau River is the closest water body and is located approximately 175 m west of the Phase I Property.

Drinking Water Wells

No potable wells were identified on the subject site or in the Phase I Study Area.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area consists of a government office/commercial use and parkland to the north and residential to the west followed by parkland, respectively, and residential to the east and south.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

Based on the historical review and review of previous engineering reports, it was concluded that a former RFO located on the property immediately west is an off-site PCA that was considered to represented an APEC on the Phase I Property, as per Table 2 of O.Reg 153/04:

- A former underground storage tank (UST) nest located on the adjacent property to the west, 365/369 North river Road.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of this Phase I-ESA is considered to be sufficient to conclude that there is an APEC on the subject site. A variety of independent sources were consulted as part of this assessment, and as such, the conclusions of this 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.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted on March 27, 2019 in conjunction with a Geotechnical Investigation. The field program consisted of drilling three (3) boreholes on the Phase II Property. The boreholes were drilled to a maximum depth of 6.69 m below the existing grade. All three (3) boreholes were completed as groundwater monitoring wells to access the groundwater table.

The boreholes were placed to address the APEC and to provide coverage of the site from a geotechnical perspective. The boreholes were drilled with a truck mounted power auger drill rig. The truck mounted drill rig was provided by George Downing Estate Drilling of Hawkesbury, Ontario. Borehole locations are shown on Drawing PE4562-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of twenty-four (24) soil samples were obtained from the boreholes by means of sampling from shallow auger flights and split spoon sampling. The depths at which auger samples, split spoon and rock coring samples were obtained from the boreholes are shown respectively, as "**AU**", "**SS**" and "**RC**" on the Soil Profile and Test Data Sheets, appended to this report.

Site soils generally consist of an asphaltic pavement structure underlain by fill material, followed by glacial till and bedrock. Fill material present beneath the pavement structure extended to depths ranging from 1.83 m to a maximum depth of 1.69 m and consisted of some gravel and reworked native soils. Glacial till was present beneath the fill material and extended to depths ranging from 3.35 to 4.11 m below the existing grade. Shale was encountered between depths of 3.35 to 4.11 m and extended to depths ranging from 6.4 to 6.69 m below the existing grade.

4.3 Field Screening Measurements

All soil samples collected were subjected to a preliminary screening procedure, which included visual screening for colour and evidence of metals, as well as soil vapour screening with a MiniRAE 2000 Portable VOC Monitor.

The soil vapours were measured by inserting the analyzer probe into the nominal headspace above the soil sample. Samples were then agitated/manipulated gently as the measurements were taken. The peak reading registered within the first 15 seconds was recorded as the vapour measurement.

The vapour readings were found to have zero reading (0 ppm). Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

There were no visual indications of potential contamination. Four (4) soil samples were selected for analytical testing

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the Phase II Property as part of the subsurface investigation. Two monitoring wells, BH2 and BH3 consisted of 51 mm diameters Schedule 40 threaded PVC risers and screens, while BH1 consisted of a 32 mm diameter Schedule 40 threaded PVC risers and screens. 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.

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	56.60	6.60	3.6-6.60	3.07-6.60	2.28-3.07	Flushmount
BH2	56.69	6.40	4.9-6.40	4.27-6.40	3.05-4.27	Flushmount
BH3	56.66	6.69	5.19-6.69	4.27-6.69	3.05-4.27	Flushmount

4.5 Field Measurement of Water Quality Parameters

Groundwater sampling was conducted on April 2, 2019. Water levels were measured in the field at that time.

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 monitoring 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 Phase I Conceptual Site Model (Section 3.3) and field screening, selected soil and groundwater samples presented in Tables 3 and 4, were submitted and analyzed for BTEX/VOC, PHCs and/or metals.

TABLE 3: Soil Samples Submitted					
Sample ID	Sample Depth / Stratigraphic Unit	Parameters Analyzed			Rationale
		PHCs (F_1-F_4)	BTEX	Metals[1]	
BH1-SS5	3.05-3.66m, Till	X	X	X	Assess potential impacts due to the former RFO immediately west of the subject site.
BH2-SS2	0.76-1.40m, Fill			X	Assess fill/reworked native soil encountered during the drilling program.
BH2-SS5	3.05-3.66m, Till	X	X	X	Assess potential impacts due to the former RFO immediately west of the subject site.
BH3-SS3	1.52-2.13m, Fill			X	Assess fill/reworked native soil encountered during the drilling program.
1 – Metals including Chromium VI and Mercury					

TABLE 4: Groundwater Samples Submitted				
Sample ID	Screened Interval/ Stratigraphic Unit	Parameters Analyzed		Rationale
		PHCs (F_1-F_4)	VOCs	
BH1-GW1	3.55-6.60m, Shale Bedrock	X	X	Assess potential groundwater impacts due to the former RFO immediately west of the subject site.
BH2-GW1	4.88-6.40m, Shale Bedrock	F1-only	X	Assess potential groundwater impacts due to the former RFO immediately west of 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 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. All borehole elevations are relative to the top of the grate of the catch basin located on McArthur Avenue, slightly west from the subject site with a geodetic elevation of 56.63m above sea level (m asl) as provided by Annis, O'Sullivan, Vollebekk Ltd.

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

The soil profile generally consists of a pavement structure over fill material, underlain by glacial till, followed by shale bedrock. The site stratigraphy is shown on Drawing PE4562-6–Cross-Section A-A'– Soil. Groundwater was encountered within shale at depths ranging from approximately 6.25 to 6.44 m below the existing grade, as shown on Drawing PE4562-7-A-A' – Groundwater.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling event on April 2, 2019, using an electronic water level meter. Groundwater levels are summarized below in Table 5. All borehole elevations are relative to the top of the grate of the catch basin located on McArthur Avenue, slightly west from the subject site, as presented in Drawing PE4562-3, with a geodetic elevation of 56.63 m asl as provided by Annis, O'Sullivan, Vollebekk Ltd.

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	56.60	6.41	50.19	April 2, 2019
BH2	56.69	6.25	50.44	April 2, 2019
BH3	56.66	6.44	50.22	April 2, 2019

Based on the groundwater elevations measured during the April 2019 sampling event, groundwater contour mapping was completed. Groundwater contours are shown on Drawing PE4562-3 –Test Hole Location Plan. Based on the contour mapping, groundwater beneath the Phase II Property appears to flow towards a north-easterly direction. A horizontal hydraulic gradient of approximately 0.03 m/m was calculated. It is expected that the groundwater typically flows in a westerly direction; however, the elevated water levels at the time of the fieldwork have affected the obtained measurements.

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 negligible vapour readings (0 ppm). 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

Four (4) soil samples were submitted for analysis of BTEX, PHCs (F1-F4) and metals. The results of the analytical testing are presented in Tables 6 and 7. The laboratory certificates of analysis are provided in Appendix 1.

TABLE 6: Analytical Test Results – Soil – BTEX and PHC (F1-F4)

Parameter	MDL (µg/g)	Soil Samples (µg/g) March 27, 2019		MECP Table 3 Residential Standards (µg/g)
		BH1-SS5	BH2-SS5	
Benzene	0.02	nd	nd	0.21
Ethylbenzene	0.05	nd	nd	2
Toluene	0.05	nd	nd	2.3
Xylenes (Total)	0.05	nd	nd	3.1
PHC F1	7	nd	nd	55
PHC F2	4	11	22	98
PHC F3	8	36	39	300
PHC F4	6	54	nd	2800

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds MECP Table 3 Standards

All BTEX and PHC parameter concentrations were in compliance with the MECP Table 3 Standards.

TABLE 7: Analytical Test Results – Soil – Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g) March 27, 2019				MECP Table 3 Residential Standards (µg/g)
		BH1-SS5	BH2-SS2	BH2-SS5	BH3-SS3	
Antimony	1.0	nd	nd	nd	nd	7.5
Arsenic	1.0	2.4	04.0	3.3	3.4	18
Barium	1.0	85.5	141	148	72.8	390
Beryllium	0.5	nd	0.7	nd	0.5	4
Boron	5.0	6.5	6.1	7.0	6.1	120
Cadmium	0.5	nd	nd	nd	nd	1.2
Chromium	1.0	16.1	30.3	16.5	9.0	160
Chromium (VI)	0.2	nd	nd	nd	nd	8
Cobalt	1.0	6.4	9.8	6.7	10.4	22
Copper	1.0	12.4	34.4	15.7	19.3	140
Lead	1.0	11.0	30.8	6.9	5.6	120
Mercury	0.1	nd	0.2	nd	nd	0.27
Molybdenum	1.0	1.4	1.8	2.1	1.8	6.9
Nickel	1.0	12.0	27.5	19.2	31.0	100
Selenium	1.0	nd	nd	nd	nd	2.4
Silver	0.5	nd	1.7	nd	nd	20
Thallium	1.0	nd	nd	nd	nd	1
Uranium	1.0	1.4	nd	1.4	nd	23
Vanadium	1.0	24.2	42.3	26.2	30.5	86
Zinc	1.0	61.6	93.8	29.8	38.9	340

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold and Underlined** – Value exceeds MECP Table 3 Standards

All metal parameter concentrations were in compliance of the selected MECP standards. Analytical results of soil sampled with respect to borehole locations is shown on Drawing PE4562-4 – Analytical Testing Plan – Soil.

