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Phase II Environmental Site Assessment

936 March Road
Ottawa, Ontario

Prepared For

Minto Communities
and 2559688 Ontario Inc.

November 26, 2018

Report: PE4343-2

TABLE OF CONTENTS

List of Figures

List of Appendices

EXECUTIVE SUMMARY

Assessment

A Phase II ESA was conducted for the property addressed 936 March Road, 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 subject land. The subsurface investigation consisted of drilling three (3) boreholes, each constructed with monitoring wells, as well as the excavation of 8 test pits.

Soil samples were obtained from the boreholes and screened using visual observations and combustible vapour measurements. A total of six (6) soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4), metals and/or polynuclear aromatic hydrocarbons (PAHs). With one (1) exception, the analytical test results were in compliance with MECP Table 8 standards. A molybdenum concentration identified in soil Sample TP7-G1 failed the Table 8 standard.

Groundwater samples from monitoring wells installed in BH40, BH41 and BH42 were recovered and analysed for BTEX and PHC parameters. The groundwater from BH41 was also analysed for metal parameters based on the above-noted failure of molybdenum at TP7. No BTEX or PHC concentrations were identified above the laboratory method detection limits. Metal parameters identified in the groundwater recovered from BH41 were in compliance with the MECP Table 8 standards.

Conclusion

Soil

As previously discussed, a molybdenum concentration exceeding the MECP Table 2 standard was identified in a near surface soil sample (TP7-G1) collected from within APEC 3.

At the time of the Phase I site visit, scrap metal was being cut and/or removed from this area. At the time of the Phase II field program, the majority of the scrap metal had been removed, however small metal pieces, bottles, paint chips and miscellaneous debris remained present on the ground surface. The molybdenum concentration of 8.1 µg/g exceeds the Table 8 standard value of 2µ/g and is not considered to represent a significant concern to the property.

It is recommended that the top 0.5m of soil be removed from the immediate vicinity of TP7. It is recommended that Paterson personnel be present at the time of the impacted soil removal, to confirm that all remnant debris has been removed from APEC 3 and 4 and to collect confirmatory soil samples from the location of TP7.

Groundwater

If the monitoring wells installed on the subject site are not going to be used in the future, or will be destroyed during site redevelopment, they should be abandoned according to Ontario Regulation 903. Otherwise, the wells will be registered with the MECP under this regulation. At this time, it is recommended that an attempt be made to maintain the integrity of the monitoring wells for possible future groundwater monitoring.

Residential Dwelling

The storage of furnace oil within the basement of the dwelling was not addressed at the time of this Phase II ESA. While potential for impacts to the underlying soil and groundwater is considered to be low, it is recommended that the sub-slab area in the vicinity of the furnace be assessed. If evidence of subsurface petroleum hydrocarbon impacts is identified, an additional borehole with a monitoring well installation could be placed near the southwest corner of the residential dwelling to confirm there has been no impact to the groundwater.

1.0 INTRODUCTION

At the request of Minto Communities (Minto), Paterson Group (Paterson) conducted a Phase II Environmental Site Assessment for the property addressed 936 March Road 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 June of 2018.

1.1 Site Description

Address:	936 March Road, Ottawa, Ontario.
Legal Description:	Part of Lot 12, Concession 4, Geographic Township of March, City of Ottawa
Property Identification Number:	04527-1004, 04527-1005
Location:	The subject site is located between March Road and March Valley Road, approximately 240m north of Maxwell Bridge Road, in the City of Ottawa, Ontario. For the purposes of this report, March Road is assumed to travel in a north-south direction. The subject site is shown on Figure 1 - Key Plan following the body of this report.
Latitude and Longitude:	45° 22' 1" N, 75° 56' 1" W
Configuration:	Irregular (2 parcels divided by a railway corridor)
Site Area:	78 hectares (approximate)

1.2 Property Ownership

The subject property is currently owned by 2559688 Ontario Inc. Paterson was retained to complete this Phase II ESA by Ms. Beth Henderson of Minto, the potential purchaser of the property. The offices of Minto are located at 200-180 Kent Street, Ottawa, Ontario. Ms. Henderson can be reached by telephone at (613) 782-2311.

1.3 Current and Proposed Future Uses

The Phase II Property is occupied by a residential dwelling, private garage and former farm buildings on the southwestern portion of the site. The remainder of the land is primarily occupied by soy fields with some treed areas, and Shirley's Brook transects the western portion of the site in an approximate north-south direction. It is our understanding that the portion of the subject land east of Shirley's Brook and the residential dwelling, will be developed with a residential subdivision. The existing residential dwelling and outbuildings will remain present while the lands to the west of Shirley's Brook may be developed for commercial purposes.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 8 of the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act", prepared by the Ontario Ministry of the Environment, Conservation and Parks (MECP), April 2011. The MECP selected Table 8 Standards are based on the following considerations:

- ❒ Coarse-grained soil conditions;
- ❒ Body of water (Shirley's Brook) on the subject land;
- ❒ Potable groundwater conditions; and
- ❒ Residential land use.

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The Phase II Property is located in a rural area surrounded by agricultural or treed lands with occasional residential dwellings to the north and west, with a residential subdivision immediately south of the eastern portion of the subject land, and a commercial development further to the south, along the east side of March Road.

An abandoned rail line transects the eastern portion of the subject land in an approximate north-south orientation, while a watercourse (Shirley's Brook) transects the western portion of the site in a similar orientation. A slope, approximately 6m high, runs in a north-south direction within the western portion of the subject site, sloping downward to the east. The slope was noted to be stable and shaped to an approximate 8H:1V slope or less.

Overall, the ground surface across the subject site slopes downward from southwest to northeast from an elevation of approximately 80m above sea level (asl) to an elevation of approximately 65m asl.

The residential subdivision and commercial properties to the south of the Phase I Property are provided with municipal services. The Phase II Property and properties further to the north have private wells and septic systems.

2.2 Past Investigations

A Phase I ESA was conducted by Paterson in June of 2018. Based on the findings of the Phase I ESA, several existing on-site potentially contaminating activities (PCAs) were considered to result in areas of potential environmental concern (APECs) on the Phase I Property, as presented in Table 1.

Table 1
Areas of Potential Environmental Concern

Area of Potential Environmental Concern	Location of Area of Potential Environmental Concern with respect to Phase I Property	Potentially Contaminating Activity	Location of PCA (on-site or off-site)	Contaminants of Potential Concern	Media Potentially Impacted (Groundwater, Soil, and/or Sediment)
APEC 1	In the immediate vicinity of the residential dwelling.	PCA 28 – Gasoline and Associated Products Storage in Fixed Tanks	On-site	BTEX PHCs (F_1-F_4)	Soil and Groundwater
APEC 2	Area around the former barn and storage area further north of the residential dwelling.	Other: farm operations, miscellaneous storage	On-site	BTEX PHCs (F_1-F_4) metals	Soil
				BTEX PHCs (F_1-F_4)	Groundwater
APEC 3	Former storage area further to the northeast of the residential dwelling	Other: storage of scrap metal and miscellaneous debris	On-site	BTEX PHCs (F_1-F_4) metals	Soil
				BTEX PHCs (F_1-F_4)	Groundwater
APEC 4	Former storage area further east of the residential dwelling	Other: storage of scrap metal and miscellaneous debris	On-site	BTEX PHCs (F_1-F_4) metals	Soil
				BTEX PHCs (F_1-F_4)	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 during the interim of July 4 through July 5, 2018. The field program consisted of drilling three (3) boreholes installed with monitoring wells upon completion, and the excavation of eight (8) test pits. It should be noted that two (2) of the test pits were surficial samples only, as they were in the vicinity of flagged butternut trees. Boreholes were drilled to depths ranging from approximately 6 to 7.2m below grade, while test pits were excavated from depths ranging from approximately 0.2 to 2.1m below grade. Two (2) of the boreholes (BH40 and BH41) were terminated in the overburden, while bedrock was encountered at BH42, at a depth of approximately 1.7m below grade. Bedrock was therefore cored at this location to access the groundwater table.

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

As noted in Table 1 above, contaminants of potential concern for soil include metals, petroleum hydrocarbons (PHCs, fractions F1-F4) and benzene, toluene, ethylbenzene and xylenes (BTEX). It should be noted that a soil sample was also analysed for polynuclear aromatic hydrocarbons (PAHs) based on observations made at the time of the field program. Contaminants of potential concern for groundwater include BTEX and PHCs. Although metals have low solubility and low subsurface mobility, one (1) groundwater sample was also analysed for metals based on the findings of the soil test results.

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 of interbedded sandstone and dolomite of the March Formation and dolomite of the Oxford Formation.

Overburden soils are reported to consist of offshore marine sediments with erosional terraces or bedrock, with drift thicknesses between 0 and 10m.

Buildings and Structures

The Phase I Property is occupied by a two-storey residential dwelling with a basement level, a private garage and two (2) outbuildings associated with the original farmstead. No other above grade buildings or structures were present on the Phase I Property.

Water Bodies

Shirley's Brook transects the western portion of the Phase I Property in an approximately north-south direction and is considered to flow in a southerly direction before heading east to Shirley's Bay. No other water bodies are present on the Phase I Property or within the Phase I Study Area.

Areas of Natural Significance

No areas of natural significance are known to exist within the Phase I Study Area.

Potable Water Wells

The MECP well mapping website was accessed to obtain well records for all drilled wells within 250 m of the Phase I Property. A well record was identified for the Phase I Property, as well as 28 well records for domestic potable wells or well abandonments on properties within the Phase I Study Area.

Monitoring Wells

The MECP well mapping did not identify any monitoring well records for the Phase I Property or for any properties within the Phase I Study Area.

Neighbouring Land Use

Neighbouring land use in the Phase I Study Area is primarily residential and agricultural or vacant land. A commercial development (various restaurants, retail and service establishments) is present further to the south of the Phase I Property. Land use is shown on Drawing PE4343-2 - Surrounding Land Use Plan in the Phase I ESA.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

As per Table 1 in Section 2.2 of this report, historical and existing PCAs resulting in APECs on the Phase I Property include the following: fuel storage on the Phase I Property and the storage of scrap metal and equipment.

The abandoned rail line that transects the eastern portion of the Phase I Property is not considered to result in an APEC on the Phase I Property based on the separation distance of the former rail lines from the subject land, in combination with the nature (low-solubility and low subsurface mobility) of potential contaminants of concern typically associated with a rail bed (polynuclear aromatic hydrocarbons and metals).

Contaminants of Potential Concern

As per Table 1 in Section 2.2 of this report, contaminants of potential concern for soil include metals, petroleum hydrocarbons (PHCs, fractions F1-F4) and benzene, toluene, ethylbenzene and xylenes (BTEX). As discussed in Section 3.2, one (1) soil sample was also analysed for polynuclear aromatic hydrocarbons (PAHs) based on observations made at the time of the field program. Contaminants of potential concern for groundwater include BTEX and PHCs. Although metals have low solubility and low subsurface mobility, one (1) groundwater sample was also analysed for metals based on the findings of the soil test results.

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 potentially contaminating activities on the subject site which have resulted in areas of potential environmental concern on the Phase I Property. The presence of potentially contaminating activities was confirmed by a variety of independent sources, including, in some cases, observations made during the Phase I site visit. 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. There were no deviations from the Sampling and Analysis Plan.