The maximum concentrations of analyzed parameters in the soil at the site are summarized below in Table 8.

TABLE 8: Maximum Concentrations – Soil			
Parameter	**Maximum Concentrations (µg/g)**	**Borehole**	**Depth Interval (m BGS)**
PHC F2	22	BH2-SS5	3.05-3.66m, Till
PHC F3	39		
PHC F4	54	BH1-SS5	3.05-3.66m, Till
Arsenic	4.0	BH2-SS2	0.76-1.40m, Fill
Barium	148	BH2-SS5	3.05-3.66m, Till
Beryllium	0.7	BH2-SS2	0.76-1.40m, Fill
Boron	7.0	BH2-SS5	3.05-3.66m, Till
Chromium	30.3	BH2-SS2	0.76-1.40m, Fill
Cobalt	10.4	BH3-SS3	1.52-2.13m, Fill
Copper	34.4	BH2-SS2	0.76-1.40m, Fill
Lead	30.8		
Mercury	0.2		
Molybdenum	2.1	BH2-SS5	3.05-3.66m, Till
Nickle	31.0	BH3-SS3	1.52-2.13m, Fill
Silver	1.7	BH2-SS2	0.76-1.40m, Fill
Uranium	1.4	BH1-SS5; BH2-SS5	3.05-3.66m, Till
Vanadium	42.3	BH2-SS2	0.76-1.40m, Fill
Zinc	93.8		

Notes:
- **Bold and Underlined** – Value exceeds MECP Table 3 Standards

All other parameter concentrations were below laboratory detection limits.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH1 and BH2 were submitted for laboratory analysis of VOC and PHC (F1-F2) parameters. Water was purged and sampled from BH3 for observational purposes and possible analysis, pending the results from BH1 and BH2. It was subsequently determined that there was no need to analyze this sample. No evidence of petroleum hydrocarbon impact was noted in/on the water acquired from BH3.

The groundwater samples were obtained from the screened intervals noted on Table 2. The results of the analytical testing are presented below in Tables 9 and 10. The laboratory certificates of analysis are provided in Appendix 1.

TABLE 9: Analytical Test Results – Groundwater – PHCs				
Parameter	MDL (µg/L)	Groundwater Samples (µg/L) April 2, 2019		MECP Table 3 Residential Standards (µg/L)
		BH1-GW1	BH2-GW1	
PHC F1	25	nd	nd	750
PHC F2	100	nd	NA	150
PHC F3	100	nd	NA	500
PHC F4	100	nd	NA	500

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- NA – parameter not analyzed due to insufficient volume
- **Bold and Underlined** – Value exceeds MECP Table 3 Standards

No detectable PHC concentrations were identified in the groundwater samples analyzed. The groundwater is in compliance with the selected Standards for PHCs.

TABLE 10: Analytical Test Results – Groundwater – VOCs				
Parameter	MDL (µg/L)	Groundwater Samples (µg/L) April 2, 2019		MECP Table 3 Residential Standards (µg/L)
		BH1-GW1	BH2-GW1	
Acetone	5	nd	nd	130,000
Benzene	0.5	nd	2.2	44
Bromodichloromethane	0.5	nd	nd	85,00
Bromoform	0.5	nd	nd	380
Bromomethane	0.5	nd	nd	5.6
Carbon Tetrachloride	0.2	nd	nd	0.79
Chlorobenzene	0.5	nd	nd	630
Chloroform	0.5	nd	nd	2.4
Dibromochloromethane	0.5	nd	nd	82,000
Dichlorodifluoromethane	1.0	nd	nd	4,400
1,2-Dichlorobenzene	0.5	nd	nd	4,600
1,3-Dichlorobenzene	0.5	nd	nd	9,600
1,4-Dichlorobenzene	0.5	nd	nd	8
1,1-Dichloroethane	0.5	nd	nd	320
1,2-Dichloroethane	0.5	nd	nd	1.6
1,1-Dichloroethylene	0.5	nd	nd	1.6
cis-1,2-Dichloroethylene	0.5	nd	nd	1.6
trans-1,2-Dichloroethylene	0.5	nd	nd	1.6
1,2-Dichloropropane	0.5	nd	nd	16
1,3-Dichloropropene, total	0.5	nd	nd	5.2
Ethylbenzene	0.5	nd	3.8	2,300
Ethylene dibromide	0.2	nd	nd	0.25
Hexane	1.0	nd	nd	51
Methyl Ethyl Ketone	5.0	nd	nd	470,000
Methyl Isobutyl Ketone	5.0	nd	nd	140,000
Methyl tert-butyl ether	2.0	nd	nd	190

TABLE 10: Analytical Test Results – Groundwater – VOCs				
Parameter	**MDL (µg/L)**	**Groundwater Samples (µg/L)**		**MECP Table 3 Residential Standards (µg/L)**
		April 2, 2019		
		BH1-GW1	**BH2-GW1**	
Methylene Chloride	5.0	nd	nd	610
Styrene	0.5	nd	nd	1,300
1,1,1,2-Tetrachloroethane	0.5	nd	nd	3.3
1,1,2,2-Tetrachloroethane	0.5	nd	nd	3.2
Tetrachloroethylene	0.5	nd	nd	1.6
Toluene	0.5	nd	9.0	18,000
1,1,1-Trichloroethane	0.5	nd	nd	640
1,1,2-Trichloroethane	0.5	nd	nd	4.7
Trichloroethylene	0.5	nd	nd	1.6
Trichlorofluoromethane	1.0	nd	nd	2,500
Vinyl Chloride	0.5	nd	nd	0.5
Xylenes, total	0.5	nd	6.0	4,200

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL

All VOC parameter concentrations were compliance with the selected MECP standards. Analytical results of groundwater sampled with respect to borehole locations are shown on Drawing PE4562-5 Analytical Testing Plan–Groundwater.

The maximum concentrations of analyzed parameters in the groundwater beneath the site are summarized below in Table 11.

TABLE 11: Maximum Concentrations – Groundwater			
Parameter	**Maximum Concentrations (µg/g)**	**Monitoring Well**	**Screened Interval (m BGS)**
Benzene	2.2	BH2-GW1	4.88-6.40 m
Toluene	3.8		
Ethylbenzene	9.0		
Xylenes	6.0		

Notes:
- **Bold and Underlined** – Value exceeds MECP Table 3 Standards

All other parameter concentrations were below laboratory detection limits.

5.7 Quality Assurance and Quality Control Results

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

As per Subsection 47(3) of O.Reg. 153/04 as amended by 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 Activity and Areas of Potential Environmental Concern

As indicated in the Phase I-ESA report and Section 2.2 of this report, the following PCA is considered to result in an APEC on the Phase I/Phase II Property:

- ❑ A former underground storage tank (UST) nest located on the property immediately west of the Phase I Property;

Contaminants of potential concern associated with the aforementioned PCA include a combination of BTEX, and PHCs (F1-F4) in the groundwater and/or soil.

Additionally, a layer of fill was identified across the subject site during the drilling program. Although it was considered likely that the fill was just reworked native soil, it was decided that the fill would be tested for metals to ensure that if had not been impacted.

Subsurface Structures and Utilities

Underground service locates were completed prior to the subsurface investigation. Underground utilities on the Phase II Property include natural gas, electrical, communications, water, and sewage services.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is illustrated on Drawings PE4562-6 and PE4562-7. The stratigraphy consists of:

- Pavement structure consisting of approximately 0.004 m thick of asphaltic concrete over crushed stone fill material.
- Fill material generally comprised of crushed stone, some gravel and organics, beneath the pavement structure and extending to depths ranging from approximately 1.83 to 1.96m below the existing grade.
- Glacial till comprised of grey silty sand with clay was identified beneath the fill material. The till material extends to depths ranging from approximately 3.35 to 4.11 m below the existing grade.
- Bedrock comprised of grey/black shale was identified beneath the glacial till. The shale extends to depths ranging from approximately 6.40 to 6.69 m below the existing grade.

Hydrogeological Characteristics

Groundwater at the Phase II Property was encountered within the shale bedrock. This unit is interpreted to function as a local aquifer at the subject site.

Water levels were measured at the subject site on April 1, 2019, at depths ranging from 6.25 to 6.44 m below grade. Based on the groundwater elevations measured during this monitoring event, groundwater contour mapping was completed and the horizontal hydraulic gradient for the subject site was calculated. Groundwater flow at the subject site was in a north-easterly direction, with a hydraulic gradient of approximately 0.03m/m. It is expected that the groundwater typically flows in a westerly direction; however, the elevated water levels at the time of the fieldwork have affected the obtained measurements.

The groundwater contour of the subject site is shown on Drawing PE4562-3.

Approximate Depth to Bedrock

Bedrock is present at approximately 3.35 to 4.11 m below the existing grade.

Approximate Depth to Water Table

Depth to water table at the subject site varies between approximately 6.25 to 6.44 m below the existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation (Site Condition Standards, Environmentally Sensitive Areas) does not apply to the subject site.

Section 43.1 of the Regulation does not apply to the subject site in that the subject site is not a Shallow Soil Property.

Fill Placement

Fill material was identified across the Phase II Property beneath the pavement structure and extending to depths ranging from 1.83 to 1.99m below grade. The fill material is suspected to be reworked native soil and was likely a result of the onsite development as well as the recently constructed condo building to the west.

Proposed Buildings and Other Structures

It is our understanding that the Phase II Property will be redeveloped with a 10-unit residential building.

Existing Buildings and Structures

A two (2)-storey building constructed pre-1928 is present onsite and currently used for residential purposes.

Areas of Natural Significance and Water Bodies

No water bodies or areas of natural significance were identified on the subject Property. The Rideau River is the closest water body and is located approximately 175 m west of the Phase II Property.

Environmental Condition

Areas Where Contaminants are Present

All parameter concentrations in soil and groundwater were in compliance with the selected MECP standards.

Types of Contaminants

Based on the analytical testing, there are no contaminants of concern in either soil or groundwater. As noted previously, both soil and groundwater at the Phase II Property are in compliance with the selected MECP Standards.

Contaminated Media

No soil or groundwater impacts were identified.

Known Areas Where Contaminants Are Present

Neither soil nor groundwater impacts were identified on the Phase II Property.

Distribution and Migration of Contaminants

As previously noted, no impacted soil or groundwater was identified on the subject site. Therefore, concerns regarding the distribution or migration of contaminants do not apply to the Phase II Property or Study Area.

Discharge of Contaminants

No impacted soil or groundwater was identified on the subject site, therefore, concerns regarding the discharge of contaminants do not apply to the Phase II Property or Study Area.

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. Based on the analytical results, there are no concerns with regards to leaching and/or migration, as there are no contaminants of concern on the subject site.

Potential for Vapour Intrusion

No impacted soil or groundwater was identified on the subject site, therefore, concern regarding potential of vapour intrusion does not apply to the Phase II Property.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 10 McArthur Avenue, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address potentially contaminating activities (PCAs) that were identified during the Phase I ESA and considered to result in areas of potential environmental concern (APECs) on the Phase II Property. The subsurface investigation was carried out in conjunction with a Geotechnical Investigation and consisted of drilling three (3) boreholes, all of which were completed as 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 benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4) and metals, including chromium six and mercury. No detectable BTEX concentrations were identified in the soil samples, and thus, complied with the MECP Table 3 Standards. Several metal parameters and PHC fractions were detected in the samples, however, all metal and PHC results were in compliance with the selected MECP standards.

Groundwater samples were recovered from BH1 and BH2 and analyzed for volatile organic compounds (VOCs) and PHC parameters. Groundwater samples were in compliance with the MECP Table 3 Standards.

Conclusion

Based on the findings of the Phase II ESA, no further environmental investigation is required.

It is expected that the groundwater monitoring wells will be abandoned in accordance with O.Reg. 903, at the time of construction excavation. Further information can be provided upon request in this regard.

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 2672915 Ontario Inc. Notification from 2672915 Ontario Inc. and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Mandy Witteman, M.A.Sc.

Mark S. D'Arcy, P.Eng.

Report Distribution:

- 2672915 Ontario Inc.
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4562-3 – TEST HOLE LOCATION PLAN

DRAWING PE4562-4 – ANALYTICAL TESTING PLAN – SOIL

DRAWING PE4562-5 – ANALYTICAL TESTING PLAN – GROUNDWATER

DRAWING PE4562-6 – CROSS-SECTION A-A' – SOIL

DRAWING PE4562-7 – CROSS-SECTION A-A' – GROUNDWATER

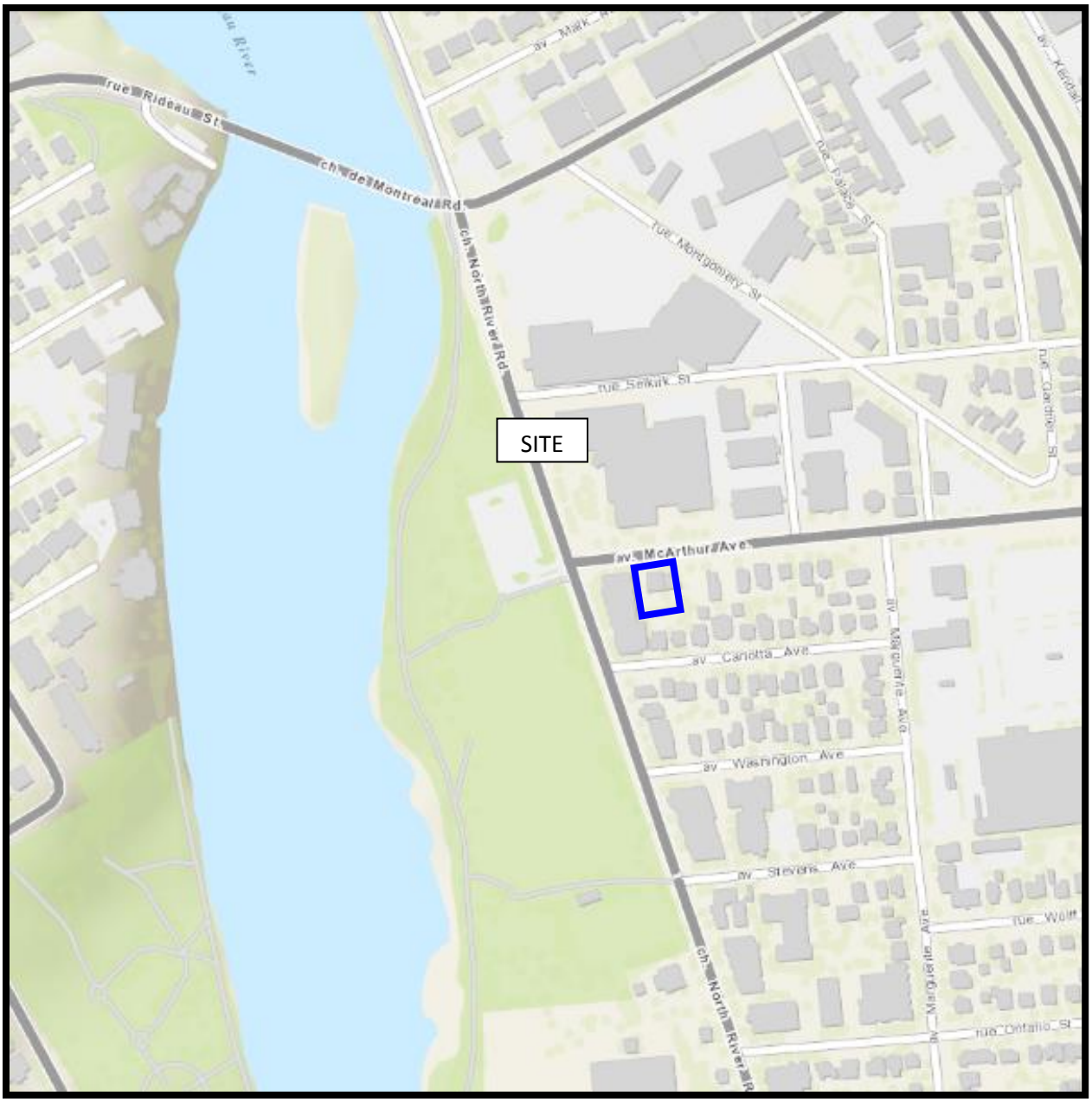
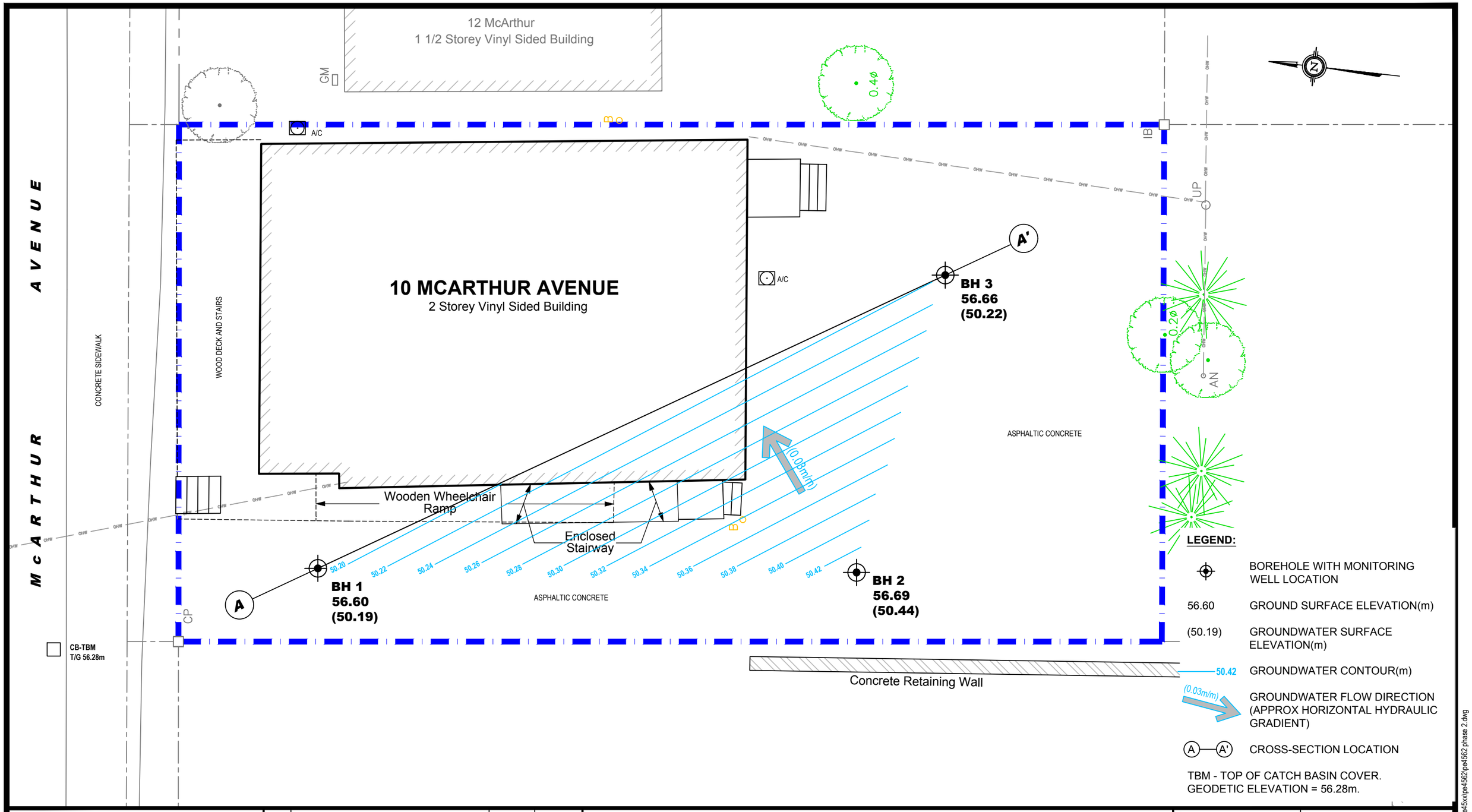