3.5 Impediments

Physical impediments encountered during the field portion of the Phase II ESA include flagged butternut trees within an area of potential environmental concern (APEC 3). Butternut trees are endangered and protected under the Ontario Endangered Species Act. To avoid excavating into the root system, surface samples were collected with a hand shovel.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted July 4 and July 5, 2018 and consisted of three (3) boreholes on the Phase II Property. Each borehole was completed with a groundwater monitoring well installation. Borehole BH42 was cored into the bedrock to access the groundwater table. The boreholes were placed to address the aforementioned areas of potential environmental concern (APECs). The boreholes were drilled with a track mounted CME 55 power auger drill rig, provided by George Downing Estate Drilling of Hawkesbury, Ontario. Borehole locations are shown on Drawing PE4343-3 – Test Hole Location Plan, appended to this report.

4.2 Soil Sampling

A total of thirty-six (36) soil samples and four (4) rock core samples were obtained from the boreholes and test pits by means of sampling directly from auger flights, split spoon sampling, grab sampling and coring. The depths at which auger samples, split spoon samples and rock core samples were obtained from the boreholes are shown as "**AU**", "**SS**", "**G**" and "**RC**" on the Soil Profile and Test Data Sheets, appended to this report.

Site soils generally consists of a layer of topsoil over native silty sand and/or silty clay. Possible glacial till was identified below the silty clay in BH40 and BH42. Bedrock was not encountered in BH40 or BH41. Bedrock was encountered at an approximate depth of 1.73m below grade in BH42 and was cored to a depth of approximately 7.2m below 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 a soil vapour screening with an RKI Eagle gas detector with methane elimination and calibrated to hexane.

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 parts per million (ppm) scale is used to measure concentrations of hydrocarbon vapours that are too low to register on the Lower Explosive Limit (LEL) scale. The explosive point, 100% LEL, represents the leanest mixture which will burn (or explode) if ignited.

The combustible vapour readings were less than 10ppm and were not considered to be indicative of petroleum hydrocarbon compounds. Vapour readings are noted on the Soil Profile and Test Data Sheets in Appendix 1.

No visual or olfactory indications of potential hydrocarbons were identified in the soil samples. Pieces of metal, wood, glass and paint chips were identified at the location TP7 and TP8 within APEC 3. Several pieces of a solid tar-like material, associated with heavy equipment stored in APEC, were also identified in the vicinity of TP7. Soil samples were selected based on a combination of the results of the vapour screening, visual and olfactory observations, and sample depth.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed on the Phase II Property, at BH40, BH41 and BH42. The monitoring wells consisted of 32mm or 51mm 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
BH40	79.19	7.62	4.62-7.62	4.22-7.62	0.30-4.22	Stick-up
BH41	78.67	6.04	3.04-6.04	2.64-6.04	0.30-2.64	Stick-up
BH42	73.50	7.21	4.21-7.21	3.81-7.21	0.30-3.81	Stick-up

4.5 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.

4.6 Analytical Testing

Based on the guidelines outlined in the Sampling and Analysis Plan appended to this report, the following soil and groundwater samples were submitted for analysis:

Table 3: Soil Samples Submitted						
Sample ID	Sample Depth/ Stratigraphic Unit	Parameters Analyzed				Rationale
		BTEX	PHCs (F_1-F_4)	Metals	PAHs	
TP1-G2	0.4-0.7m; Native silty sand	X	X			Assessment of potential metal, BTEX and PHC impact associated with former farm operations.
TP3-G3	0.7-1.0m; Native silty sand	X	X			Assessment of potential BTEX and PHC impacts associated with storage of equipment.
TP4-G2	0.3-0.6m; Native silty clay	X	X			
TP6-G2	0.5-0.8m; Native silty sand			X	X	Assessment of potential impacts from storage of scrap metal and equipment.
TP7-G1	0.1-0.4m; Native silty sand			.X	X	
BH40-AU1	1.52-2.13; Native silty sand			X		Assessment of potential impacts from farm operations.

Table 4: Groundwater Samples Submitted					
Sample ID	Screened Interval/ Stratigraphic Unit	Parameters Analyzed			Rationale
		PHCs (F_1-F_4)	BTEX	Metals	
BH40-GW1	4.62-7.62m; Native silty clay	X	X		Assessment of former farm operations, storage of scrap metal and construction equipment.
BH41-GW1	3.04-6.04m; Native silty clay	X	X	X	
BH42-GW1	4.21-7.21m; Limestone Bedrock	X	X		

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.

4.7 Residue Management

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

4.8 Elevation Surveying

The monitoring well locations were selected by Paterson, and located and surveyed in the field by Stantec. The ground surface elevations at the monitoring well locations are referenced to a geodetic datum and are presented on Drawing PE4343-3 - Test Hole Location Plan appended to this report.

4.9 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 generally consist of topsoil over native silty sand and/or silty clay, followed by a silty clay glacial till and underlain by shaley limestone bedrock.

Groundwater was encountered within the bedrock at BH42, at a depth of approximately 4.0m below ground surface, and within the overburden at BH40 and BH41 at depths of approximately 4.4 and 4.3m below ground surface.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured during the groundwater sampling event on July 13, 2018, using an electronic water level meter. Groundwater levels are summarized below in Table 5. Based on the groundwater elevations, contour mapping was completed. Groundwater contours are shown on Drawing PE4343-4 – Groundwater Contour Plan. Based on the contours, groundwater beneath the Phase II Property is in an easterly direction. A hydraulic gradient of 0.049m/m was calculated.

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
BH40	79.19	4.44	74.75	July 13, 2018
BH41	78.67	4.28	74.39	July 13, 2018
BH42	73.50	4.04	69.46	July 13, 2018

No free product was observed in the monitoring wells sampled at the Phase II Property.

5.3 Fine-Coarse Soil Texture

Based on field soil observations, fine-grained soil standards are not applicable to the Phase II Property.

5.4 Soil: Field Screening

Field screening of the soil samples collected during drilling resulted in combustible vapour readings ranging from 0 to 10ppm. Field screening results of each individual soil sample are provided on the Soil Profile and Test Data Sheets appended to this report. As noted previously, debris including pieces of metal, glass and paint chips as well as pieces of a solid tar-like material were present in the vicinity of TP7 and TP8 within APEC 3.

5.5 Soil Quality

A total of six (6) soil samples were submitted for analysis of BTEX and PHCs (F1-F4), metals and PAHs. The results of the analytical testing are presented below in Tables 6, 7 and 8. The laboratory certificates of analysis are provided in Appendix 1.

Table 6
Analytical Test Results – Soil
BTEX and PHCs (F1-F4)

Parameter	MDL (µg/g)	Soil Samples (µg/g) July 5, 2018			MECP Table 8 Residential Standards (µg/g)
		TP1-G2 (0.4-0.7m)	TP3-G3 (0.7-1.0m)	TP4-G2 (0.3-0.6m)	
Benzene	0.02	nd	nd	nd	0.02
Ethylbenzene	0.05	nd	nd	nd	0.05
Toluene	0.05	nd	nd	nd	0.2
Xylenes (Total)	0.05	nd	nd	nd	0.05
PHC F1	7	nd	nd	nd	25
PHC F2	4	nd	nd	nd	10
PHC F3	8	nd	nd	nd	240
PHC F4	6	nd	nd	nd	120

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

No BTEX or PHC concentrations were identified above the laboratory detection limits in any of the samples submitted for analysis. The soil results are in compliance with MECP Table 8 Standards.

Table 7
Analytical Test Results – Soil
Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MOECC Table 8 Residential Standards (µg/g)
		July 5, 2018		July 4, 2018	
		TP6-G2 (0.5-0.8m)	TP7-G1 (0-0.3m)	BH40-AU1 (0-0.6m)	
Antimony	1.0	nd	nd	nd	1.3
Arsenic	1.0	nd	4.2	4.2	18
Barium	1.0	112	43.6	33.8	220
Beryllium	0.5	0.5	nd	nd	2.5
Boron	5.0	nd	nd	nd	36
Cadmium	0.5	nd	0.6	nd	1.2
Chromium	5.0	33.8	17.2	19.6	70
Cobalt	1.0	8.3	4.3	4.0	22
Copper	5.0	16.7	10.8	80.2	92
Lead	1.0	5.3	30.4	13.9	120
Molybdenum	1.0	nd	**8.1**	nd	2
Nickel	5.0	17.1	10.6	6.8	82
Selenium	1.0	nd	nd	nd	1.5
Silver	0.3	nd	nd	nd	0.5
Thallium	1.0	nd	nd	nd	1
Uranium	1.0	nd	nd	nd	2.5
Vanadium	10.0	68.4	22.0	39.4	86
Zinc	20.0	41.5	82.5	97.1	290

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **bold** – value exceeds the MECP Table 8 standard

The metal concentrations identified in the analysed samples were in compliance with the MECP Table 8 standards, with the exception of the molybdenum concentration (8.1µg/g) which exceeds the MOECC Table 8 standard of 2.0µg/g.

Table 8
Analytical Test Results – Soil (PAHs)

Parameter	MDL (µg/g)	Soil Samples (µg/g) July 5, 2018		MECP Table 8 Residential (µg/g)
		TP6-G2 (0.5-0.8m)	TP7-G1 (0-0.3m)	
Acenaphthene	0.02	nd	nd	0.072
Acenaphthylene	0.02	nd	nd	0.093
Anthracene	0.02	nd	0.05	0.22
Benzo[a]anthracene	0.02	nd	nd	0.36
Benzo[a]pyrene	0.02	nd	nd	0.3
Benzo[b]fluoranthene	0.02	nd	0.13	0.47
Benzo[g,h,i]perylene	0.02	nd	nd	0.68
Benzo[k]fluoranthene	0.02	nd	0.13	0.48
Chrysene	0.02	nd	nd	2.8
Dibenzo[a,h]anthracene	0.02	nd	nd	0.1
Flouranthene	0.02	nd	0.02	0.69
Fluorene	0.02	nd	nd	0.19
Indeno[1,2,3-cd]pyrene	0.02	nd	nd	0.23
1-Methylnaphthalene	0.02	nd	nd	0.59
2-Methylnaphthalene	0.02	nd	0.03	0.59
Methylnaphthalene (1&2)	0.04	nd	nd	0.59
Naphthalene	0.01	nd	nd	0.09
Phenanthrene	0.02	nd	0.05	0.69
Pyrene	0.02	nd	0.02	1

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

No PAH parameters were identified above the laboratory method detection limits in soil Sample TP6-G2. Several PAH parameters were identified in soil Sample TP7-G1, at concentrations below the MECP Table 8 standards.

5.6 Groundwater Quality

Groundwater samples from monitoring wells installed in BH40/MW1, BH41/MW2, and BH42/MW3 were submitted for laboratory analysis of BTEX and PHC parameters. A groundwater sample recovered from BH41/MW2 was also submitted for analysis of metals, based on the soil results. 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
BTEX and PHCs (F1-F4)

Parameter	MDL (µg/L)	Groundwater Samples (µg/L) July 13, 2018			MECP Table 8 Standards (µg/L)
		BH40-GW1 (4.62-7.62m)	BH41-GW1 (3.04-6.04m)	BH42-GW1 (4.21-7.21m)	
Benzene	0.5	nd	nd	nd	5
Ethylbenzene	0.5	nd	nd	nd	2.4
Toluene	0.5	nd	nd	nd	22
Xylenes (Total)	0.5	nd	nd	nd	300
PHC F1	25	nd	nd	nd	420
PHC F2	100	nd	nd	nd	150
PHC F3	100	nd	nd	nd	500
PHC F4	100	nd	nd	nd	500

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

No BTEX or PHC parameters were detected above the laboratory method detection limits in any of the groundwater samples submitted for analytical testing. The results are in compliance with the MOECC Table 8 standards.

It is our interpretation that the analyzed parameter concentrations do not indicate the potential presence of light non-aqueous phase liquids (LNAPLs). No free phase hydrocarbons were noted in the wells at the time of sampling.