FIGURE 1

KEY PLAN



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

2672915 ONTARIO INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
10 McARTHUR AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:100	Date: 04/2019
Drawn by: RCG	Report No.: PE4562-2
Checked by: MW	**PE4562-3**
Approved by: MSD	Revision No.:

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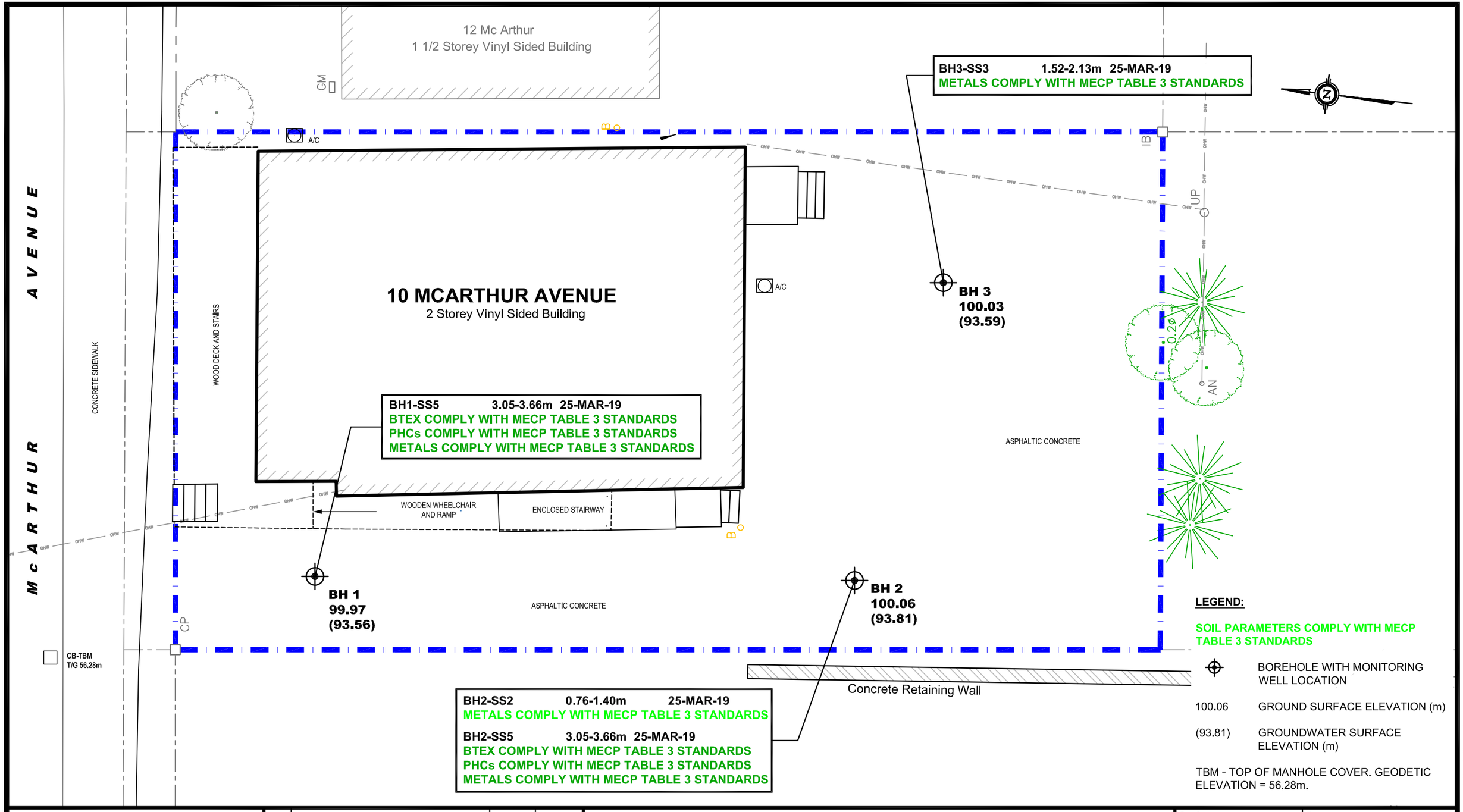

patersongroup
consulting engineers
154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

2672915 ONTARIO INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
10 Mc ARTHUR AVENUE
OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - SOIL

Scale: 1:100	Date: 04/2019
Drawn by: RCG	Report No.: PE4562-2
Checked by: MW	PE4562-4
Approved by: MSD	Revision No.:

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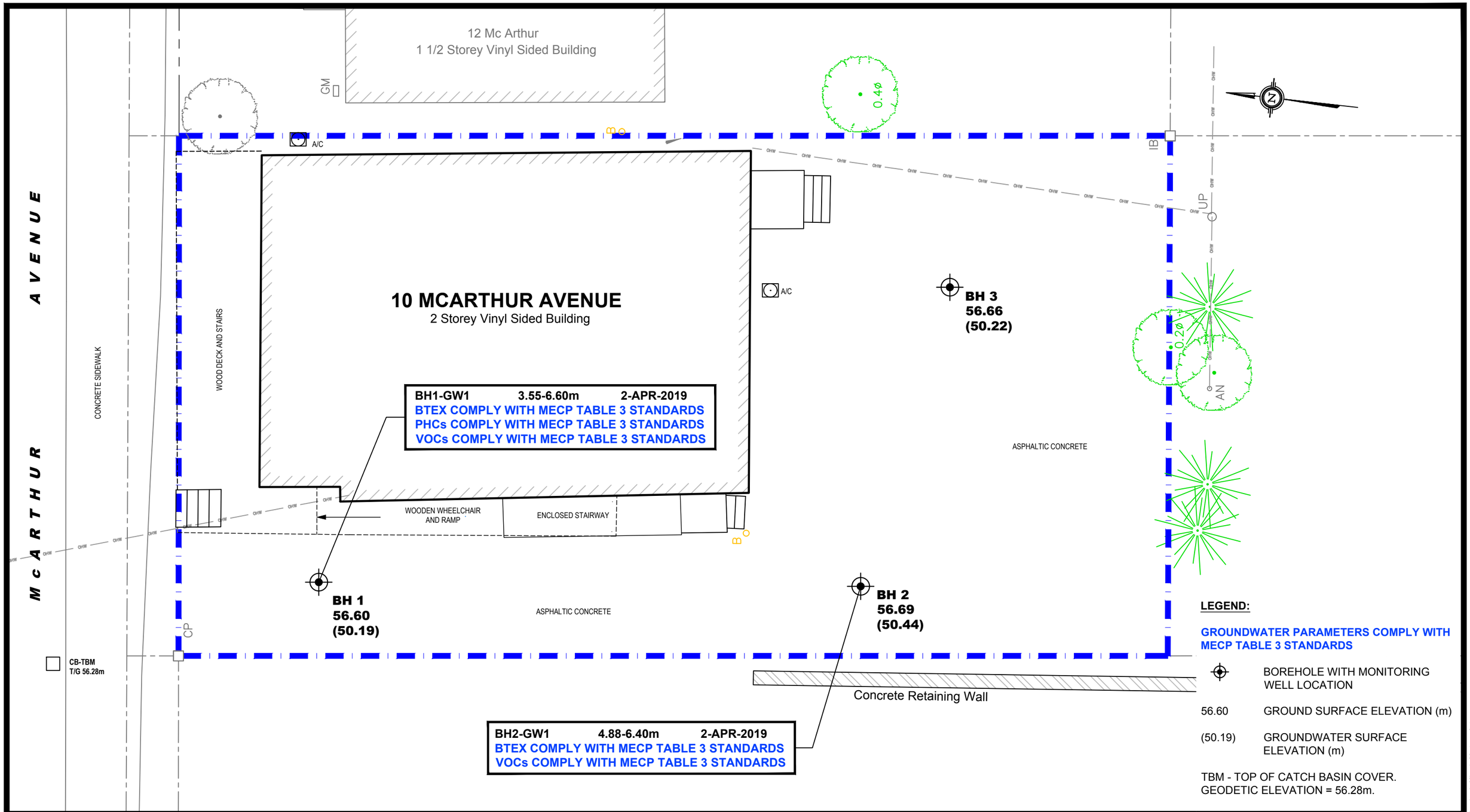