Table 10
Analytical Test Results – Groundwater
Metals

Parameter	MDL (µg/L)	Groundwater Sample (µg/L) July 13, 2018	MECP Table 8 Standards (µg/L)
		BH41-GW1 (3.04-6.04m)	
Antimony	0.5	nd	6
Arsenic	1	nd	25
Barium	1	96	1,000
Beryllium	0.5	nd	4
Boron	10	nd	5,000
Cadmium	0.1	nd	2.1
Chromium	1	2	50
Cobalt	0.5	nd	3.8
Copper	0.5	2.3	69
Lead	0.1	0.2	10
Molybdenum	0.5	3.0	70
Nickel	1	nd	100
Selenium	1	nd	10
Silver	0.1	nd	1.2
Sodium	200	7,420	490,000
Thallium	0.1	nd	2
Uranium	0.1	0.4	20
Vanadium	0.5	1.3	6.2
Zinc	5	nd	890

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

Metal parameters detected in groundwater Sample BH41-GW1 are in compliance with the MECP Table 8 standards.

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of the July 2018 groundwater sampling event were handled in accordance with the Analytical Protocol with respect to holding time, preservation method, storage requirement, and container type. As noted previously, hold time had been exceeded for the soil samples due to laboratory error; this is not considered to have affected the findings of the Phase II ESA.

As per Subsection 47(3) of O.Reg. 153/04 as amended by O.Reg. 269/11, 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 amending O.Reg. 153/04 - Record of Site Condition regulation, made under 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 PCAs are considered to result in APECs on the Phase I and Phase II Property:

- Item 28, Table 2, O.Reg. 153/04 as amended by O.Reg. 269/11: "Gasoline and Associated Products Storage in Fixed Tanks" - this PCA was identified based on the partially buried copper fuel supply line in the concrete floor slab within the residential dwelling.

Although not listed in Table 2, the storage of scrap metal and construction equipment is considered to be a PCA. The aforementioned on-site PCAs are considered to result in APECs on the Phase I Property as further discussed in the following section.

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

Subsurface Structures and Utilities

A potable well is present to the southeast of the residential dwelling on site, while a septic system is reportedly present to the north of the dwelling. Otherwise there are no underground utilities or below grade structures on the Phase I Property. Telephone and Hydro services are provided via overhead wires.

Physical Setting

Site Stratigraphy

The site stratigraphy is presented on Drawing PE4343-7 – Cross-Section A-A' generally consists of:

- Topsoil to depths ranging from 0.15 to 0.4m below grade. Topsoil was not identified at TP7 or TP8; the topsoil at this location is considered to have been disturbed during the removal of scrap metal and equipment.

- Native sand or silty sand to depths ranging from 0.6 to 1.5m below grade.

- Native silty clay was encountered below the sand (and directly below the topsoil at TP4) at all locations with the exception of BH42. The test pits and BH41 were terminated in this layer.

- Glacial till consisting of silty clay with gravel and cobbles, was identified at BH42 directly beneath the sand layer at a depth of 1.52m below grade and extending to 1.73m below grade. Glacial till was also identified at BH40 at from 6.86 to 76.2m below grade.

- Practical refusal to augering on shaley limestone bedrock was achieved at a depth of 6.04m below grade at BH41 and 1.73m at BH42. Bedrock was cored at BH42 to an approximately depth of 7.2m below grade.

Hydrogeological Characteristics

Groundwater at the Phase II Property was encountered within the overburden and within the bedrock. These units are interpreted to function as local aquifers at the subject site.

Water levels were measured at the subject site on July 13, 2018, at depths ranging from approximately 4.0 to 4.4m below grade. Based on groundwater contour mapping, the groundwater is considered to flow in an easterly direction.

Approximate Depth to Bedrock

Bedrock was encountered at depths ranging from approximately 1.7 to greater than 7.6m below grade. Based on the concurrent Geotechnical Investigation conducted by Paterson, inferred bedrock depth across the site ranges from 1.7 to 7.8m below grade.

Approximate Depth to Water Table

Depth to water table at the subject site varies between approximately 4.0 and 4.4m below existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 of the Regulation (Site Condition Standards, Environmentally Sensitive Areas) applies to the Phase II Property as Shirley's Brook transects the western portion of the Phase II Property.

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 not identified on the Phase II Property. Sand was identified at ground surface at TP7 and TP8, however topsoil at these locations is considered to have been removed during the removal of scrap metal and equipment. The sand is considered to consist of the native sand generally identified beneath the topsoil at the remainder of the test hole locations.

Proposed Buildings and Other Structures

It is our understanding that the lands to the east of the creek and dwelling are to be developed with a residential subdivision. The existing residential dwelling will remain, while the lands west of the creek may be developed in the future for commercial purposes.

Existing Buildings and Structures

The Phase II Property is occupied by a two-storey residential dwelling with a basement level, a private garage and two (2) outbuildings associated with the original farmstead. No other above grade buildings or structures were present on the Phase II Property.

Water Bodies

Shirley's Brook transects the western portion of the Phase I Property in an approximate north-south direction and is considered to flow in a southerly direction before heading east to Shirley's Bay. No other water bodies are present on the Phase II Property or within the vicinity of the subject land.

Areas of Natural Significance

No areas of natural significance are known to exist on or within the immediate vicinity of the Phase II Property.

Environmental Condition

Areas Where Contaminants are Present

Based on the findings of the Phase II ESA, a molybdenum exceedance was identified in a near surface soil sample collected from within APEC 3. Otherwise soil results are in compliance with MECP Table 8 standards. Groundwater is also in compliance with MECP Table 8 standards. Analytical test results are shown on Drawings PE4343-5 – Analytical Testing Plan (Soil) and PE4343-6 – Analytical Testing Plan (Groundwater).

Types of Contaminants

Based on the findings of the Phase II ESA, an elevated concentration of molybdenum was identified within APEC 3 on the Phase II Property. Otherwise there are no contaminants on the Phase II Property.

Contaminated Media

Native, near surface silty sand in the vicinity of TP7 is impacted with an elevated concentration of molybdenum. Otherwise soil results are in compliance with MECP Table 8 standards. Groundwater is also in compliance with MECP Table 8 standards. Analytical test results are shown on Drawings PE4343-5 – Analytical Testing Plan (Soil) and PE4343-6 – Analytical Testing Plan (Groundwater).

What Is Known About Areas Where Contaminants Are Present

Based on the findings of the Phase II ESA, an elevated molybdenum concentration was identified at TP7 in a soil sample recovered from just below ground surface. The impact is considered to be associated with the storage of scrap metal and construction equipment.

Distribution and Migration of Contaminants

Based on the nature of metal parameters (low solubility in water) the metal impact is considered to be limited to surficial soils within APEC 3, where scrap metal and equipment was stored.

Discharge of Contaminants

As noted above, the metal impact is considered to be the result of the onsite storage of scrap metal and construction equipment. Scrap metal was recently cut on-site for removal purposes.

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 low solubility of metal parameters and clean groundwater results, climatic and meteorological conditions are not considered to have affected contaminant distribution.

Potential for Vapour Intrusion

Based on the findings of the Phase II ESA, there is no potential for vapour intrusion on the Phase II Property.

6.0 CONCLUSIONS

Assessment

A Phase II ESA was conducted for the property addressed 936 March Road, 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 subject land. The subsurface investigation consisted of drilling three (3) boreholes, each constructed with monitoring wells, as well as the excavation of 8 test pits.

Soil samples were obtained from the boreholes and screened using visual observations and combustible vapour measurements. A total of six (6) soil samples were submitted for laboratory analysis of a combination of benzene, toluene, ethylbenzene and xylenes (BTEX), petroleum hydrocarbons (PHCs, F_1-F_4), metals and/or polynuclear aromatic hydrocarbons (PAHs). With one (1) exception, the analytical test results were in compliance with MECP Table 8 standards. A molybdenum concentration identified in soil Sample TP7-G1 failed the Table 8 standard.

Groundwater samples from monitoring wells installed in BH40, BH41 and BH42 were recovered and analysed for BTEX and PHC parameters. The groundwater from BH41 was also analysed for metal parameters based on the above-noted failure of molybdenum at TP7. No BTEX or PHC concentrations were identified above the laboratory method detection limits. Metal parameters identified in the groundwater recovered from BH41 were in compliance with the MECP Table 8 standards.

Conclusion

Soil

As previously discussed, a molybdenum concentration exceeding the MECP Table 2 standard was identified in a near surface soil sample (TP7-G1) collected from within APEC 3.

At the time of the Phase I site visit, scrap metal was being cut and/or removed from this area. At the time of the Phase II field program, the majority of the scrap metal had been removed, however small metal pieces, bottles, paint chips and miscellaneous debris remained present on the ground surface. The molybdenum concentration of 8.1 µg/g exceeds the Table 8 standard value of 2µ/g and is not considered to represent a significant concern to the property.

It is recommended that the top 0.5m of soil be removed from the immediate vicinity of TP7. It is recommended that Paterson personnel be present at the time of the impacted soil removal, to confirm that all remnant debris has been removed from APEC 3 and 4 and to collect confirmatory soil samples from the location of TP7.

Groundwater

If the monitoring wells installed on the subject site are not going to be used in the future, or will be destroyed during site redevelopment, they should be abandoned according to Ontario Regulation 903. Otherwise, the wells will be registered with the MECP under this regulation. At this time, it is recommended that an attempt be made to maintain the integrity of the monitoring wells for possible future groundwater monitoring.

Residential Dwelling

The storage of furnace oil within the basement of the dwelling was not addressed at the time of this Phase II ESA. While potential for impacts to the underlying soil and groundwater is considered to be low, it is recommended that the sub-slab area in the vicinity of the furnace be assessed. If evidence of subsurface petroleum hydrocarbon impacts is identified, an additional borehole with a monitoring well installation could be placed near the southwest corner of the residential dwelling to confirm there has been no impact to the groundwater.

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 by O.Reg. 269/11, 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 Minto Communities (Minto) and 2559688 Ontario Inc. Notification from Minto, 2559688 Ontario Inc. and Paterson Group will be required to release this report to any other party.

Paterson Group Inc.