LEGEND:

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 3 STANDARDS

BOREHOLE WITH MONITORING WELL LOCATION

56.60 GROUND SURFACE ELEVATION (m)

(50.19) GROUNDWATER SURFACE ELEVATION (m)

TBM - TOP OF CATCH BASIN COVER.
GEODETIC ELEVATION = 56.28m.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

2672915 ONTARIO INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
10 McARTHUR AVENUE
OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - GROUNDWATER

Scale: 1:100	Date: 04/2019
Drawn by: RCG	Report No.: PE4562-2
Checked by: MW	PE4562-5
Approved by: MSD	Revision No.:

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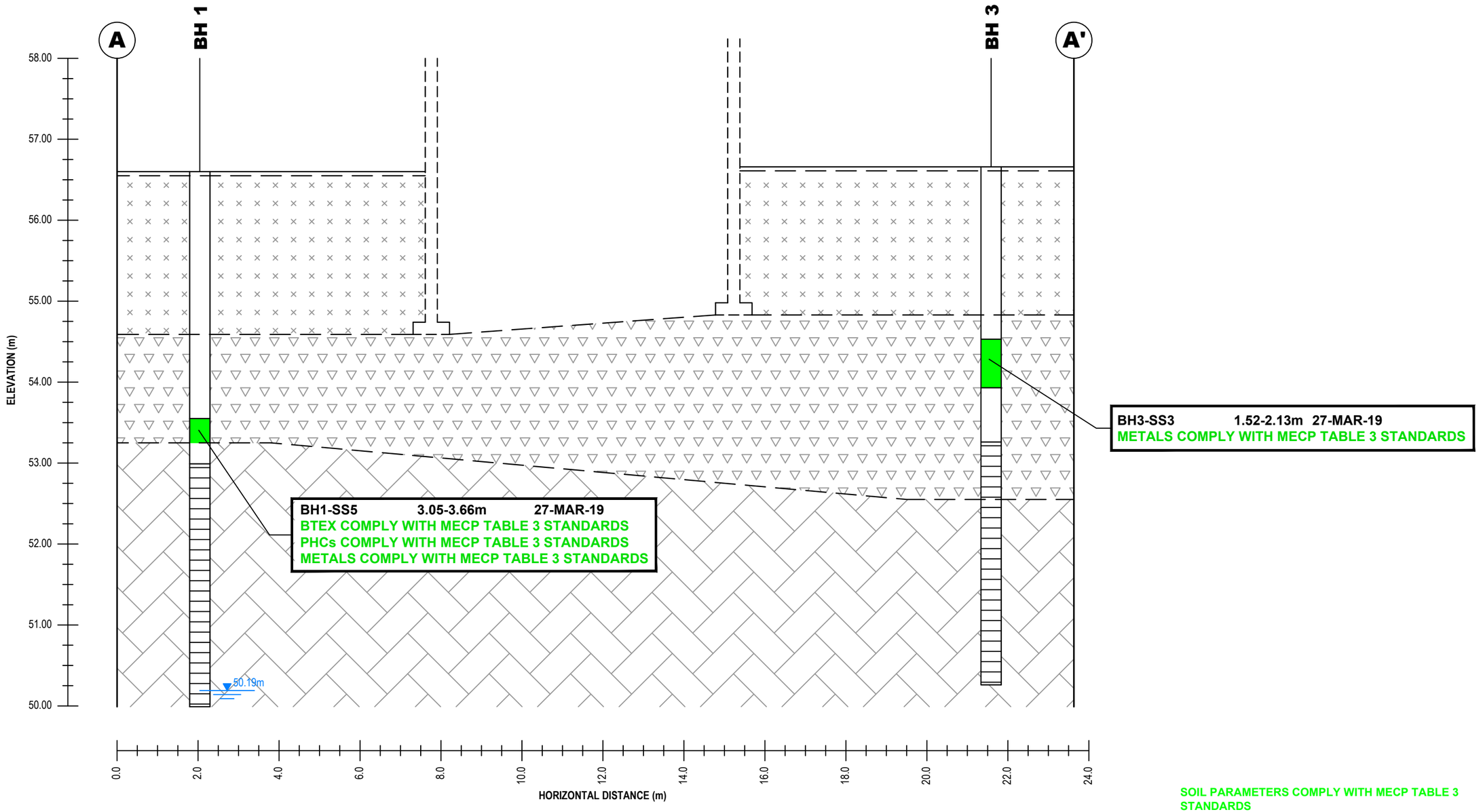

SOIL PARAMETERS COMPLY WITH MECP TABLE 3 STANDARDS

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

2672915 ONTARIO INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
10 McARTHUR AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - SOIL

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4562-2
Checked by: MW	PE4562-6
Approved by: MSD	Revision No.:

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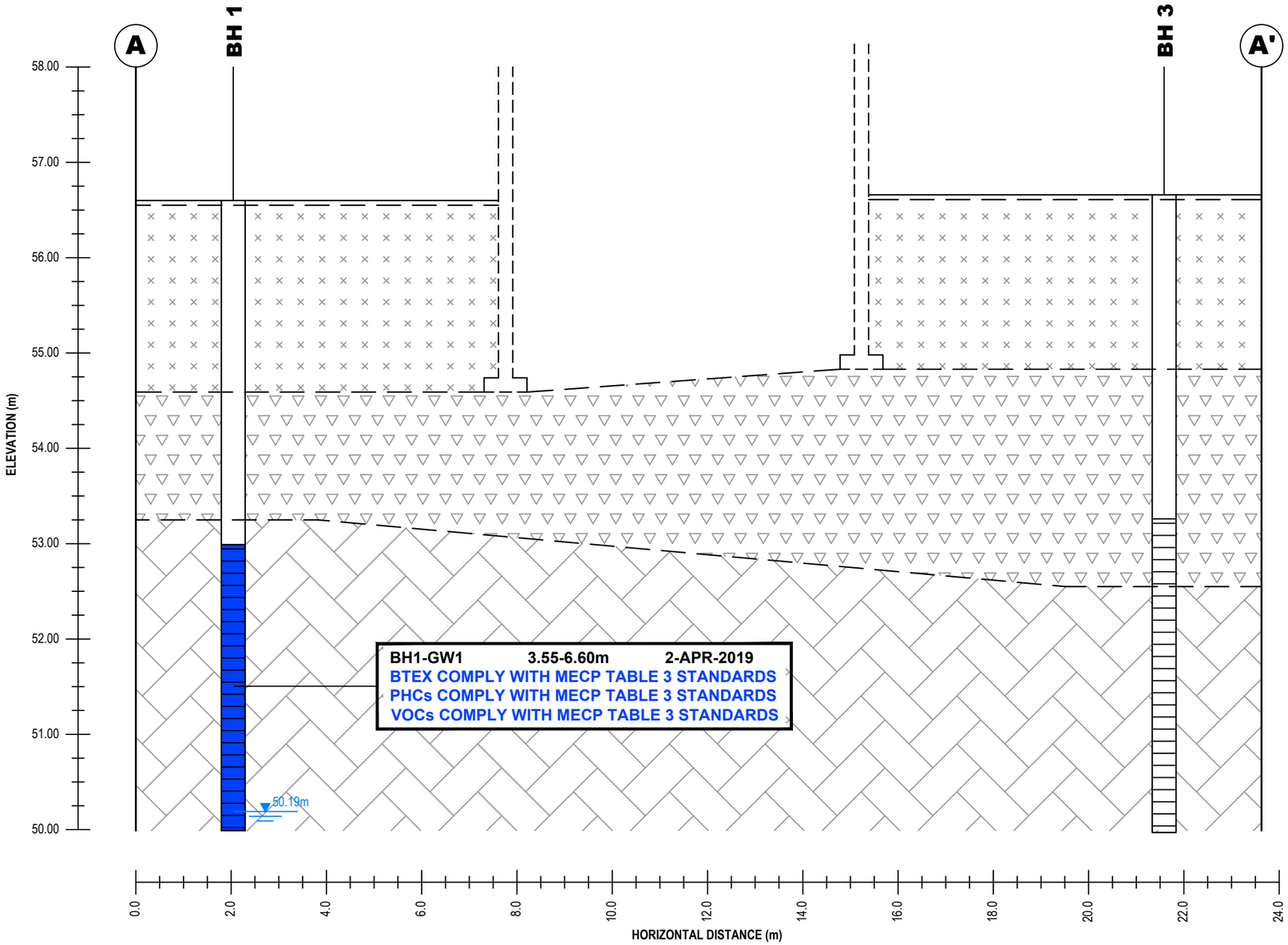

GROUNDWATER PARAMETERS COMPLY WITH MECP TABLE 3 STANDARDS

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

2672915 ONTARIO INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
10 McARTHUR AVENUE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A' - GROUNDWATER

Scale: AS SHOWN	Date: 04/2019
Drawn by: MPG	Report No.: PE4562-2
Checked by: MW	PE4562-7
Approved by: MSD	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

Paterson Group Inc.

Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

patersongroup

Sampling & Analysis Plan

Phase II Environmental Site Assessment
10 McArthur Avenue
Ottawa, Ontario

Prepared For

2672915 Ontario Inc.

March 2019

Report: PE4562-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Mr. Mo Sleiman to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 10 McArthur Avenue, in the City of Ottawa, Ontario

The Phase II ESA was carried out to address the APEC identified in the Paterson Phase I ESA. The following subsurface investigation program was developed to identify and delineate any potential concerns:

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1	Assess the potential subsurface impacts due to the former retail fuel outlet, situated on the adjacent property to the west.	Boreholes to be advanced to intercept water table to facilitate installation of groundwater monitoring wells.
BH2	Assess the potential subsurface impacts due to the former retail fuel outlet, situated on the adjacent property to the west.	
BH3	Assess the potential subsurface impacts due to the former retail fuel outlet, situated on the adjacent property to the west.	

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 MOECC 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. All borehole elevations are relative to the top of the grate of the catch basin located on McArthur Avenue, slightly west from the subject site with a geodetic elevation of 56.63m above sea level (m asl) as provided by Annis, O'Sullivan, Vollebekk Ltd.

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

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
10 McArthur Avenue
Ottawa, Ontario

DATUM TBM - Top of catch basin cover on south side of McArthur Avenue. Geodetic elevation = 56.28m.

FILE NO. PE4562

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** March 27, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	56.60
Asphaltic concrete 0.05		AU	1				
FILL: Brown silty sand with gravel, some organics		SS	2	46	12	1	55.60
1.96		SS	3	100	17	2	54.60
GLACIAL TILL: Brown silty sand and gravel with cobbles		SS	4	12	7		
3.35		SS	5	58	50+	3	53.60
		RC	1	80	42	4	52.60
BEDROCK: Poor to very poor quality, black weathered shale		RC	2	70	12	5	51.60
		RC	3	61	17	6	50.60
6.61							
End of Borehole							
(GWL @ 6.41m - April 1, 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

Phase II - Environmental Site Assessment
10 McArthur Avenue
Ottawa, Ontario

DATUM TBM - Top of catch basin cover on south side of McArthur Avenue. Geodetic elevation = 56.28m.

FILE NO. PE4562

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** March 27, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.05						0	56.69
FILL: Brown silty sand with gravel 0.60		AU	1				
FILL: Brown clayey silt with sand and gravel		SS	2	79	15	1	55.69
1.83		SS	3	71	14	2	54.69
GLACIAL TILL: Grey silty clay to clayey silt with sand, gravel and cobbles		SS	4	46	6	3	53.69
		SS	5	54	12		
4.11		SS	6	100	50+	4	52.69
		SS	7	100	50+	5	51.69
BEDROCK: Weathered black shale		AU	8				
6.40						6	50.69
End of Borehole							
(GWL @ 6.25m - April 1, 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

Phase II - Environmental Site Assessment
10 McArthur Avenue
Ottawa, Ontario

DATUM TBM - Top of catch basin cover on south side of McArthur Avenue. Geodetic elevation = 56.28m.

FILE NO. PE4562

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** March 27, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	56.66
Asphaltic concrete 0.05		AU	1				
FILL: Brown silty sand with gravel		SS	2	75	17	1	55.66
1.83		SS	3	75	9	2	54.66
GLACIAL TILL: Grey sandy silt to silty sand with clay, gravel and cobbles		SS	4	100	8	3	53.66
		SS	5	29	18		
4.11		SS	6	79	50+	4	52.66
		SS	7	100	50+	5	51.66
BEDROCK: Weathered black shale		AU	8			6	50.66
6.69							
End of Borehole							
(GWL @ 6.44m - April 1, 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 relative strength of cohesionless soils is the compactness condition, 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. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water 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 at 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

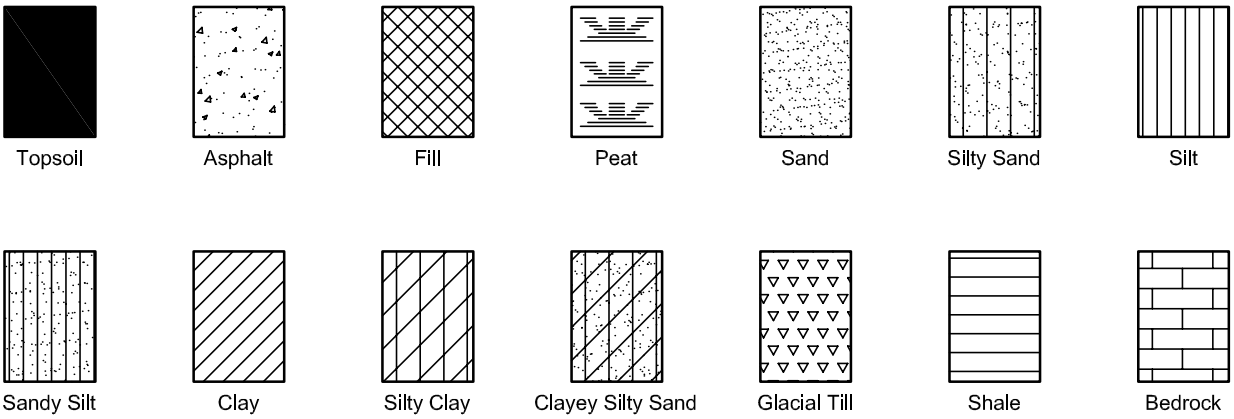
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

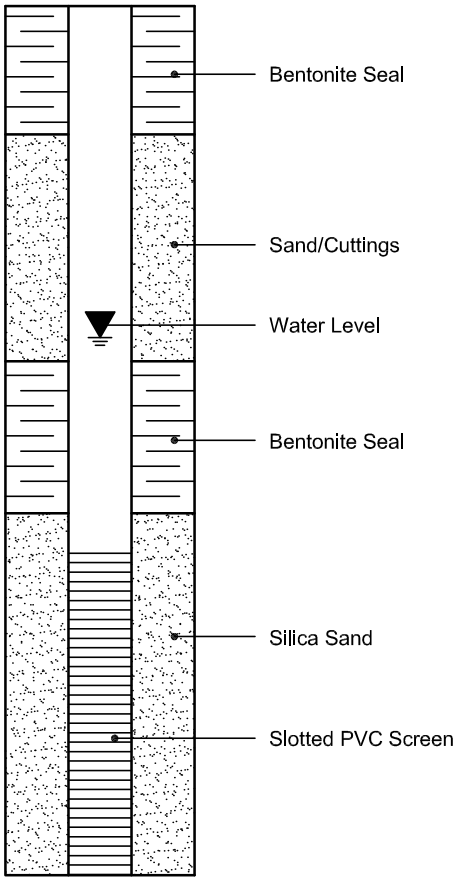
SYMBOLS AND TERMS (continued)

STRATA PLOT

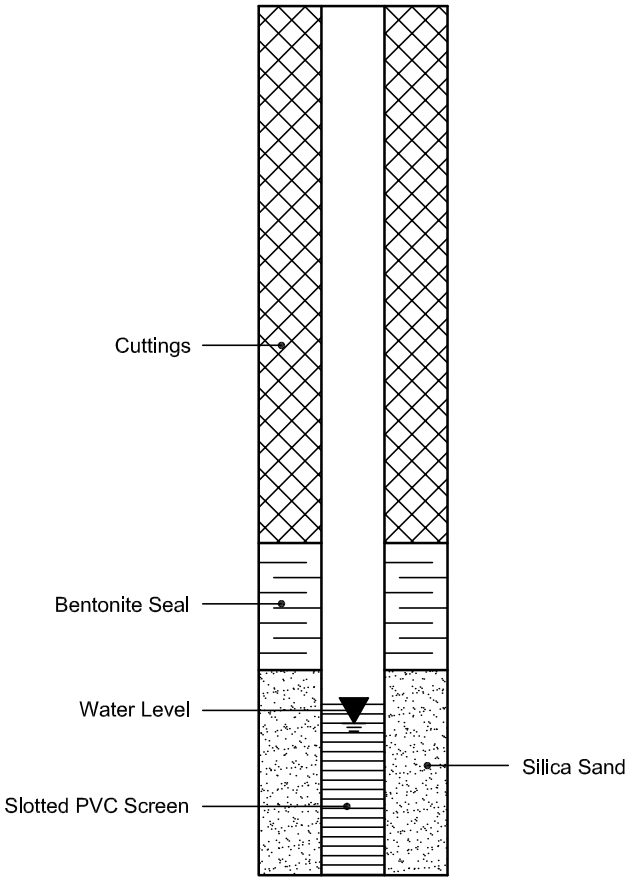


MONITORING WELL AND PIEZOMETER CONSTRUCTION

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: Mark D'Arcy

Client PO: 26276
Project: PE4562
Custody: 121605

Report Date: 4-Apr-2019
Order Date: 29-Mar-2019

Order #: 1913669

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

Paracel ID	Client ID
1913669-01	BH1-SS5
1913669-02	BH2-SS2
1913669-03	BH2-SS5
1913669-04	BH3-SS3