Karyn Munch, P.Eng., QP_{ESA}

Mark S. D'Arcy, P.Eng., QP_{ESA}

Report Distribution:

- ❒ Minto Communities
- ❒ Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4343-3 – TEST HOLE LOCATION PLAN

DRAWING PE4343-4 – GROUNDWATER CONTOUR PLAN

DRAWING PE4343-5 – ANALYTCIAL TESTING PLAN (SOIL)

DRAWING PE4343-6 – ANALYTICAL TESTING PLAN (GROUNDWATER)

DRAWING PE4343-7 – CROSS-SECTION A-A'

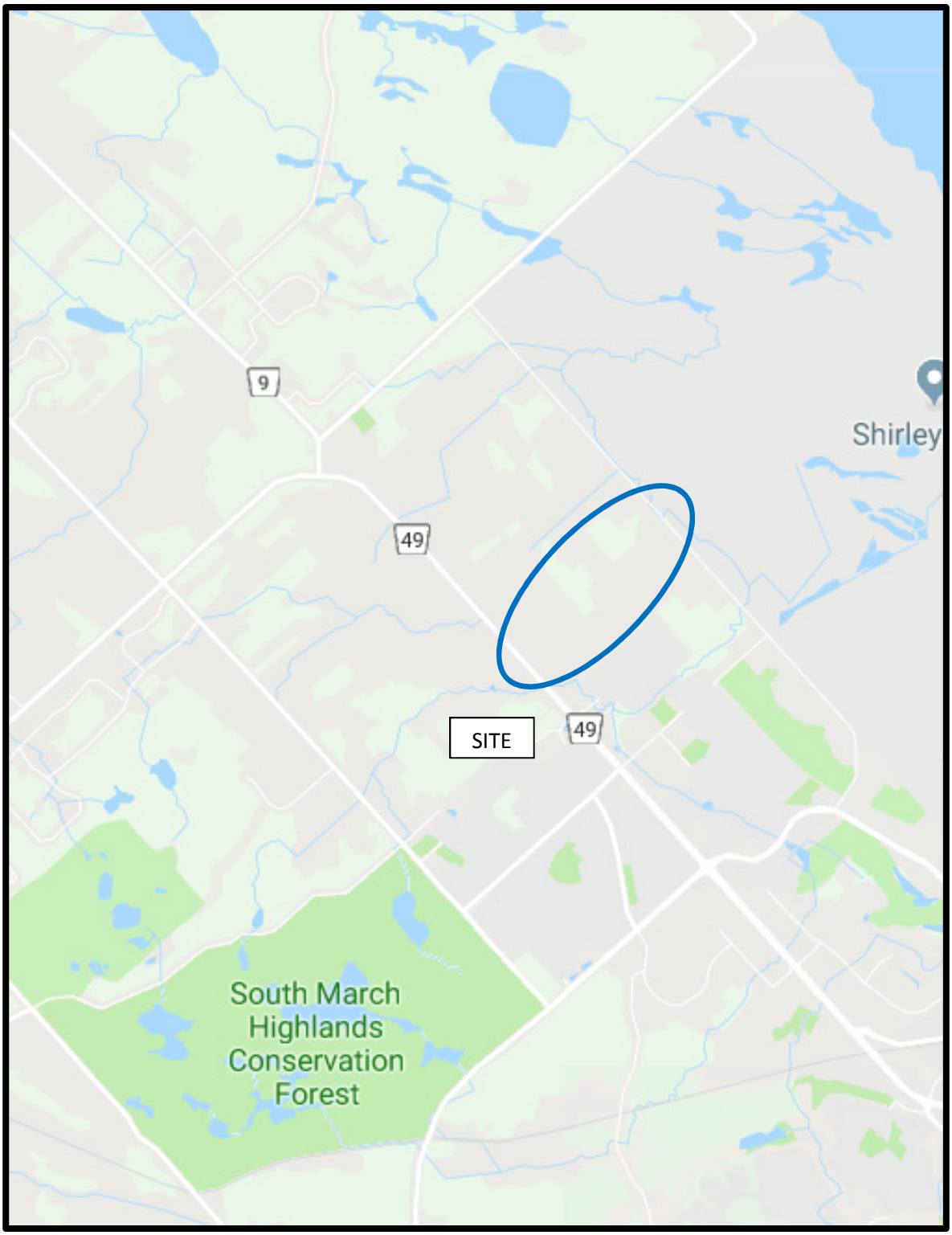
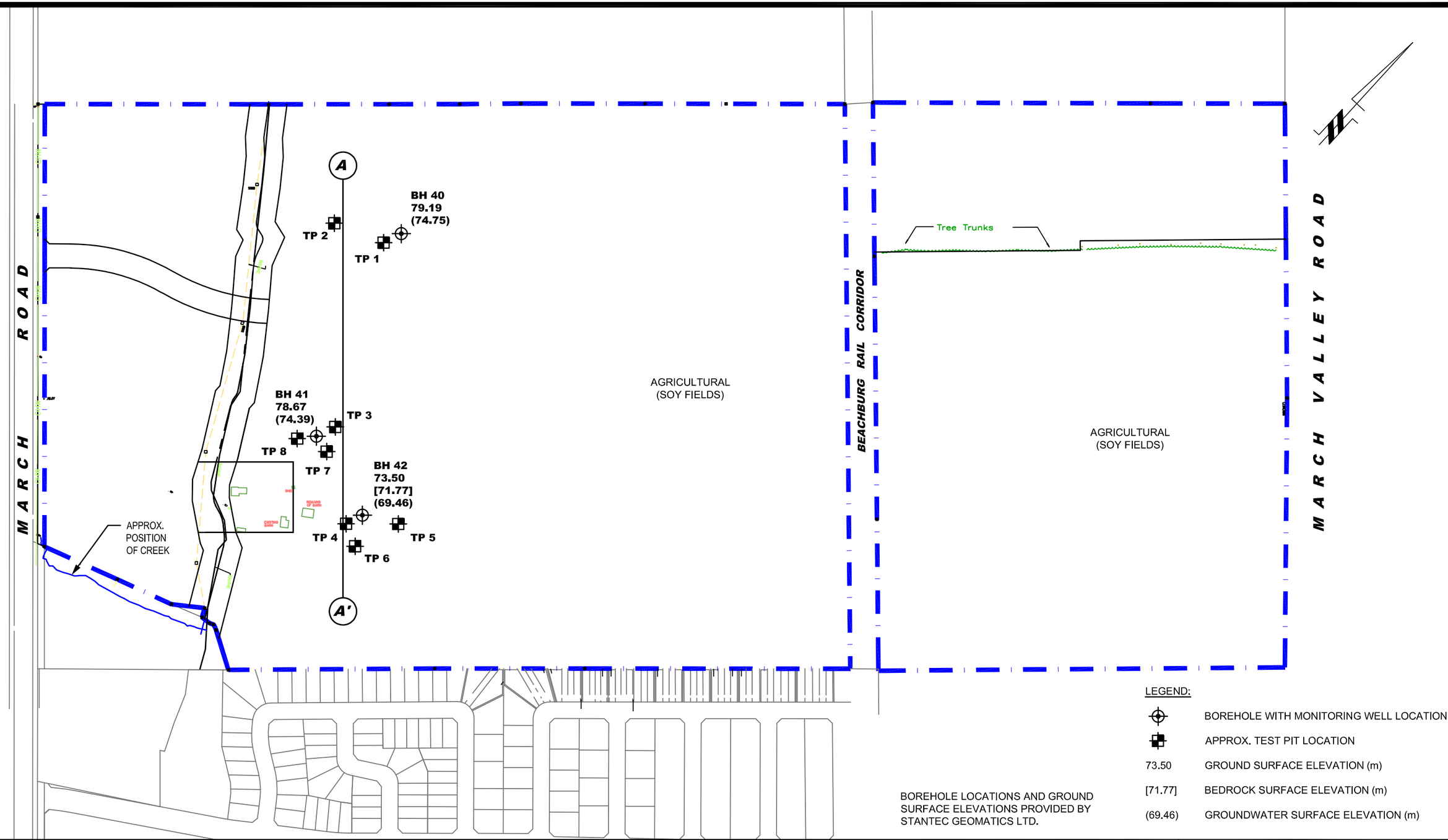


FIGURE 1

KEY PLAN



LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊡	APPROX. TEST PIT LOCATION
73.50	GROUND SURFACE ELEVATION (m)
[71.77]	BEDROCK SURFACE ELEVATION (m)
(69.46)	GROUNDWATER SURFACE ELEVATION (m)

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
0			

MINTO COMMUNITIES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
936 MARCH ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:4000	Date: 07/2018
Drawn by: MPG	Report No.: PE4343-2
Checked by: KM	Dwg. No.: PE4343-3
Approved by: MSD	Revision No.: 0

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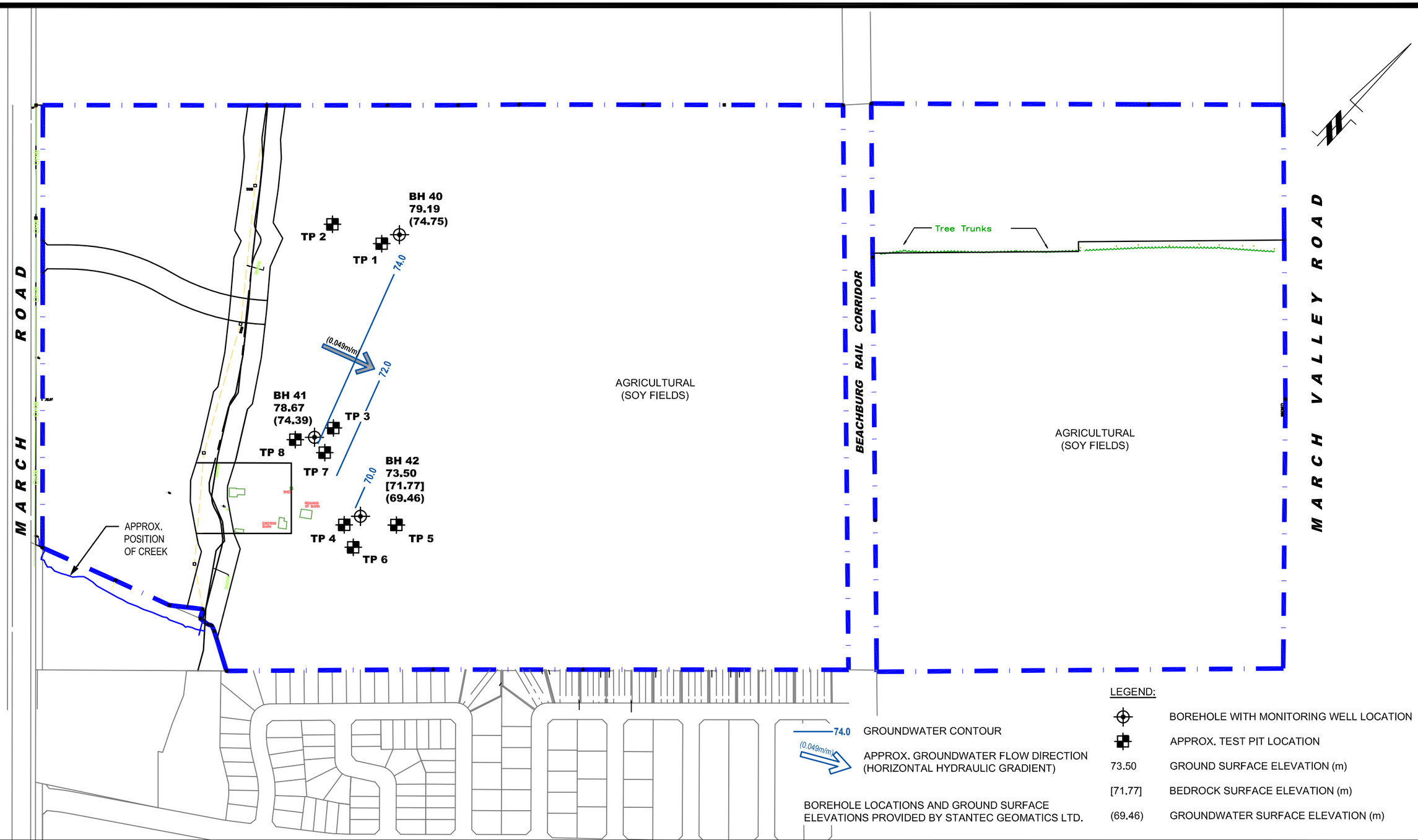

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0			

MINTO COMMUNITIES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
936 MARCH ROAD

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:4000	Date: 07/2018
Drawn by: MPG	Report No.: PE4343-2
Checked by: KM	Dwg. No.: PE4343-4
Approved by: MSD	Revision No.: 0

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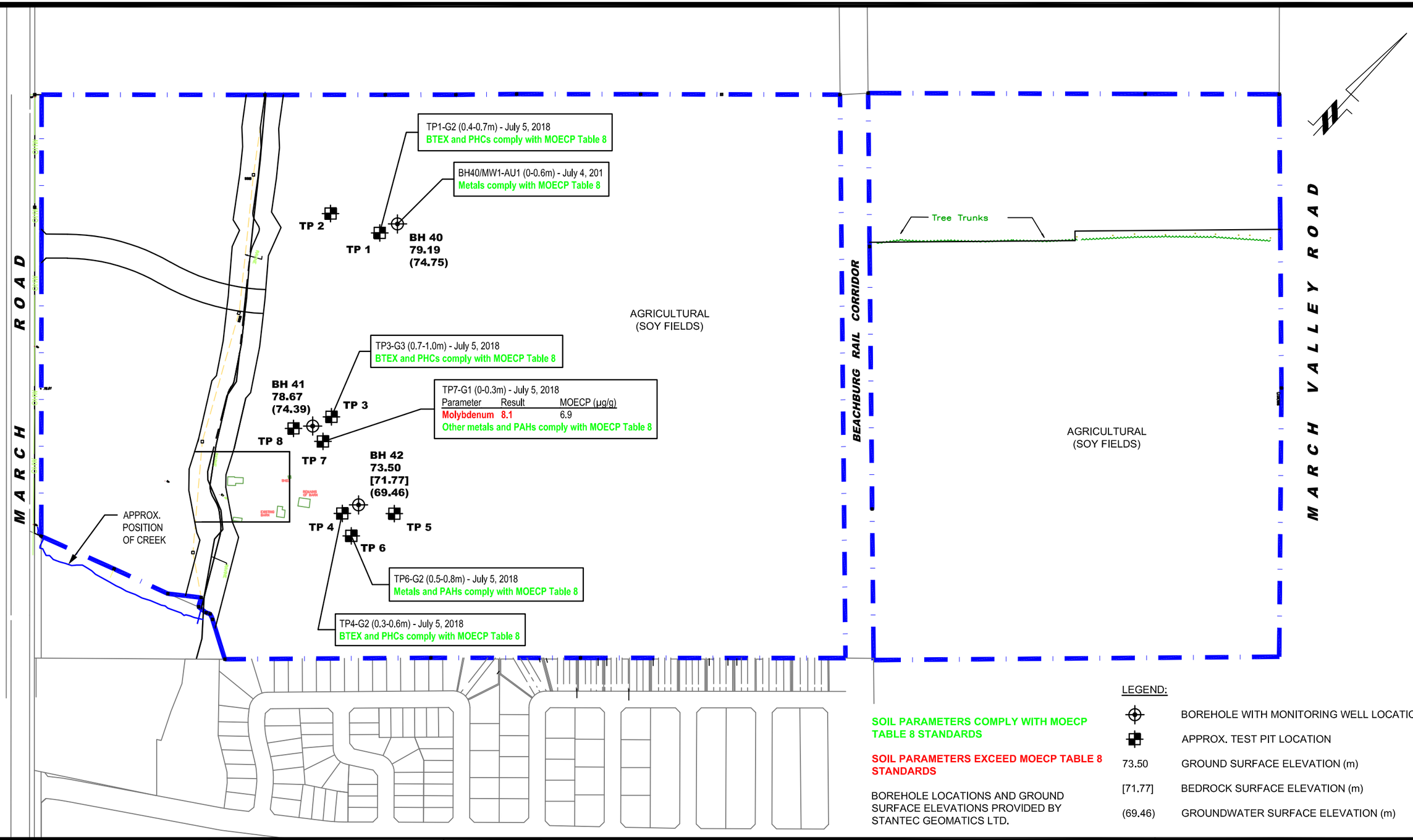

SOIL PARAMETERS COMPLY WITH MOECP TABLE 8 STANDARDS

SOIL PARAMETERS EXCEED MOECP TABLE 8 STANDARDS

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
✚	APPROX. TEST PIT LOCATION
73.50	GROUND SURFACE ELEVATION (m)
[71.77]	BEDROCK SURFACE ELEVATION (m)
(69.46)	GROUNDWATER SURFACE ELEVATION (m)

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
936 MARCH ROAD

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN - SOIL

Scale: 1:4000	Date: 07/2018
Drawn by: MPG	Report No.: PE4343-2
Checked by: KM	Dwg. No.: PE4343-5
Approved by: MSD	Revision No.: 0

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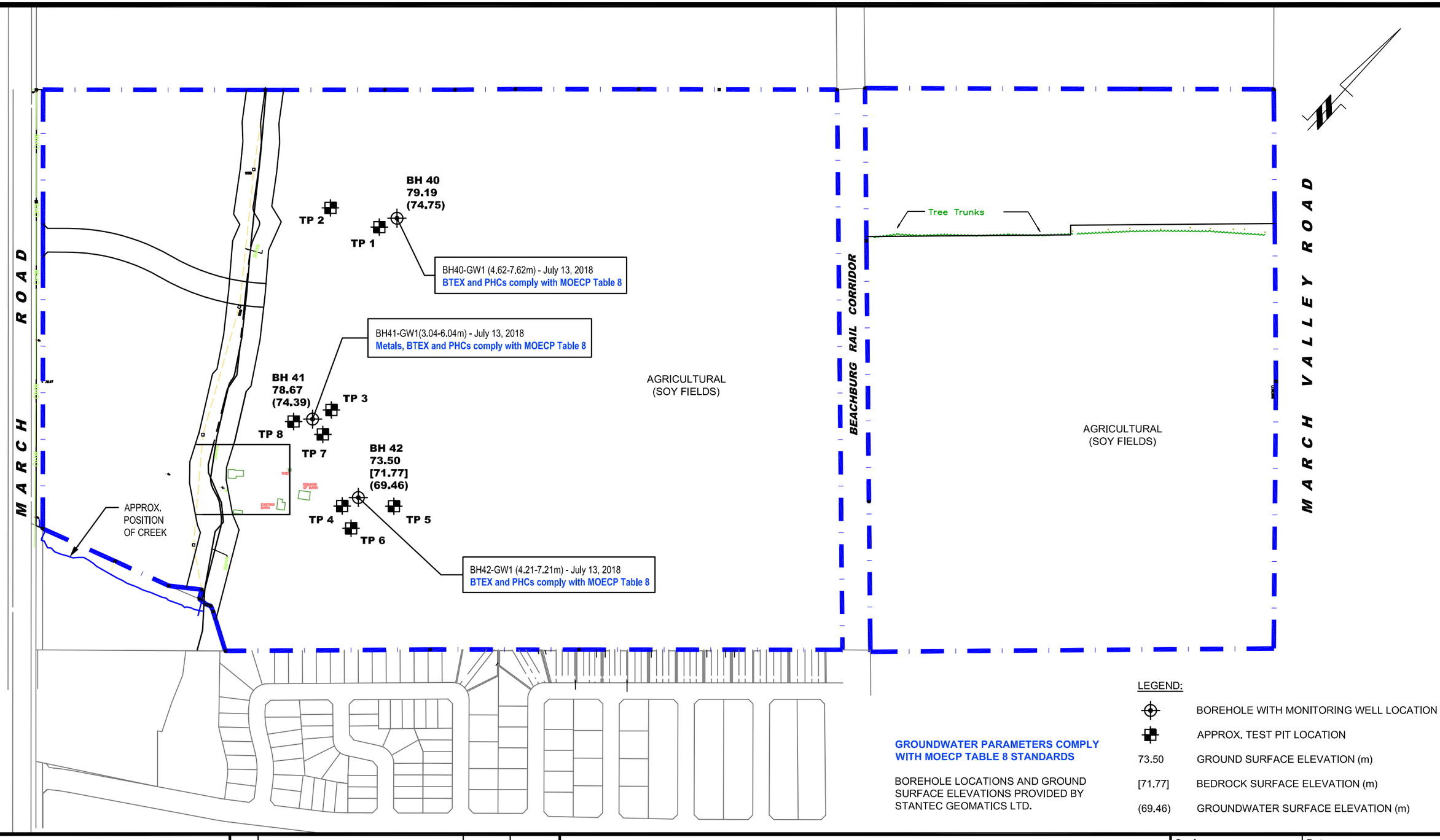

GROUNDWATER PARAMETERS COMPLY WITH MOECP TABLE 8 STANDARDS

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
■	APPROX. TEST PIT LOCATION
73.50	GROUND SURFACE ELEVATION (m)
[71.77]	BEDROCK SURFACE ELEVATION (m)
(69.46)	GROUNDWATER SURFACE ELEVATION (m)

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PHASE II - ENVIRONMENTAL SITE ASSESSMENT
936 MARCH ROAD

OTTAWA, ONTARIO

Title:
ANALYTICAL TESTING PLAN - GROUNDWATER

Scale: 1:4000	Date: 07/2018
Drawn by: MPG	Report No.: PE4343-2
Checked by: KM	Dwg. No.: PE4343-6
Approved by: MSD	Revision No.: 0

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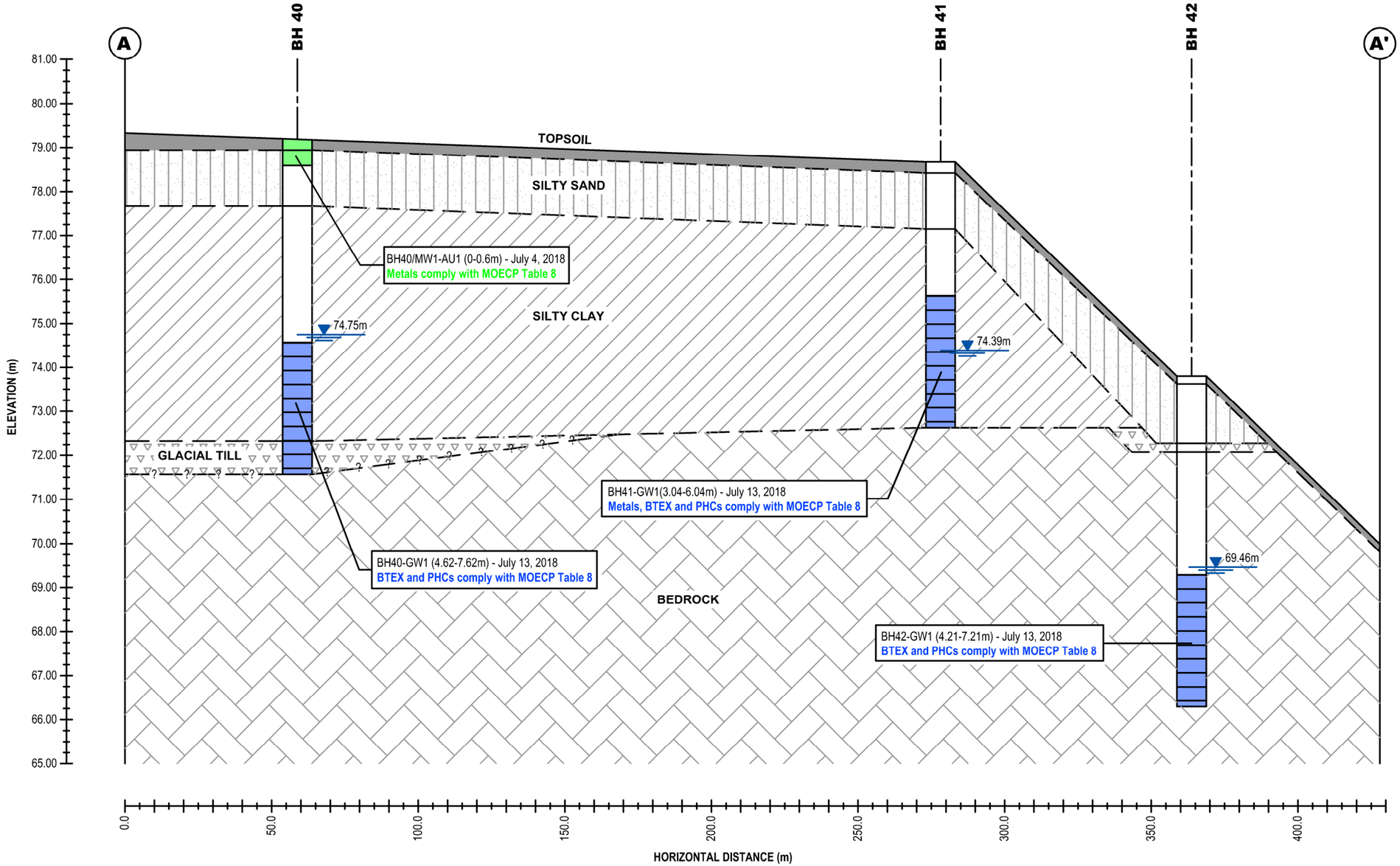

SOIL PARAMETERS COMPLY WITH MOECP TABLE 8 STANDARDS

GROUNDWATER PARAMETERS COMPLY WITH MOECP TABLE 8 STANDARDS

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MINTO COMMUNITIES

PHASE II- ENVIRONMENTAL SITE ASSESSMENT
936 MARCH ROAD

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A'

Scale: AS SHOWN	Date: 07/2018
Drawn by: MPG	Report No.: PE4343-2
Checked by: KM	Dwg. No.: PE4343-7
Approved by: MSD	Revision No.: 0

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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
936 March Road
Ottawa, Ontario

Prepared For

Minto Communities

June 2018

Report: PE4343-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned by Minto Communities to conduct a Phase II Environmental Site Assessment (ESA) for the property addressed 936 March Road, in the City of Ottawa, Ontario. A subsurface investigation program consisting of borehole drilling and test pits, was developed for the property based on the findings of a Phase I ESA conducted by Paterson in June of 2018.

Borehole	Location & Rationale	Proposed Depth & Rationale
BH40/MW1	Place borehole in vicinity of the former barn and stored items (noted in aerial photograph review) further to the north of the residential dwelling.	Sample overburden to at least 1.5m below the water table for monitoring well installation. If shallow bedrock is encountered, core the bedrock to at least 6 m below ground surface.
BH41/MW2	Place borehole in the vicinity of the stored scrap metal and construction equipment, northeast of the residential dwelling.	
BH42/MW3	Place borehole in the vicinity of the stored scrap metal and construction equipment east of the residential dwelling.	
TP1	Place borehole in vicinity of the former barn and stored items (noted in aerial photograph review) further to the north of the residential dwelling.	Excavate test pits to approximately 2.0m below ground surface to assess potential for near surface impacts.
TP2		
TP3	Place borehole in the vicinity of the stored scrap metal and construction equipment, northeast of the residential dwelling.	
TP4	Place borehole in the vicinity of the stored scrap metal and construction equipment east of the residential dwelling.	
TP5		
TP6		
TP7	Place borehole in the vicinity of the stored scrap metal and construction equipment, northeast of the residential dwelling.	
TP8		

At each borehole, split-spoon samples of overburden soils will be obtained at 0.76 m (2'6") intervals until practical refusal to augering. At each test pit, grab samples will be obtain at approximate 0.3m intervals. 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 and test pit 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 and test pits 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
- ❒ trowel
- ❒ 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 and orientations of boreholes with respect to site features (buildings, roadways, etc.) must be provided. Distances should be measured using a measuring tape or wheel rather than paced off. Ground surface elevations at each borehole should be surveyed relative to geodetic benchmark.

Drilling Procedure

The actual drilling procedure for environmental boreholes/test pits is the same as geotechnical boreholes/test pits (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, or for test pits, grab samples (every 0.3m or 1') 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 or hand held sampling equipment (shovel or trowel) 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). Test pits will be excavated to shallow depths to target shallow soil impacts.
- ❒ 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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. BH40

BORINGS BY CME 55 Power Auger **DATE** July 4, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	79.19
TOPSOIL 0.25		AU	1				
Compact, brown **SILTY SAND,** trace clay		SS	2	71	11	1	78.19
1.52		SS	3	96	8	2	77.19
Stiff, brown **SILTY CLAY,** trace sand		SS	4	96	7		
		SS	5	96	7	3	76.19
- grey by 3.8m depth		SS	6	94	6	4	75.19
		SS	7	96	5	5	74.19
		SS	8	96	4	6	73.19
		SS	9	96	W		
6.86						7	72.19
GLACIAL TILL: Grey silty clay with sand and gravel		SS	10	96	2		
7.62							
End of Borehole							
(GWL @ 4.44m - July 13, 2018)							

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

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FILE NO. PE4343

REMARKS

HOLE NO. BH41

BORINGS BY CME 55 Power Auger **DATE** July 4, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.67
TOPSOIL 0.25		AU	1				
Compact, brown **SILTY SAND,** trace clay		SS	2	75	12	1	77.67
1.52		SS	3	21	6	2	76.67
Stiff to firm, brown **SILTY CLAY,** trace sand		SS	4	54	8		
- grey by 2.3m depth		SS	5	62	8	3	75.67
		SS	6	88	3	4	74.67
		SS	7	96	1	5	73.67
		SS	8	88	W		
6.04						6	72.67
End of Borehole							
Practical refusal to augering at 6.04m depth							
(GWL @ 4.28m - July 13, 2018)							

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

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FILE NO. PE4343

REMARKS

HOLE NO. BH42

BORINGS BY CME 55 Power Auger **DATE** July 4, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	73.50
TOPSOIL 0.18		AU	1				
Compact, brown **SILTY SAND,** trace clay		SS	2	21	10	1	72.50
1.52							
GLACIAL TILL: Brown silty sand with gravel 1.73		SS	3	20	50+	2	71.50
		RC	1	98	98		
						3	70.50
		RC	2	98	79		
BEDROCK: Grey limestone with shale seams						4	69.50
		RC	3	100	93	5	68.50
						6	67.50
		RC	4	100	81		
7.21						7	66.50
End of Borehole							
(GWL @ 4.04m - July 13, 2018)							

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

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FILE NO. PE4343

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
TOPSOIL		G	1						
0.30									
Brown **SILTY SAND**		G	2						
0.60									
Grey-brown **SILTY CLAY**		G	3			1			
		G	4						
2.10						2			
End of Test Pit									

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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

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FILE NO. PE4343

REMARKS

HOLE NO. TP 2

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL		G	1				
0.15							
		G	2				
Brown to light brown **SILTY SAND**							
		G	3			1	
1.50							
Grey **SILTY CLAY**							
		G	4			2	
2.10							
End of Test Pit							

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
TOPSOIL		G	1						
0.20									
		G	2						
Brown **SILTY SAND**									
		G	3			1			
1.10									
Grey **SILTY CLAY**		G	4						
1.70									
End of Test Pit									

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.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. TP 4

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
TOPSOIL		G	1						
0.30									
Brown **SILTY CLAY**		G	2						
		G	3			1			
1.10									
End of Test Pit									
TP terminated on inferred bedrock surface at 1.10m depth									

Lower Explosive Limit % scale: 20 40 60 80

RKI Eagle Rdg. (ppm) scale: 100 200 300 400 500

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. TP 5

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: Volatile Organic Rdg. (ppm) / Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
TOPSOIL 0.20		G	1						
Brown **SILTY FINE SAND,** trace clay 0.90		G	2						
GLACIAL TILL: Brown silty clay, some sand, gravel, cobbles 1.70		G	3			1			
End of Test Pit TP terminated on inferred bedrock surface at 1.70m depth									

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.

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
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FILE NO. PE4343

REMARKS

HOLE NO. TP 6

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL		G	1				
0.40							
Brown **SILTY FINE SAND,** trace clay		G	2				
0.90						1	
Grey-brown **SILTY CLAY**		G	3				
1.60							
End of Test Pit							
TP terminated on inferred bedrock surface at 1.60m depth							

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. TP 7

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: ● Volatile Organic Rdg. (ppm) / ○ Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
Brown silty sand and topsoil (reworked native material) with debris - metal, wood, glass		G	1						
0.80									
End of Test Pit									

Photo Ionization Detector: ○ Lower Explosive Limit % — 20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PE4343

REMARKS

HOLE NO. TP 8

BORINGS BY Backhoe **DATE** July 5, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Photo Ionization Detector: ● Volatile Organic Rdg. (ppm) / ○ Lower Explosive Limit %	Monitoring Well Construction
GROUND SURFACE						0			
TOPSOIL with debris (metal, plastic, paint chips) 0.20		G	1						
End of Test Pit									

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.

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 = $(D30)^2 / (D10 \times D60)$
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

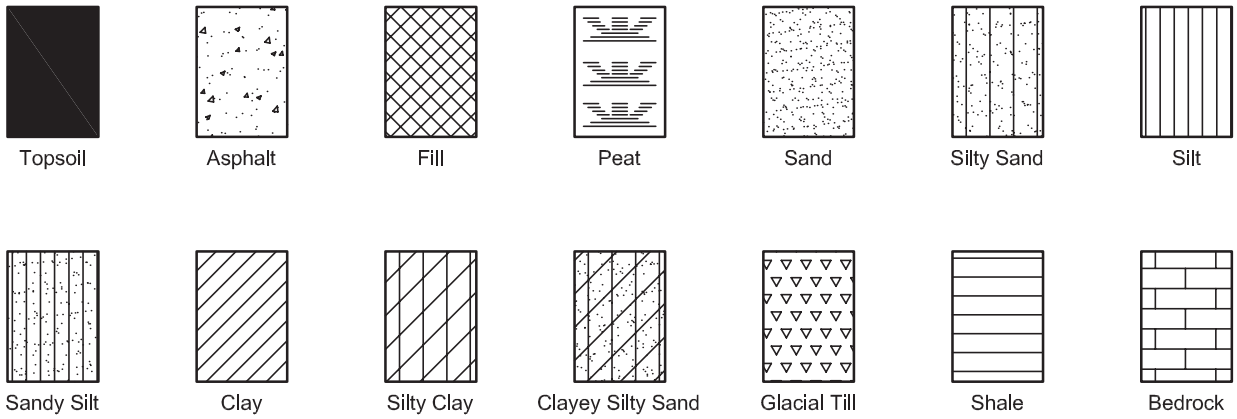
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

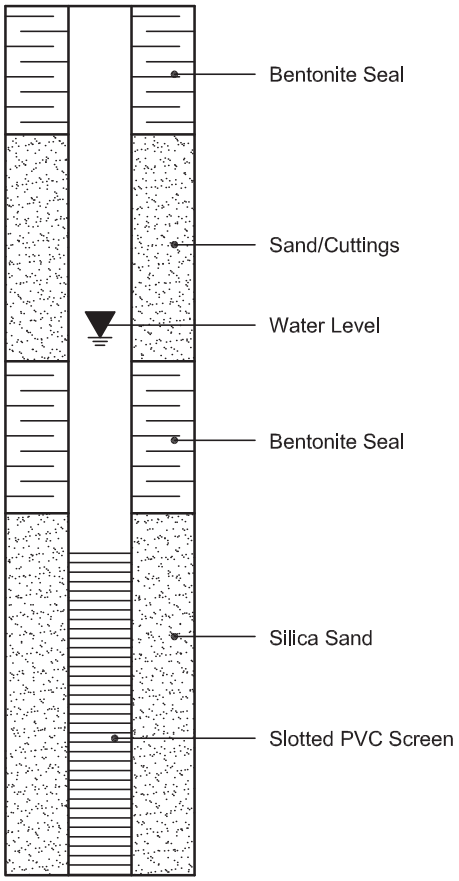
SYMBOLS AND TERMS (continued)

STRATA PLOT

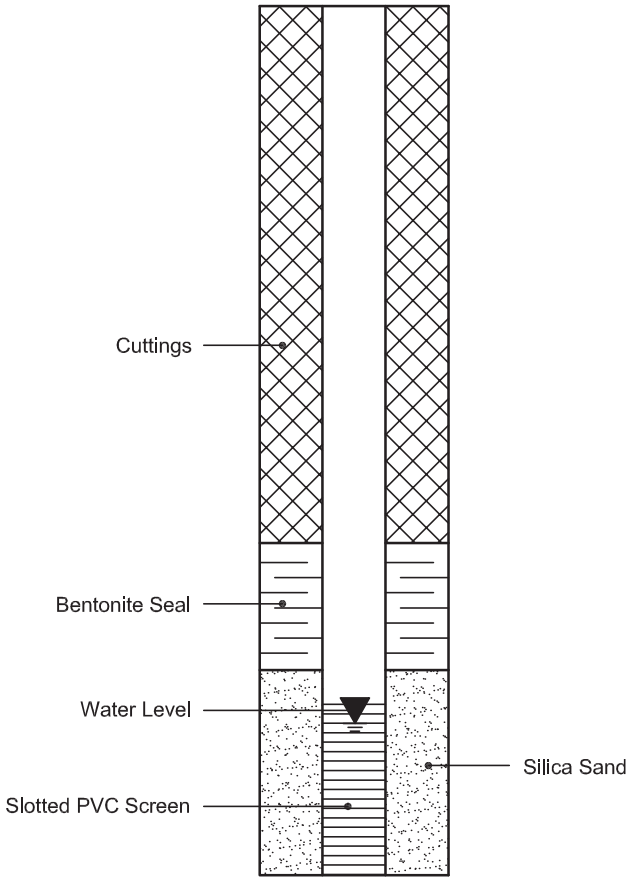


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Client PO: 24120
Project: PE4343
Custody: 118654

Report Date: 16-Jul-2018
Order Date: 10-Jul-2018

Order #: 1828249

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

Paracel ID	Client ID
1828249-01	TP1-G2
1828249-02	TP3-G3
1828249-03	TP4-G2
1828249-04	TP6-G2
1828249-05	TP7-G1
1828249-06	BH40/MW1-AU1

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24120

Report Date: 16-Jul-2018
Order Date: 10-Jul-2018
Project Description: PE4343

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	12-Jul-18	13-Jul-18
PHC F1	CWS Tier 1 - P&T GC-FID	12-Jul-18	13-Jul-18
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	11-Jul-18	12-Jul-18
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	16-Jul-18	16-Jul-18
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	11-Jul-18	11-Jul-18
Solids, %	Gravimetric, calculation	11-Jul-18	11-Jul-18

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24120

Report Date: 16-Jul-2018

Order Date: 10-Jul-2018

Project Description: PE4343

	Client ID:	TP1-G2	TP3-G3	TP4-G2	TP6-G2
	Sample Date:	07/05/2018 09:00	07/05/2018 09:00	07/05/2018 09:00	07/05/2018 09:00
	Sample ID:	1828249-01	1828249-02	1828249-03	1828249-04
	MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics					
% Solids	0.1 % by Wt.	89.1	87.0	80.1	82.9
Metals					
Antimony	1.0 ug/g dry	-	-	-	<1.0
Arsenic	1.0 ug/g dry	-	-	-	<1.0
Barium	1.0 ug/g dry	-	-	-	112
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	-	-	-	33.8
Cobalt	1.0 ug/g dry	-	-	-	8.3
Copper	5.0 ug/g dry	-	-	-	16.7
Lead	1.0 ug/g dry	-	-	-	5.3
Molybdenum	1.0 ug/g dry	-	-	-	<1.0
Nickel	5.0 ug/g dry	-	-	-	17.1
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	-	-	-	68.4
Zinc	20.0 ug/g dry	-	-	-	41.5
Volatiles					
Benzene	0.02 ug/g dry	<0.02	<0.02	<0.02	-
Ethylbenzene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
m,p-Xylenes	0.05 ug/g dry	<0.05	<0.05	<0.05	-
o-Xylene	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Xylenes, total	0.05 ug/g dry	<0.05	<0.05	<0.05	-
Toluene-d8	Surrogate	106%	105%	106%	-
Hydrocarbons					
F1 PHCs (C6-C10)	7 ug/g dry	<7	<7	<7	-
F2 PHCs (C10-C16)	4 ug/g dry	<4	<4	<4	-
F3 PHCs (C16-C34)	8 ug/g dry	<8	<8	<8	-
F4 PHCs (C34-C50)	6 ug/g dry	<6	<6	<6	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	-	-	-	<0.02

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24120

Report Date: 16-Jul-2018

Order Date: 10-Jul-2018

Project Description: PE4343

	Client ID:	TP1-G2	TP3-G3	TP4-G2	TP6-G2
	Sample Date:	07/05/2018 09:00	07/05/2018 09:00	07/05/2018 09:00	07/05/2018 09:00
	Sample ID:	1828249-01	1828249-02	1828249-03	1828249-04
	MDL/Units	Soil	Soil	Soil	Soil
Acenaphthylene	0.02 ug/g dry	-	-	-	<0.02
Anthracene	0.02 ug/g dry	-	-	-	<0.02
Benzo [a] anthracene	0.02 ug/g dry	-	-	-	<0.02
Benzo [a] pyrene	0.02 ug/g dry	-	-	-	<0.02
Benzo [b] fluoranthene	0.02 ug/g dry	-	-	-	<0.02
Benzo [g,h,i] perylene	0.02 ug/g dry	-	-	-	<0.02
Benzo [k] fluoranthene	0.02 ug/g dry	-	-	-	<0.02
Chrysene	0.02 ug/g dry	-	-	-	<0.02
Dibenzo [a,h] anthracene	0.02 ug/g dry	-	-	-	<0.02
Fluoranthene	0.02 ug/g dry	-	-	-	<0.02
Fluorene	0.02 ug/g dry	-	-	-	<0.02
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	-	-	-	<0.02
1-Methylnaphthalene	0.02 ug/g dry	-	-	-	<0.02
2-Methylnaphthalene	0.02 ug/g dry	-	-	-	<0.02
Methylnaphthalene (1&2)	0.04 ug/g dry	-	-	-	<0.04
Naphthalene	0.01 ug/g dry	-	-	-	<0.01
Phenanthrene	0.02 ug/g dry	-	-	-	<0.02
Pyrene	0.02 ug/g dry	-	-	-	<0.02
2-Fluorobiphenyl	Surrogate	-	-	-	84.9%
Terphenyl-d14	Surrogate	-	-	-	108%

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24120

Report Date: 16-Jul-2018

Order Date: 10-Jul-2018

Project Description: PE4343

	Client ID:	TP7-G1	BH40/MW1-AU1	-	-
	Sample Date:	07/05/2018 09:00	07/04/2018 09:00	-	-
	Sample ID:	1828249-05	1828249-06	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	97.4	94.2	-	-
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	-	-
Arsenic	1.0 ug/g dry	4.2	4.2	-	-
Barium	1.0 ug/g dry	43.6	33.8	-	-
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	0.6	<0.5	-	-
Chromium	5.0 ug/g dry	17.2	19.6	-	-
Cobalt	1.0 ug/g dry	4.3	4.0	-	-
Copper	5.0 ug/g dry	10.8	80.2	-	-
Lead	1.0 ug/g dry	30.4	13.9	-	-
Molybdenum	1.0 ug/g dry	8.1	<1.0	-	-
Nickel	5.0 ug/g dry	10.6	6.8	-	-
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	22.0	39.4	-	-
Zinc	20.0 ug/g dry	82.5	97.1	-	-
Semi-Volatiles					
Acenaphthene	0.02 ug/g dry	<0.02	-	-	-
Acenaphthylene	0.02 ug/g dry	<0.02	-	-	-
Anthracene	0.02 ug/g dry	0.05	-	-	-
Benzo [a] anthracene	0.02 ug/g dry	<0.02	-	-	-
Benzo [a] pyrene	0.02 ug/g dry	<0.02	-	-	-
Benzo [b] fluoranthene	0.02 ug/g dry	0.13	-	-	-
Benzo [g,h,i] perylene	0.02 ug/g dry	<0.02	-	-	-
Benzo [k] fluoranthene	0.02 ug/g dry	0.13	-	-	-
Chrysene	0.02 ug/g dry	<0.02	-	-	-
Dibenzo [a,h] anthracene	0.02 ug/g dry	<0.02	-	-	-
Fluoranthene	0.02 ug/g dry	0.02	-	-	-
Fluorene	0.02 ug/g dry	<0.02	-	-	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g dry	<0.02	-	-	-
1-Methylnaphthalene	0.02 ug/g dry	<0.02	-	-	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24120

Report Date: 16-Jul-2018
Order Date: 10-Jul-2018
Project Description: PE4343

	Client ID:	TP7-G1	BH40/MW1-AU1	-	-
	Sample Date:	07/05/2018 09:00	07/04/2018 09:00	-	-
	Sample ID:	1828249-05	1828249-06	-	-
	MDL/Units	Soil	Soil	-	-
2-Methylnaphthalene	0.02 ug/g dry	0.03	-	-	-
Methylnaphthalene (1&2)	0.04 ug/g dry	<0.04	-	-	-
Naphthalene	0.01 ug/g dry	<0.01	-	-	-
Phenanthrene	0.02 ug/g dry	0.05	-	-	-
Pyrene	0.02 ug/g dry	0.02	-	-	-
2-Fluorobiphenyl	Surrogate	90.9%	-	-	-
Terphenyl-d14	Surrogate	83.5%	-	-	-

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	ND	5.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	5.0	ug/g						
Lead	ND	1.0	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	*1.38*		*ug/g*		*103*	*50-140*			
Surrogate: Terphenyl-d14	*1.66*		*ug/g*		*124*	*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	*8.85*		*ug/g*		*111*	*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)	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	2.0	1.0	ug/g dry	ND			0.0	30	
Arsenic	1.9	1.0	ug/g dry	1.6			18.1	30	
Barium	16.1	1.0	ug/g dry	15.6			3.2	30	
Beryllium	ND	0.5	ug/g dry	ND			0.0	30	
Boron	ND	5.0	ug/g dry	6.3			0.0	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium	ND	5.0	ug/g dry	ND			0.0	30	
Cobalt	2.5	1.0	ug/g dry	2.4			6.6	30	
Copper	9.8	5.0	ug/g dry	9.5			3.9	30	
Lead	10.9	1.0	ug/g dry	10.8			0.7	30	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	5.6	5.0	ug/g dry	5.2			9.2	30	
Selenium	1.3	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	12.6	10.0	ug/g dry	11.9			5.9	30	
Zinc	39.7	20.0	ug/g dry	37.8			4.8	30	
Physical Characteristics									
% Solids	82.8	0.1	% by Wt.	86.0			3.8	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	*8.88*		*ug/g dry*		*52.9*	*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)	174	7	ug/g		86.9	80-120			
F2 PHCs (C10-C16)	84	4	ug/g	ND	93.7	60-140			
F3 PHCs (C16-C34)	265	8	ug/g	ND	121	60-140			
F4 PHCs (C34-C50)	127	6	ug/g	ND	91.5	60-140			
Metals									
Antimony	45.6		ug/L	ND	91.1	70-130			
Arsenic	46.9		ug/L	ND	92.6	70-130			
Barium	55.7		ug/L	6.2	99.0	70-130			
Beryllium	48.7		ug/L	ND	97.3	70-130			
Boron	48.5		ug/L	ND	92.0	70-130			
Cadmium	45.5		ug/L	ND	90.9	70-130			
Chromium	52.6		ug/L	ND	102	70-130			
Cobalt	50.8		ug/L	1.0	99.8	70-130			
Copper	52.7		ug/L	ND	97.8	70-130			
Lead	54.3		ug/L	4.3	100	70-130			
Molybdenum	44.8		ug/L	ND	89.6	70-130			
Nickel	52.1		ug/L	ND	100	70-130			
Selenium	45.9		ug/L	ND	91.3	70-130			
Silver	45.4		ug/L	ND	90.9	70-130			
Thallium	50.9		ug/L	ND	102	70-130			
Uranium	53.3		ug/L	ND	106	70-130			
Vanadium	56.0		ug/L	ND	103	70-130			
Zinc	60.3		ug/L	ND	90.4	70-130			
Semi-Volatiles									
Acenaphthene	0.152	0.02	ug/g		91.2	50-140			
Acenaphthylene	0.136	0.02	ug/g		81.5	50-140			
Anthracene	0.126	0.02	ug/g		75.7	50-140			
Benzo [a] anthracene	0.106	0.02	ug/g		63.4	50-140			
Benzo [a] pyrene	0.136	0.02	ug/g		81.7	50-140			
Benzo [b] fluoranthene	0.135	0.02	ug/g		81.3	50-140			
Benzo [g,h,i] perylene	0.120	0.02	ug/g		71.9	50-140			
Benzo [k] fluoranthene	0.129	0.02	ug/g		77.3	50-140			
Chrysene	0.134	0.02	ug/g		80.4	50-140			
Dibenzo [a,h] anthracene	0.113	0.02	ug/g		68.0	50-140			
Fluoranthene	0.130	0.02	ug/g		78.2	50-140			
Fluorene	0.143	0.02	ug/g		85.5	50-140			
Indeno [1,2,3-cd] pyrene	0.127	0.02	ug/g		76.5	50-140			
1-Methylnaphthalene	0.121	0.02	ug/g		72.3	50-140			
2-Methylnaphthalene	0.133	0.02	ug/g		79.7	50-140			
Naphthalene	0.134	0.01	ug/g		80.4	50-140			
Phenanthrene	0.133	0.02	ug/g		80.0	50-140			
Pyrene	0.134	0.02	ug/g		80.2	50-140			
Surrogate: 2-Fluorobiphenyl	*1.18*		*ug/g*		*88.4*	*50-140*			
Volatiles									
Benzene	4.69	0.02	ug/g		117	60-130			
Ethylbenzene	4.13	0.05	ug/g		103	60-130			
Toluene	4.05	0.05	ug/g		101	60-130			
m,p-Xylenes	8.25	0.05	ug/g		103	60-130			
o-Xylene	4.24	0.05	ug/g		106	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.

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 LABORATORIES LTD

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Paracel ID: 1828249

Chain of Custody (Lab Use Only)

№ 118654

Page __ of __

Client Name: Paterson Group Inc.	Project Reference: PE4343
Contact Name: Karyn Munch	Quote #
Address: 154 Colonnade Rd S.	PO # 24120
Telephone: 613-226-7381	Email Address: Kmunch

Turnaround Time: ☐ 1 Day ☐ 3 Day ☐ 2 Day ☒ Regular

Date Required:

Criteria: ☒ O. Reg. 153/04 (As Amended) Table 2 ☐ 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: 1828249

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Date	Time	PHCs F1-F4+BTEX	VOCs	PAHs	Metals by ICP	Hg	CrVI	B (HWS)	
1	TP1-G2	S		2	July 5/18		✓							250 mL + 1 vial
2	TP3-G3	S		2	July 5/18		✓							↓
3	TP4-G2	S		2	"		✓							↓
4	TP6-G2	S		1	"				✓	✓				250 mL
5	TP7-G1	S		1	"				✓	✓				↓
6	BH40/MW1-AU1	S		1	July 4/18					✓				120 mL
7														
8														
9														
10														

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): KMunch	Received by Driver/Depot: [signature]	Received at Lab: Sumetporn Dommi	Verified By: [signature]
Relinquished By (Print): KMunch	Date/Time: 10/07/18 4:10 PM	Date/Time: JUL 10, 2018 05:00	Date/Time: July 10/18 6:54
Date/Time: July 10, 2018	Temperature: °C	Temperature: 20.2 °C	pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

154 Colonnade Road South
Nepean, ON K2E 7J5
Attn: Karyn Munch

Client PO: 24124
Project: PE4343
Custody: 118657

Report Date: 23-Jul-2018
Order Date: 16-Jul-2018

Order #: 1829003

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

Paracel ID	Client ID
1829003-01	BH40-GW1
1829003-02	BH41-GW1
1829003-03	BH42-GW1

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24124

Report Date: 23-Jul-2018
Order Date: 16-Jul-2018
Project Description: PE4343

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
BTEX by P&T GC-MS	EPA 624 - P&T GC-MS	20-Jul-18	20-Jul-18
Metals, ICP-MS	EPA 200.8 - ICP-MS	20-Jul-18	20-Jul-18
PHC F1	CWS Tier 1 - P&T GC-FID	19-Jul-18	19-Jul-18
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	16-Jul-18	17-Jul-18

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24124

Report Date: 23-Jul-2018

Order Date: 16-Jul-2018

Project Description: PE4343

	Client ID:	BH40-GW1	BH41-GW1	BH42-GW1	-
	Sample Date:	07/13/2018 09:00	07/13/2018 09:00	07/13/2018 09:00	-
	Sample ID:	1829003-01	1829003-02	1829003-03	-
	MDL/Units	Water	Water	Water	-
Metals					
Antimony	0.5 ug/L	-	<0.5	-	-
Arsenic	1 ug/L	-	<1	-	-
Barium	1 ug/L	-	96	-	-
Beryllium	0.5 ug/L	-	<0.5	-	-
Boron	10 ug/L	-	<10	-	-
Cadmium	0.1 ug/L	-	<0.1	-	-
Chromium	1 ug/L	-	2	-	-
Cobalt	0.5 ug/L	-	<0.5	-	-
Copper	0.5 ug/L	-	2.3	-	-
Lead	0.1 ug/L	-	0.2	-	-
Molybdenum	0.5 ug/L	-	3.0	-	-
Nickel	1 ug/L	-	<1	-	-
Selenium	1 ug/L	-	<1	-	-
Silver	0.1 ug/L	-	<0.1	-	-
Sodium	200 ug/L	-	7420	-	-
Thallium	0.1 ug/L	-	<0.1	-	-
Uranium	0.1 ug/L	-	0.4	-	-
Vanadium	0.5 ug/L	-	1.3	-	-
Zinc	5 ug/L	-	<5	-	-
Volatiles					
Benzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene	0.5 ug/L	<0.5	<0.5	<0.5	-
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	<0.5	-
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Xylenes, total	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene-d8	Surrogate	96.7%	95.8%	97.6%	-
Hydrocarbons					
F1 PHCs (C6-C10)	25 ug/L	<25	<25	<25	-
F2 PHCs (C10-C16)	100 ug/L	<100	<100	<100	-
F3 PHCs (C16-C34)	100 ug/L	<100	<100	<100	-
F4 PHCs (C34-C50)	100 ug/L	<100	<100	<100	-

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 24124

Report Date: 23-Jul-2018
Order Date: 16-Jul-2018
Project Description: PE4343

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
Metals									
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Lead	ND	0.1	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Thallium	ND	0.1	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						
Zinc	ND	5	ug/L						
Volatiles									
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	*76.4*		*ug/L*		*95.5*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Metals									
Antimony	ND	0.5	ug/L	ND			0.0	20	
Arsenic	1.7	1	ug/L	1.4			14.4	20	
Barium	168	1	ug/L	167			0.7	20	
Beryllium	ND	0.5	ug/L	ND			0.0	20	
Boron	119	10	ug/L	119			0.4	20	
Cadmium	ND	0.1	ug/L	0.26			0.0	20	
Chromium	3.4	1	ug/L	4.4			24.3	20	QR-01
Cobalt	ND	0.5	ug/L	ND			0.0	20	
Copper	2.50	0.5	ug/L	2.41			3.5	20	
Lead	0.70	0.1	ug/L	0.68			3.0	20	
Molybdenum	0.65	0.5	ug/L	0.56			14.3	20	
Nickel	4.3	1	ug/L	4.4			1.1	20	
Selenium	ND	1	ug/L	ND			0.0	20	
Silver	ND	0.1	ug/L	ND			0.0	20	
Thallium	1.97	0.1	ug/L	1.97			0.0	20	
Uranium	1.9	0.1	ug/L	1.9			2.2	20	
Vanadium	0.83	0.5	ug/L	1.15			32.9	20	QR-01
Zinc	ND	5	ug/L	ND			0.0	20	
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	*78.6*		*ug/L*		*98.2*	*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)	1890	25	ug/L		94.3	68-117			
F2 PHCs (C10-C16)	1550	100	ug/L		97.1	60-140			
F3 PHCs (C16-C34)	3960	100	ug/L		101	60-140			
F4 PHCs (C34-C50)	3090	100	ug/L		125	60-140			
Metals									
Antimony	42.6		ug/L		85.2	80-120			
Arsenic	45.1		ug/L		90.2	80-120			
Barium	44.1		ug/L		88.2	80-120			
Beryllium	43.6		ug/L		87.1	80-120			
Boron	42		ug/L		83.4	80-120			
Cadmium	44.2		ug/L		88.4	80-120			
Chromium	43.6		ug/L		87.2	80-120			
Cobalt	43.9		ug/L		87.7	80-120			
Copper	44.0		ug/L		87.9	80-120			
Lead	43.2		ug/L		86.3	80-120			
Molybdenum	43.3		ug/L		86.6	80-120			
Nickel	43.3		ug/L		86.5	80-120			
Selenium	44.6		ug/L		89.1	80-120			
Silver	44.9		ug/L		89.7	80-120			
Sodium	840		ug/L		84.0	80-120			
Thallium	43.7		ug/L		87.4	80-120			
Uranium	46.7		ug/L		93.4	80-120			
Vanadium	44.3		ug/L		88.5	80-120			
Zinc	44		ug/L		88.9	80-120			
Volatiles									
Benzene	39.5	0.5	ug/L		98.7	60-130			
Ethylbenzene	40.8	0.5	ug/L		102	60-130			
Toluene	38.6	0.5	ug/L		96.6	60-130			
m,p-Xylenes	82.1	0.5	ug/L		103	60-130			
o-Xylene	40.5	0.5	ug/L		101	60-130			
Surrogate: Toluene-d8	*69.6*		*ug/L*		*87.0*	*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.

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: 1829003

PARACEL LABORATORIES LTD.

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Chain of Custody
(Lab Use Only)
№ 118657

Page ___ of ___

Client Name: Paterson Group Inc.	Project Reference: PE4343	**Turnaround Time:**
Contact Name: Kaelyn Munch	Quote #	☐ 1 Day ☐ 3 Day
Address: 154 Colonnade Rd S.	PO # 24124	☐ 2 Day ☒ Regular
Telephone: 613-226-7381	Email Address: kmunch@patersongroup.ca	Date Required: July 20/18

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: 1829003

	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	BH40-GW1	GW		3	July 13/18		✓						
2	BH41-GW1	GW		3	July 13/18		✓						
3	BH42-GW1	GW		3	July 13/18		✓						
4													
5													
6													
7													
8													
9													
10													

Comments:

Method of Delivery: Walkin

Relinquished By (Sign): KMunch	Received by Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): KMunch	Date/Time:	Date/Time: July 16/18 7:34a	Date/Time: 16/7/18 8:50
Date/Time: July 16 7:00	Temperature: °C	Temperature: 20.2°	pH Verified [ ] By: NA