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26276

Report Date: 04-Apr-2019
Order Date: 29-Mar-2019
Project Description: PE4562

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	2-Apr-19	4-Apr-19
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	1-Apr-19	2-Apr-19
Mercury by CVAA	EPA 7471B - CVAA, digestion	2-Apr-19	3-Apr-19
PHC F1	CWS Tier 1 - P&T GC-FID	2-Apr-19	4-Apr-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	31-Mar-19	4-Apr-19
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	2-Apr-19	2-Apr-19
Solids, %	Gravimetric, calculation	2-Apr-19	2-Apr-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 26276

Report Date: 04-Apr-2019

Order Date: 29-Mar-2019

Project Description: PE4562

	Client ID:	BH1-SS5	BH2-SS2	BH2-SS5	BH3-SS3
	Sample Date:	03/27/2019 09:00	03/27/2019 09:00	03/27/2019 09:00	03/27/2019 09:00
	Sample ID:	1913669-01	1913669-02	1913669-03	1913669-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	91.0	86.1	91.3	92.0
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Arsenic	1.0 ug/g dry	2.4	4.0	3.3	3.4
Barium	1.0 ug/g dry	85.5	141	148	72.8
Beryllium	0.5 ug/g dry	<0.5	0.7	<0.5	0.5
Boron	5.0 ug/g dry	6.5	6.1	7.0	6.1
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	<0.5
Chromium	5.0 ug/g dry	16.1	30.3	16.5	19.4
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	<0.2
Cobalt	1.0 ug/g dry	6.4	9.8	6.7	10.4
Copper	5.0 ug/g dry	12.4	34.4	15.7	19.3
Lead	1.0 ug/g dry	11.0	30.8	6.9	5.6
Mercury	0.1 ug/g dry	<0.1	0.2	<0.1	<0.1
Molybdenum	1.0 ug/g dry	1.4	1.8	2.1	1.8
Nickel	5.0 ug/g dry	12.0	27.5	19.2	31.0
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Silver	0.3 ug/g dry	<0.3	1.7	<0.3	<0.3
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	<1.0
Uranium	1.0 ug/g dry	1.4	<1.0	1.4	<1.0
Vanadium	10.0 ug/g dry	24.2	42.3	26.2	30.5
Zinc	20.0 ug/g dry	61.6	93.8	29.8	38.9
Volatiles					
Benzene	0.02 ug/g dry	<0.02	-	<0.02	-
Ethylbenzene	0.05 ug/g dry	<0.05	-	<0.05	-
Toluene	0.05 ug/g dry	<0.05	-	<0.05	-
m,p-Xylenes	0.05 ug/g dry	<0.05	-	<0.05	-
o-Xylene	0.05 ug/g dry	<0.05	-	<0.05	-
Xylenes, total	0.05 ug/g dry	<0.05	-	<0.05	-
Toluene-d8	Surrogate	107%	-	109%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	-	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	11	-	22	-
F3 PHCs (C16-C34)	8 ug/g dry	36	-	39	-
F4 PHCs (C34-C50)	6 ug/g dry	54	-	<6	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26276

Report Date: 04-Apr-2019
Order Date: 29-Mar-2019
Project Description: PE4562

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						
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	*9.39*		*ug/g*		*117*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g dry	ND				40	
F2 PHCs (C10-C16)	11	4	ug/g dry	18			52.0	30	QR-01
F3 PHCs (C16-C34)	52	8	ug/g dry	49			7.1	30	
F4 PHCs (C34-C50)	ND	6	ug/g dry	ND				30	
Metals									
Antimony	1.2	1.0	ug/g dry	ND			0.0	30	
Arsenic	1.8	1.0	ug/g dry	1.7			1.3	30	
Barium	52.3	1.0	ug/g dry	43.0			19.7	30	
Beryllium	ND	0.5	ug/g dry	ND			0.0	30	
Boron	9.3	5.0	ug/g dry	7.9			15.9	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	19.4	5.0	ug/g dry	17.4			10.5	30	
Cobalt	8.7	1.0	ug/g dry	7.5			15.5	30	
Copper	21.0	5.0	ug/g dry	17.5			18.2	30	
Lead	8.0	1.0	ug/g dry	6.1			25.9	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	15.9	5.0	ug/g dry	13.9			13.0	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.3	ug/g dry	ND			0.0	30	
Thallium	ND	1.0	ug/g dry	ND			0.0	30	
Uranium	ND	1.0	ug/g dry	ND			0.0	30	
Vanadium	35.9	10.0	ug/g dry	32.2			10.8	30	
Zinc	91.2	20.0	ug/g dry	63.3			36.1	30	QR-01
Physical Characteristics									
% Solids	79.2	0.1	% by Wt.	88.0			10.6	25	
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	
Surrogate: Toluene-d8	*10.2*		*ug/g dry*		*115*	*50-140*			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	181	7	ug/g		90.6	80-120			
F2 PHCs (C10-C16)	112	4	ug/g	18	98.3	60-140			
F3 PHCs (C16-C34)	332	8	ug/g	49	121	60-140			
F4 PHCs (C34-C50)	205	6	ug/g	ND	139	60-140			
Metals									
Antimony	47.5		ug/L	ND	94.8	70-130			
Arsenic	54.2		ug/L	ND	107	70-130			
Barium	66.8		ug/L	17.2	99.1	70-130			
Beryllium	56.2		ug/L	ND	112	70-130			
Boron	55.3		ug/L	ND	104	70-130			
Cadmium	49.9		ug/L	ND	99.7	70-130			
Chromium (VI)	4.2	0.2	ug/g		83.5	70-130			
Chromium	64.2		ug/L	7.0	114	70-130			
Cobalt	52.3		ug/L	3.0	98.6	70-130			
Copper	61.1		ug/L	7.0	108	70-130			
Lead	48.9		ug/L	2.5	92.8	70-130			
Mercury	1.61	0.1	ug/g	ND	108	70-130			
Molybdenum	53.4		ug/L	ND	107	70-130			
Nickel	59.9		ug/L	5.6	109	70-130			
Selenium	51.4		ug/L	ND	103	70-130			
Silver	47.9		ug/L	ND	95.9	70-130			
Thallium	47.2		ug/L	ND	94.3	70-130			
Uranium	48.0		ug/L	ND	95.7	70-130			
Vanadium	69.3		ug/L	12.9	113	70-130			
Zinc	75.9		ug/L	25.3	101	70-130			
Volatiles									
Benzene	4.16	0.02	ug/g		104	60-130			
Ethylbenzene	3.77	0.05	ug/g		94.2	60-130			
Toluene	3.81	0.05	ug/g		95.3	60-130			
m,p-Xylenes	7.80	0.05	ug/g		97.5	60-130			
o-Xylene	3.85	0.05	ug/g		96.3	60-130			
Surrogate: Toluene-d8	*7.77*		*ug/g*		*97.1*	*50-140*			

Qualifier Notes:

QC Qualifiers :

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

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

CCME PHC additional information:

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

Paracel ID: 1913669

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Page 1 of 1

Client Name: Paterson Group	Project Reference: PE4562
Contact Name: Mark D'Arcy	Quote #
Address: 154 Colonnade Rd. S	PO # 26276
Telephone: 613-226-7381	Email Address: mdarcy@patersongroup.ca

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)

Required Analyses

Paracel Order Number: 1913669

	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)	Notes
1	BH1-SS5	S		2	Ma/27/19		X							120ml + 1 vial
2	BH2-SS2	S		1	↓		~~X~~			✓	✓	✓		Not BTEX/PHCs; 250ml
3	BH2-SS5	S		2			X							250ml + 1 vial
4	BH3-SS~~4~~3	S		2	↓		~~X~~			✓	✓	✓		" " " " " ↓
5														
6														
7														
8														
9														
10														

Comments:

Method of Delivery: ~~Cour~~ Paracel

Relinquished By (Sign): N. Sullivan	Received by Driver/Depot: T. Ducousse	Received at Lab: Sumitporn Dommi	Verified By: [illegible]
Relinquished By (Print): Nick Sullivan	Date/Time: 29/03/19 4:20	Date/Time: Mar 29, 2019 05.02	Date/Time: 3/29/19 17:07
Date/Time: March 29, 2019	Temperature: / °C 7H.	Temperature: 20.5 °C	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:
Project: PE4562
Custody: 121621

Report Date: 8-Apr-2019
Order Date: 2-Apr-2019

Order #: 1914279

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

Paracel ID	Client ID
1914279-01	BH1-GW1
1914279-02	BH2-GW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

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

Report Date: 08-Apr-2019
Order Date: 2-Apr-2019
Project Description: PE4562

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
PHC F1	CWS Tier 1 - P&T GC-FID	5-Apr-19	5-Apr-19
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	5-Apr-19	6-Apr-19
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	5-Apr-19	5-Apr-19

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO:

Report Date: 08-Apr-2019

Order Date: 2-Apr-2019

Project Description: PE4562

	Client ID:	BH1-GW1	BH2-GW1	-	-
	Sample Date:	04/02/2019 10:00	04/02/2019 11:45	-	-
	Sample ID:	1914279-01	1914279-02	-	-
	MDL/Units	Water	Water	-	-
Volatiles					
Acetone	5.0 ug/L	<5.0	<5.0	-	-
Benzene	0.5 ug/L	<0.5	2.2	-	-
Bromodichloromethane	0.5 ug/L	<0.5	<0.5	-	-
Bromoform	0.5 ug/L	<0.5	<0.5	-	-
Bromomethane	0.5 ug/L	<0.5	<0.5	-	-
Carbon Tetrachloride	0.2 ug/L	<0.2	<0.2	-	-
Chlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
Chloroform	0.5 ug/L	<0.5	<0.5	-	-
Dibromochloromethane	0.5 ug/L	<0.5	<0.5	-	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	<1.0	-	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	-	-
1,1-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,2-Dichloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
1,2-Dichloropropane	0.5 ug/L	<0.5	<0.5	-	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	-	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	-	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	<0.5	-	-
Ethylbenzene	0.5 ug/L	<0.5	3.8	-	-
Ethylene dibromide (dibromoethan	0.2 ug/L	<0.2	<0.2	-	-
Hexane	1.0 ug/L	<1.0	<1.0	-	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	<5.0	-	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	<5.0	-	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	<2.0	-	-
Methylene Chloride	5.0 ug/L	<5.0	<5.0	-	-
Styrene	0.5 ug/L	<0.5	<0.5	-	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	-	-
Tetrachloroethylene	0.5 ug/L	<0.5	<0.5	-	-
Toluene	0.5 ug/L	<0.5	9.0	-	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	-

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO:

Report Date: 08-Apr-2019

Order Date: 2-Apr-2019

Project Description: PE4562

	Client ID:	BH1-GW1	BH2-GW1	-	-
	Sample Date:	04/02/2019 10:00	04/02/2019 11:45	-	-
	Sample ID:	1914279-01	1914279-02	-	-
	MDL/Units	Water	Water	-	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	<0.5	-	-
Trichloroethylene	0.5 ug/L	<0.5	<0.5	-	-
Trichlorofluoromethane	1.0 ug/L	<1.0	<1.0	-	-
Vinyl chloride	0.5 ug/L	<0.5	<0.5	-	-
m,p-Xylenes	0.5 ug/L	<0.5	4.3	-	-
o-Xylene	0.5 ug/L	<0.5	1.7	-	-
Xylenes, total	0.5 ug/L	<0.5	6.0	-	-
4-Bromofluorobenzene	Surrogate	97.1%	100%	-	-
Dibromofluoromethane	Surrogate	103%	106%	-	-
Toluene-d8	Surrogate	94.7%	96.5%	-	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<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	-	-	-

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						
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*79.0*		*ug/L*		*98.7*	*50-140*			
Surrogate: Dibromofluoromethane	*88.4*		*ug/L*		*111*	*50-140*			
Surrogate: Toluene-d8	*78.2*		*ug/L*		*97.7*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Ethylene dibromide (dibromoethane	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*78.8*		*ug/L*		*98.5*	*50-140*			
Surrogate: Dibromofluoromethane	*96.2*		*ug/L*		*120*	*50-140*			
Surrogate: Toluene-d8	*76.3*		*ug/L*		*95.3*	*50-140*			

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

Report Date: 08-Apr-2019
Order Date: 2-Apr-2019
Project Description: PE4562

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	1630	25	ug/L		81.5	68-117			
F2 PHCs (C10-C16)	1520	100	ug/L		94.9	60-140			
F3 PHCs (C16-C34)	4010	100	ug/L		102	60-140			
F4 PHCs (C34-C50)	2490	100	ug/L		100	60-140			
Volatiles									
Acetone	115	5.0	ug/L		115	50-140			
Benzene	42.0	0.5	ug/L		105	60-130			
Bromodichloromethane	37.0	0.5	ug/L		92.4	60-130			
Bromoform	26.3	0.5	ug/L		65.8	60-130			
Bromomethane	46.3	0.5	ug/L		116	50-140			
Carbon Tetrachloride	34.8	0.2	ug/L		87.1	60-130			
Chlorobenzene	41.2	0.5	ug/L		103	60-130			
Chloroform	46.4	0.5	ug/L		116	60-130			
Dibromochloromethane	35.6	0.5	ug/L		89.0	60-130			
Dichlorodifluoromethane	43.8	1.0	ug/L		110	50-140			
1,2-Dichlorobenzene	34.2	0.5	ug/L		85.5	60-130			
1,3-Dichlorobenzene	34.1	0.5	ug/L		85.2	60-130			
1,4-Dichlorobenzene	31.4	0.5	ug/L		78.6	60-130			
1,1-Dichloroethane	47.1	0.5	ug/L		118	60-130			
1,2-Dichloroethane	51.8	0.5	ug/L		130	60-130			
1,1-Dichloroethylene	39.7	0.5	ug/L		99.3	60-130			
cis-1,2-Dichloroethylene	41.7	0.5	ug/L		104	60-130			
trans-1,2-Dichloroethylene	42.3	0.5	ug/L		106	60-130			
1,2-Dichloropropane	42.2	0.5	ug/L		105	60-130			
cis-1,3-Dichloropropylene	27.1	0.5	ug/L		67.7	60-130			
trans-1,3-Dichloropropylene	28.7	0.5	ug/L		71.8	60-130			
Ethylbenzene	33.3	0.5	ug/L		83.2	60-130			
Ethylene dibromide (dibromoethane	46.2	0.2	ug/L		115	60-130			
Hexane	26.3	1.0	ug/L		65.6	60-130			
Methyl Ethyl Ketone (2-Butanone)	90.7	5.0	ug/L		90.7	50-140			
Methyl Isobutyl Ketone	75.1	5.0	ug/L		75.1	50-140			
Methyl tert-butyl ether	91.1	2.0	ug/L		91.1	50-140			
Methylene Chloride	41.6	5.0	ug/L		104	60-130			
Styrene	29.6	0.5	ug/L		74.1	60-130			
1,1,1,2-Tetrachloroethane	40.3	0.5	ug/L		101	60-130			
1,1,2,2-Tetrachloroethane	51.1	0.5	ug/L		128	60-130			
Tetrachloroethylene	37.2	0.5	ug/L		92.9	60-130			
Toluene	45.0	0.5	ug/L		112	60-130			
1,1,1-Trichloroethane	37.9	0.5	ug/L		94.6	60-130			
1,1,2-Trichloroethane	42.5	0.5	ug/L		106	60-130			
Trichloroethylene	37.0	0.5	ug/L		92.4	60-130			
Trichlorofluoromethane	43.4	1.0	ug/L		109	60-130			
Vinyl chloride	26.5	0.5	ug/L		66.3	50-140			
m,p-Xylenes	73.9	0.5	ug/L		92.4	60-130			
o-Xylene	42.2	0.5	ug/L		105	60-130			
Surrogate: 4-Bromofluorobenzene	*70.5*		*ug/L*		*88.1*	*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: 1914279

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Head Office
300-2319 St. Laurent Blvd.
Ottawa, Ontario K1G 4J8
p: 1-800-749-1947
e: paracel@paracellabs.com

Chain of Custody
(Lab Use Only)
№ 121621

Page ___ of ___

Client Name: Paterson Group	Project Reference: PE 4562
Contact Name: Mark St Pierre	Quote #
Address: 154 Colonnade Road South	PO #
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)

Required Analyses

Paracel Order Number: 1914279.

	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)	PHC - F1						
1	BH1-GW1	GW	-	3	Apr.2.2019	10:00am	✓	✓												
2	BH3-GW1 (HOLD)	GW	-	3	Apr.2.2019	11:15am												HOLD		
3	BH2-GW1	GW		1	Apr.2.2019	11:45am		✓						✓						
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

Relinquished By (Sign):	Received by Driver/Depot: M. LEDUC	Received at Lab:	Verified By:
Relinquished By (Print): Mark St Pierre	Date/Time: 02/04/19 4:30 PM	Date/Time: 04/04/19 17:17	Date/Time: 3:15 9/4
Date/Time:	Temperature:	Temperature: 15.9 °C	pH Verified [ ] By: