Geotechnical Engineering

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Phase II - Environmental Site Assessment

5 Orchard Drive
Ottawa, Ontario

Prepared For

Campanale Homes

January 28, 2018

Report: PE4212-2

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EXECUTIVE SUMMARY

Assessment

A Phase II-Environmental Site Assessment (ESA) was conducted for the property at 5 Orchard Drive, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the Area of Potential Environmental Concern for the subject site identified during a 2015 Phase I ESA. The Phase II-ESA consisted of the drilling of fifteen (15) boreholes in conjunction with a geotechnical investigation and installing three (3) groundwater monitoring wells to assess soil and groundwater quality at the subject site.

Soil samples were obtained from the boreholes and were screened using visual observations and vapour measurements. Site soils consist of a layer of topsoil, which is underlain by silty sand, glacial till and limestone bedrock. A fill layer consisting of silty sand and crushed stone was encountered in the western portion of the subject site in the area of the former farmstead. Based on the screening results, samples were selected for analysis of metals, petroleum hydrocarbons, fractions 1 through 4 (PHCs F_1-F_4), including benzene, toluene, ethylbenzene and xylenes (BTEX). Based on the analytical results, the fill material at the subject site is in compliance with the Ontario Ministry of the Environment and Climate Change (MOECC) Table 9 Standards for PHC, BTEX and metal parameters.

A native soil sample consisting of topsoil was submitted for herbicide/pesticide analysis to address the historical agricultural use of the subject site. There were no detected concentrations of herbicide/pesticide parameters in the soil sample analyzed.

Groundwater samples were collected from the monitoring wells installed in BH13, BH14 and BH15, and analyzed for PHC and VOC parameters. All detected concentrations were in compliance with the MOECC Table 9 Standards.

Based on the findings of the Phase II ESA, the soil and groundwater on the subject site are considered to be in compliance with the selected MOECC Table 9 standards. No further work is required for the property at this time.

Recommendations

If the monitoring wells installed in BH13, BH14 and BH15 are not going to be used in the future, they should be abandoned according to Ontario Regulation 903. The monitoring wells will be registered with the MOECC under this regulation. Further information can be provided up request in this regard.

1.0 INTRODUCTION

Paterson Group (Paterson) conducted a Phase II-Environmental Site Assessment (ESA) of the property addressed 5 Orchard Drive, in the City of Ottawa, Ontario. The purpose of this Phase II-ESA was to address the potential for the historical on-site activities identified by a 2015 Phase I-ESA to have impacted the subject site.

1.1 Site Description

Address:	5 Orchard Drive, Ottawa, Ontario.
Legal Description:	Part of Lots 26 and 27, Concession 11, Geographic Township of Goulbourn, City of Ottawa.
Property Identification Number:	04463-0004 and 04463-0005.
Location:	The subject site is located on the southwest corner of the Hazeldean Road and Fringewood Drive intersection, in the City of Ottawa, Ontario. The subject site is shown on Figure 1 - Key Plan following the body of this report.
Latitude and Longitude:	45° 16' 48" N, 75° 54' 55" W.
Configuration:	Irregular
Site Area:	4.69 hectares (approximate).

1.2 Property Ownership

The subject property is currently owned by Relocatable Homes Limited. Paterson was commissioned to prepare the Phase II-ESA report by Mr. Tony Campanale with Campanale Homes. Mr. Campanale can be reached by telephone at (613) 730-7000.

1.3 Current and Proposed Future Uses

The subject site is currently vacant. It is our understanding that the subject site is to be developed.

1.4 Applicable Site Condition Standard

The site condition standards for the property were obtained from Table 9 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 (MOECC), April 2011. The MOECC Table 9 Standards are based on the following considerations:

- Part of the property is within 30 meters of a surface water body
- Non-potable groundwater conditions
- Residential/Parkland/Commercial land use

2.0 BACKGROUND INFORMATION

2.1 Physical Setting

The subject site is located at the southwest corner of the intersection of Hazeldean Road and Fringewood Drive, in the City of Ottawa, Ontario. At the time of the 2015 Phase I ESA, the subject site was vacant (no buildings and not being utilized). The ground surface on the subject site consists primarily of grass and brush. A private gravel and asphalt laneway crosses the subject site, connecting Hazeldean Road and Sweetnam Drive.

2.2 Past Investigations

A Phase I-ESA was completed by Paterson in November 2015 and was conducted in general accordance with the Ontario Regulation (O.Reg.) 153/04, amended by O.Reg. 269/11. The historical review identified one (1) historic on-site potentially contaminating activity with the potential to have impacted the subject site, as listed in Table 1.

Table 1 – Areas of Potential Environmental Concern

APEC 1	Area of former farmstead; particularly the drive shed and storage building used to store farm equipment (No specific PCA item under Table 2, O.Reg. 153/04)

Paterson conducted a geotechnical investigation at the subject site in November 2015 in conjunction with a Phase II ESA, in which three (3) groundwater monitoring wells were installed. The subsurface profile encountered during the investigation consisted of topsoil underlain by a layer of loose silty sand followed by a layer of compact glacial till.

Limestone bedrock was encountered between 1.12 and 4.90 meters below ground surface (mbgs). A layer of fill consisting of silty sand and crushed stone was encountered in the western portion of the subject site in the area of the former farmstead, drive shed and storage building.

3.0 SCOPE OF INVESTIGATION

3.1 Overview of Site Investigation

The subsurface investigation conducted as a component of this Phase II ESA consisted of installing three (3) groundwater monitoring wells in conjunction with a geotechnical investigation. Boreholes were drilled through overburden soils until practical refusal. One (1) borehole was cored into the limestone bedrock to a depth of 5.41 mbgs. The groundwater monitoring wells were installed in boreholes drilled within the footprint of the former barn, drive shed and storage building.

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 former on-site activities identified in the Phase I ESA. Metals were added as a contaminant of concern (COC) based on the fill encountered in the area of the former farmstead. Contaminants with the potential to have been introduced by the former on-site activities are metals, benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons, fractions 1 through 4 (PHCs F1-F4), and volatile organic compounds (VOCs). Although there was no definite information confirming the use of pesticides on the crop land (eastern portion of subject site) a composite soil sample was also analyzed for pesticides.

3.3 Phase I Conceptual Site Model

Geological and Hydrogeological Setting

Based on information from the Geological Survey of Canada and subsurface investigations at the subject site, the site is located in an area of silty sand and glacial till with the thickness of overburden ranging from 1 to 5 mbgs with an average over 2 m. Based on the investigation, groundwater was encountered between 0.71 and 1.57 mbgs.

Subsurface conditions encountered during the Phase II-ESA are discussed in greater detail in Section 5.1.

Contaminants of Potential Concern

Based on the past and current uses of the subject site, the following Contaminants of Potential Concern (CPCs) have been identified:

- Volatile Organic Compounds (VOCs) – this suite of parameters includes Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), associated with various fuels, as well as solvents associated with de-greasing. These parameters were selected as CPCs for the Phase I study area due to the historic storage of farm equipment on the western portion of the property. VOCs may be present in the soil matrix as well as in the dissolved phase in the groundwater system.

- Petroleum Hydrocarbons fractions 1 through 4 (PHCs F_1-F_4) – this suite of parameters encompasses gasoline (Fraction 1), diesel and fuel oil (Fraction 2), and heavy oils (Fractions 3 and 4). PHCs F_1-F_4 were selected as CPCs for the Phase I property based on the historic storage of farm equipment on the western portion of the property. Gasoline and diesel are commonly used motor vehicle fuels, and diesel-fraction hydrocarbons were commonly used as heating oil. Heavy oils may be present in the form of lubricants and transmission or hydraulic fluids. PHCs may be present in the soil matrix, sorbed to soil particles, as well as in free or dissolved phase in the groundwater system. PHCs are generally considered to be LNAPLs – light non-aqueous phase liquids, indicating that when present in sufficient concentrations above the solubility limit, they will partition into a separate phase above the water table, due to their lower density.

- Metals – this suite of parameters encompasses various metals for which MOECC standards exist. Metals may be present in the soil matrix or dissolved in site groundwater. Metals were selected as CPCs for the Phase I property based on the fill material encountered in the three (3) boreholes advanced on the western portion of the subject site.

Although there was no definite information confirming the use of pesticides on the crop land (eastern portion of subject site) a composite soil sample was also analyzed for pesticides.

The mechanisms of contaminant transport within the site soils include physical transportation and leaching. Physical transportation includes any intentional or unintentional movement or distribution of soil by physical means. Contamination

arising from localized spills or runoff from the washing area on-site may be physically transported by vehicle movement or site grading. Leaching may occur in areas of the site where the ground surface is permeable; precipitation infiltrating in these areas may transport surficial contaminants into the lower strata. As such, this mechanism represents a potential pathway for soil contaminants to migrate into site groundwater.

The mechanisms of contaminant transport within the groundwater system include advection, dispersion, and diffusion. Advection and dispersion will be the dominant mechanisms of contaminant transport in soils with higher hydraulic conductivities, such as sands, gravels, silts, and some glacial till soils, whereas diffusion will dominate in soils with lower hydraulic conductivity, such as clays.

Buildings and Structures

The subject site is vacant and primarily covered by grass and brush. A sewer manhole was observed on the western portion of the subject site.

Water Bodies

There are no water bodies on the subject site. Poole Creek is located adjacent to the west.

Areas of Natural Significance

No areas of natural significance were observed on the site or in the Phase I study area.

Drinking Water Wells

The properties in the Phase I Study area are serviced by municipal water and sewage services. As such, drinking water wells are not expected to be located at the subject site or neighbouring properties within the Phase I study area.

Neighbouring Land Use

Neighbouring land use in the Phase I study area is currently residential and commercial.

Potentially Contaminating Activities and Areas of Potential Environmental Concern

The storage of farm equipment on the western portion of the subject site was identified as a historic on-site Potentially Contaminating Activity (PCA) resulting in an Area of Potential Environmental Concern (APEC). Off-site PCAs were

identified within the Phase I study area but were not considered to represent APECs on the subject site.

Assessment of Uncertainty and/or Absence of Information

The information available for review as part of the preparation of the 2015 Phase I ESA is considered to be sufficient to conclude that one (1) historical PCA was present at the subject site. The presence of this historical PCA was confirmed by a variety of independent sources. 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. Field parameters for groundwater stabilization were not measured during the groundwater purging and sampling events on November 16, 2015. A sufficient volume of groundwater was purged to suggest the well development was adequate. No other deviations from the Sampling and Analysis Plan were noted.

3.5 Impediments

No physical impediments or denial of access were encountered during the Phase II Environmental Site Assessment.

4.0 INVESTIGATION METHOD

4.1 Subsurface Investigation

The subsurface investigation was conducted on November 4 and 5, 2015 and consisted of the placement of fifteen (15) boreholes (BH1 to BH15). The boreholes were placed to provide general coverage of the property for a concurrent geotechnical investigation and to address the aforementioned APEC. The boreholes were advanced using a track-mounted CME 55 power auger drill rig. Drilling occurred under full-time supervision of Paterson personnel. The borehole locations are indicated on the attached Drawing PE4212-3 - Test Hole Location Plan.

4.2 Soil Sampling

A total of sixty-five (65) soil samples were obtained from the boreholes by means of split spoon sampling and the sampling of shallow soils directly from auger flights. Split spoon samples were taken at approximate 0.76 to 1.52 m intervals. The depths at which split spoon and auger flight samples were obtained from the boreholes are shown as "**SS**" and "**AU**" respectively on the Soil Profile and Test Data Sheets, appended to this report.

The boreholes were terminated upon refusal of the augers with the exception of one (1) borehole which was advanced into bedrock using a diamond coring system. Two (2) rock core samples were recovered and are shown as "**RC**" on the Soil Profile and Test Data Sheets.

Site soils consist of a layer of topsoil, which is underlain by a layer of silty sand and glacial till. Limestone bedrock was encountered at a depth of approximately 1.12 to 4.90 mbgs. Fill material consisting of silty sand and crushed stone and relating to the former buildings and access lanes was encountered in the western portion of the subject site. The fill material was underlain by glacial till.

4.3 Field Screening Measurements

All soil samples collected were submitted to a preliminary screening procedure, which included visual screening for colour and evidence of metals, as well as screening with an RKI Eagle combustible gas detector. The detection limit of the RKI Eagle is 5 ppm, with a precision of +/- 5 ppm.

The soil vapours were measured by inserting the analyzer probe into the nominal headspace above the soil sample. Samples were then agitated and the peak readings recorded. The RKI Eagle vapour readings were found to range from 0 to 5.1 ppm. These readings are not considered to be indicative of the presence of volatile substances (such as gasoline). The vapour results cannot be used to identify the presence of heavier petroleum hydrocarbons, such as heavy oil. Please refer to the Soil Profile and Test Data sheets attached for soil sample headspace results. Combustible vapour readings are noted on the Soil Profile and Test Data Sheets appended to this report.

Soil samples were selected for analysis based on visual appearance, location, and vapour readings.

4.4 Groundwater Monitoring Well Installation

Three (3) groundwater monitoring wells were installed under full-time supervision by Paterson personnel. The monitoring wells consisted of 32 mm and 50 mm diameter Schedule 40 threaded PVC risers and screens. A sand pack consisting of silica sand was placed around the screen, and a bentonite seal was placed above the screen to minimize cross-contamination. Monitoring well construction details are provided on the Soil Profile and Test Data Sheets appended to this report. A summary of monitoring well construction details is provided below in Table 2.

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
BH13	108.32	3.58	2.06 – 3.58	1.25 – 3.58	0.00 – 1.25	Stickup
BH14	108.26	4.50	2.98 – 4.50	2.72 – 4.50	0.81 – 2.72	Stickup
BH15	106.99	5.41	3.89 – 5.41	3.63 – 5.41	0.60 – 3.63	Stickup

Notes:
- Elevations at test hole locations provided by Annis, O'Sullivan, Vollebekk Limited

4.5 Groundwater Sampling

Groundwater sampling protocols were followed using the MOECC 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.

4.6 Analytical Testing

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

Table 4: Soil Samples Submitted

Sample ID	Sample Depth/ Stratigraphic Unit	Parameters Analyzed			Rationale
		PHC (F_1-F_4) / BTEX	Herbicide/ Pesticide	Metals	
November 5, 2015					
BH13-SS2/SS3*	0.78-1.38. mbgs; fill	X		X	Assess quality of fill; general site coverage
BH14-AU1	0.0-0.6 mbgs; fill	X		X	Assess quality of fill; general site coverage
BH15-AU1	0.0-0.6 mbgs; fill	X		X	Assess quality of fill; general site coverage
BH4-5-6 AU1*	0.0-0.6 mbgs; topsoil		X		Assessment of topsoil in area used for agriculture

Notes:
- *Composite Sample

Table 5: Groundwater Samples Submitted

Sample ID	Sample Depth/ Stratigraphic Unit	Parameters Analyzed		Rationale
		VOCs	PHC (F_1-F_4)	
November 16, 2015				
BH13-GW1	2.06-3.58 mbgs; Glacial Till	X	X	Assessment of groundwater quality within the footprint of former barn, drive shed and storage building
BH14-GW1	2.98 -4.50 mbgs; Glacial Till	X	X	
BH15-GW1	3.89-5.41 mbgs; Bedrock	X	X	

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

4.7 Residue Management

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

4.8 Elevation Surveying

Monitoring well and borehole locations were obtained from Annis, O'Sullivan, Vollebekk Limited. The locations are shown on Drawing PE4212-3 – Test Hole Location Plan.

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 geology details are provided in the Soil Profile and Test Data Sheets appended to this report. Site soils consist of a layer of topsoil, which is underlain by a layer of silty sand and glacial till. Limestone bedrock was encountered at a depth of approximately 1.12 to 4.90 mbgs. A layer of fill, consisting of silty sand and crushed stone, was encountered in the western portion of the subject site overlying the glacial till.

Groundwater was encountered in the glacial till or the bedrock at depths ranging from 0.71 m to 1.57 m below existing grade.

5.2 Groundwater Elevations, Flow Direction, and Hydraulic Gradient

Groundwater levels were measured using an electronic water level meter. Groundwater levels are summarized below in Table 6. It should be noted that groundwater levels are expected to fluctuate throughout the year with seasonal variations.

Table 6: Groundwater Level Measurements

Borehole Location	Ground Surface Elevation (m ASL)	Water Level Depth (m below grade)	Water Level Elevation (m ASL)	Date of Measurement
BH13	108.32	0.75	107.57	November 16, 2015
BH14	108.26	0.71	107.55	November 16, 2015
BH15	106.99	1.57	105.42	November 16, 2015

5.3 Fine-Medium Soil Texture

Based on observed soil conditions, it is our opinion that fine- to medium-grained soil standards would not be applicable at the subject site. Coarse-grained soil standards would be applicable for the subject site. Grain size analysis was not completed.

5.4 Soil: Field Screening

Field screening of the soil samples collected during drilling resulted in soil vapour readings of 0 ppm to 5.1 ppm. Field screening results of each individual soil

sample are provided on the Soil Profile and Test Data Sheets appended to this report.

5.5 Soil Quality

Three (3) soil samples were submitted to Paracel Laboratories for analysis of a combination of BTEX, PHC (F_1-F_4) and metal parameters. A copy of the analytical test results is attached to this report. The results of the soil analytical testing are presented in Tables 7, 8, and 9. The laboratory certificates of analysis are appended to this report

One (1) soil sample was submitted to Exova for herbicide/pesticide analysis to address the historical agricultural use of the subject site.

Table 7:
Analytical Test Results – Soil
BTEX and PHCs F_1-F_4

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MOECC Table 9 Standards (µg/g)
		BH13-SS2/SS3	BH14-AU1	BH15-AU1	
		November 5, 2015	November 5, 2015	November 5, 2015	
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	0.05	nd	nd	nd	0.05
PHC F_1	7	nd	nd	nd	25
PHC F_2	4	nd	nd	nd	10
PHC F_3	8	nd	nd	nd	240
PHC F_4	6	nd	nd	nd	120

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- **Bold** – Value exceeds MOECC Table 9 Standards

No detectable concentrations of PHC (F_1-F_4) or BTEX parameters were detected in the soil samples tested. The soil samples are in compliance with the MOECC Table 9 Standards.

Table 8:
Analytical Test Results – Soil
Herbicide/Pesticide

Parameter	MDL (µg/g)	Soil Samples (µg/g) November 5, 2015	MOECC Table 9 Standards (µg/g)
		BH4-5-6 AU1	
Atrazine	0.05	nd	N/V
Cyanazine	0.1	nd	N/V
Metolachlor	0.1	nd	N/V
Prometryne	0.1	nd	N/V
Simazine	0.1	nd	N/V

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- NV – No value derived

No detectable concentrations of herbicide/pesticide parameters were detected in the soil sample tested.

Table 9:
Analytical Test Results – Soil
Metals

Parameter	MDL (µg/g)	Soil Samples (µg/g)			MOECC Table 9 Standards (µg/g)
		BH13-SS2/SS3	BH14-AU1	BH15-AU1	
		November 5, 2015	November 5, 2015	November 5, 2015	
Antimony	1	nd	nd	nd	1.9
Arsenic	1	2.2	2.6	2.0	18
Barium	1	68.1	75.5	79.3	220
Beryllium	1	nd	nd	nd	2.5
Boron	1	6.1	5.3	5.9	36
Boron, Available	0.5	nd	nd	nd	1.5
Cadmium	0.5	nd	nd	nd	1.2
Chromium	1	16.7	19.5	21.8	70
Chromium (VI)	0.2	nd	nd	nd	0.66
Cobalt	1	4.3	6.6	5.8	22
Copper	1	13.3	11.4	12.5	92
Lead	1	22.6	7.6	12.8	120
Mercury	0.1	nd	nd	0.1	0.27
Molybdenum	1	nd	nd	nd	2
Nickel	1	8.8	13.0	12.5	82
Selenium	1	nd	nd	nd	1.5
Silver	0.5	nd	nd	nd	0.5
Thallium	1	nd	nd	nd	1
Uranium	1	nd	nd	nd	2.5
Vanadium	1	18.3	27.6	24.4	86
Zinc	1	66.6	30.0	38.3	290

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

All metal parameters are in compliance with the MOECC Table 9 Standards.

Table 10: Maximum Concentrations – Soil			
Parameter	**Maximum Concentration (µg/g)**	**Borehole/ Test Pit**	**Depth Interval (m BGS)**
Arsenic	2.6	BH14-AU1	0.0-0.6 mbgs; fill
Barium	79.3	BH15-AU1	0.0-0.6 mbgs; fill
Boron	6.1	BH13-SS2/SS3	0.78-1.38 mbgs; fill
Chromium	21.8	BH15-AU1	0.0-0.6 mbgs; fill
Cobalt	6.6	BH14-AU1	0.0-0.6 mbgs; fill
Copper	13.3	BH13-SS2/SS3	0.78-1.38 mbgs; fill
Lead	22.6	BH13-SS2/SS3	0.78-1.38 mbgs; fill
Mercury	0.1	BH15-AU1	0.0-0.6 mbgs; fill
Nickel	13.0	BH14-AU1	0.0-0.6 mbgs; fill
Vanadium	27.6	BH14-AU1	0.0-0.6 mbgs; fill
Zinc	66.6	BH13-SS2/SS3	0.78-1.38 mbgs; fill

Notes:.
- All other parameter concentrations were below the laboratory detection limits

5.6 Groundwater Quality

Groundwater samples from the monitoring wells installed in BH13, BH14 and BH15 were submitted for laboratory analysis of VOC and PHC (F_1-F_4) parameters. The groundwater samples were obtained from the screened intervals noted on Table 2. The results of the analytical testing are presented below in Tables 11 and 12. The laboratory certificates of analysis are appended to this report.

Table 11:
Analytical Test Results – Groundwater
PHC (F_1 – F_4)

Parameter	**MDL (µg/L)**	**Groundwater Samples (µg/L)**			**MOECC Table 9 Standards (µg/L)**
		BH13-GW1	**BH14-GW1**	**BH15-GW1**	
		November 16, 2015	**November 16, 2015**	**November 16, 2015**	
PHC F_1	25	nd	nd	nd	25
PHC F_2	100	nd	nd	nd	10
PHC F_3	100	nd	nd	nd	240
PHC F_4	100	nd	nd	nd	120

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

There were no detected concentrations of PHC (F_1-F_4) in the analyzed groundwater samples.

Table 12:
Analytical Test Results – Groundwater
VOCs

Parameter	MDL (µg/L)	Groundwater Samples (µg/L)			MOECC Table 9 Standards (µg/L)
		BH13-GW1	BH14-GW1	BH15-GW1	
		November 16, 2015	November 16, 2015	November 16, 2015	
Acetone	5.0	nd	nd	17.0	100000
Benzene	0.5	nd	nd	0.6	44
Bromodichloromethane	0.5	nd	nd	nd	67000
Bromoform	0.5	nd	nd	nd	380
Bromomethane	0.5	nd	nd	nd	5.6
Carbon Tetrachloride	0.2	nd	nd	nd	0.79
Chlorobenzene	0.5	nd	nd	nd	500
Chloroform	0.5	nd	nd	nd	2.4
Dibromochloromethane	0.5	nd	nd	nd	65000
Dichlorodifluoromethane	1.0	nd	nd	nd	3500
1,2-Dichlorobenzene	0.5	nd	nd	nd	4600
1,3-Dichlorobenzene	0.5	nd	nd	nd	7600
1,4-Dichlorobenzene	0.5	nd	nd	nd	8
1,1-Dichloroethane	0.5	nd	nd	nd	320
1,2-Dichloroethane	0.5	nd	nd	nd	1.6
1,1-Dichloroethylene	0.5	nd	nd	nd	1.6
cis-1,2-Dichloroethylene	0.5	nd	nd	nd	1.6
trans-1,2-Dichloroethylene	0.5	nd	nd	nd	1.6
1,2-Dichloropropane	0.5	nd	nd	nd	16
cis-1,3-Dichloropropylene	0.5	nd	nd	nd	N/V
Trans-1,3-Dichloropropylene	0.5	nd	nd	nd	N/V
1,3-Dichloropropene, total	0.5	nd	nd	nd	5.2
Ethylbenzene	0.5	nd	nd	0.8	1800
Ethylene dibromide	0.2	nd	nd	nd	0.25
Hexane	1.0	nd	nd	nd	51
Methyl Ethyl Ketone	5.0	nd	nd	nd	470000
Methyl Isobutyl Ketone	5.0	nd	nd	nd	140000
Methyl tert-butyl Ether	2.0	nd	nd	nd	190
Methylene Chloride	5.0	nd	nd	nd	610
Styrene	0.5	nd	nd	nd	1300
1,1,1,2-Tetrachloroethane	0.5	nd	nd	nd	3.3
1,1,2,2-Tetrachloroethane	0.5	nd	nd	nd	3.2
Tetrachloroethylene	0.5	nd	nd	nd	1.6
Toluene	0.5	nd	nd	1.4	14000
1,1,1-Trichloroethane	0.5	nd	nd	nd	640
1,1,2-Trichloroethane	0.5	nd	nd	nd	4.7
Trichloroethylene	0.5	nd	nd	nd	1.6
Trichlorofluoromethane	1.0	nd	nd	nd	2000
Vinyl Chloride	0.5	nd	nd	nd	0.5
Xylenes	0.5	nd	nd	0.8	3300

Notes:
- MDL – Method Detection Limit
- nd – not detected above the MDL
- NV – No value derived

There were no detected concentrations of VOCs in the analyzed groundwater samples collected from BH13 and BH14. The detected concentrations of VOCs in the analyzed groundwater sample from BH15 were in compliance with the MOECC Table 9 Standards.

The maximum final concentrations of all parameters analyzed in groundwater are summarized below.

Table 13: Maximum Concentrations – Groundwater

Parameter	Maximum Concentration (µg/L)	Borehole/Sample Location	Depth Interval (m BGS)
Acetone	17.0	BH15-GW1	3.89 – 5.41 mbgs; bedrock
Benzene	0.6	BH15-GW1	3.89 – 5.41 mbgs; bedrock
Ethylbenzene	0.8	BH15-GW1	3.89 – 5.41 mbgs; bedrock
Toluene	1.4	BH15-GW1	3.89 – 5.41 mbgs; bedrock
Xylenes	0.8	BH15-GW1	3.89 – 5.41 mbgs; bedrock

Notes:
- All other parameter concentrations were below the laboratory detection limits

5.7 Quality Assurance and Quality Control Results

All samples submitted as part of this Phase II ESA were handled in accordance with the Analytical Protocol with respect to holding time, preservation method, storage requirement, and container type.

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. 153/04 as amended by O.Reg. 269/11 - Record of Site Condition regulation, made under the Environmental Protection Act. Conclusions and recommendations are discussed in a subsequent section.

Site Description

Potentially Contaminating Activities

Based on the results of the 2015 Phase I ESA completed for the subject site, several PCAs were identified at the study site and within the Phase I study area. The rationale for identifying these PCAs was based on city directories, aerial photographs, previous reports, field observations, and personal interviews. One (1) of these PCAs was considered to represent an APEC with respect to the subject site, and is discussed in the following section.

Areas of Potential Environmental Concern

Based on the results of the 2015 Phase I ESA completed for the subject site, one (1) APEC was identified at the subject site. The PCA considered to represent an APEC on the subject site is summarized below:

- The historical use and storage of farm equipment on the western portion of the subject site; No Specific Item, Table 2, O.Reg. 153/04 as amended by O.Reg. 269/11.

Other PCAs within the Phase I study area are not considered to pose an area of potential environmental concern to the subject site due to their separation distance and/or location down- or cross-gradient of the subject site.

Contaminants of Potential Concern

PHCs, VOCs and metals (due to the presence of fill encountered during the subsurface investigation) were identified as Contaminants of Potential Concern with respect to the subject site.

Subsurface Structures and Utilities

All utility services on the subject site were located prior to the subsurface investigation. A decommissioned water line crosses the subject site heading from the area of the former mobile homes out towards Fringewood Drive. There is an active sewer line that crosses the subject site. The sewer connects the adjacent property to the northwest (5816 Hazeldean Road) to the sewer within the Cloverloft Court road allowance to the south.

Physical Setting

Site Stratigraphy

The site stratigraphy, from ground surface to the deepest aquifer or aquitard investigated, is provided in the Soil Profile and Test Data Sheets provided in Appendix 1 and illustrated on Drawing PE4212-6 - Cross-Section A-A'. Stratigraphy consists of:

- The majority of the site consists of topsoil underlain by silty sand and glacial till with the thickness of overburden ranging from 1 to 5 mbgs. A layer of fill material was encountered in BH13, BH14 and BH15 consisting of silty sand and crushed stone. The fill ranged in thickness from 0.66 to 2.23 m. Groundwater was not encountered in this layer.
- A layer of glacial till was encountered with a thickness ranging from 1.35 to 3.79 m. Groundwater was encountered in this layer at approximately 0.71 to 0.75 meters below ground surface.
- The overburden is underlain by limestone bedrock identified at depths ranging from 1.12 to 4.90 m below ground surface. Groundwater was encountered at approximately 1.57 m below ground surface in the bedrock layer.

Hydrogeological Characteristics

Groundwater was encountered in the till and bedrock units on the subject site. Groundwater levels from the three (3) monitoring wells were measured at the subject site on November 16, 2015. Groundwater was encountered at depths of 0.71 m to 1.57 m below existing grade.

Based on the groundwater elevations from the November 16, 2015 monitoring event, groundwater contour mapping in the overburden/bedrock at the subject property was completed and the horizontal hydraulic gradient for the subject site was calculated. Groundwater flow at the subject site is in a northerly direction. A hydraulic gradient of approximately 0.047 m/m was calculated. Groundwater contours are shown on Drawing PE4212-5.

Approximate Depth to Bedrock

Bedrock was encountered at depths ranging from 1.12 m to 4.90 m below ground surface.

Approximate Depth to Water Table

Depth to the water table at the subject site varies between approximately 0.71 m and 1.57 m below existing grade.

Sections 41 and 43.1 of the Regulation

Section 41 and 43.1 of the Regulation applies to the subject site, as a body of water (Poole Creek) is located within 30 m of the subject site. There are no areas of natural significance adjacent to the subject site and the property is not considered to be environmentally sensitive.

Fill Placement

Fill encountered on the western portion of the subject site is considered to have been brought on-site for grading in the area of the former farmstead.

Existing Buildings and Structures

There are no structures that exist on the subject site.

Water Bodies

No water bodies are present on the subject site. Poole Creek is located adjacent to the west of the subject site. Poole Creek is a tributary to the Carp River located further to the north.

Areas of Natural Significance

No areas of natural significance are present on the subject site or within 250 m of the subject site.

Environmental Condition

Areas Where Contaminants are Present

No impacted soil or groundwater exceeding the selected MOECC Table 9 standards was encountered on the subject site. The analytical results are shown on Drawings PE4212-5 and PE4212-6.

Types of Contaminants

Based on the potentially contaminating activities identified at the subject site the contaminants of concern (COCs) at the subject site were considered to be PHCs, VOCs and metals.

Contaminated Media

None of the soil or groundwater test parameter results exceeded the selected MOECC Table 9 standards.

What Is Known About Areas Where Contaminants Are Present

No contaminated soil or groundwater was encountered on the subject site.

Distribution of Contaminants

Contaminants are not considered to have been dispersed on the subject site.

Discharge of Contaminants

No discharge of contaminants was identified on the subject site.

Migration of Contaminants

No soil or groundwater exceedances were identified during the analytical testing.

Climatic and Meteorological Conditions

In general, climatic and meteorological conditions have the potential to affect contaminant distribution. Two 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 results of the Phase II ESA, downward leaching has not affected contaminant distribution at the subject site. Site groundwater was in compliance with MOECC Table 9 standards, so the fluctuation of the groundwater table was considered to have a limited effect on the distribution of contaminants at the subject site.

Potential for Vapour Intrusion

There is no potential for vapour intrusion at the subject site.

6.0 CONCLUSIONS

Assessment

A Phase II-Environmental Site Assessment (ESA) was conducted for the property at 5 Orchard Drive, in the City of Ottawa, Ontario. The purpose of the Phase II ESA was to address the Area of Potential Environmental Concern for the subject site identified during the 2015 Phase I ESA. The Phase II-ESA consisted of the drilling of fifteen (15) boreholes in conjunction with a geotechnical investigation and installing three (3) groundwater monitoring wells to assess soil and groundwater quality at the subject site.

Soil samples were obtained from the boreholes and were screened using visual observations and vapour measurements. Site soils consist of a layer of topsoil, which is underlain by silty sand, glacial till and limestone bedrock. A fill layer consisting of silty sand and crushed stone was encountered in the western portion of the subject site in the area of the former farmstead. Based on the screening results, samples were selected for analysis of metals, petroleum hydrocarbons, fractions 1 through 4 (PHCs F_1-F_4), including benzene, toluene, ethylbenzene and xylenes (BTEX). Based on the analytical results, the fill material at the subject site is in compliance with the Ontario Ministry of the Environment and Climate Change (MOECC) Table 9 Standards for PHC, BTEX and metal parameters.

A native soil sample consisting of topsoil was submitted for herbicide/pesticide analysis to address the historical agricultural use of the subject site. There were no detected concentrations of herbicide/pesticide parameters in the soil sample analyzed.

Groundwater samples were collected from the monitoring wells installed in BH13, BH14 and BH15, and analyzed for PHC and VOC parameters. All detected concentrations were in compliance with the MOECC Table 9 Standards.

Based on the findings of the Phase II ESA, the soil and groundwater on the subject site are considered to be in compliance with the selected MOECC Table 9 standards. No further work is required for the property at this time.

Recommendations

If the monitoring wells installed in BH13, BH14 and BH15 are not going to be used in the future, they should be abandoned according to Ontario Regulation 903. The monitoring wells will be registered with the MOECC under this regulation. Further information can be provided up request in this regard.

7.0 STATEMENT OF LIMITATIONS

This Phase II - Environmental Site Assessment report has been prepared in general accordance with O.Reg. 153/04 as amended 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 Campanale Homes. Permission and notification from Campanale Homes and Paterson will be required to release this report to any other party.

Paterson Group Inc.

Anna Graham, M.E.S.

Mark S. D'Arcy, P.Eng.

Report Distribution:

- Campanale Homes
- Paterson Group

FIGURES

FIGURE 1 – KEY PLAN

DRAWING PE4212-3 – TEST HOLE LOCATION PLAN

DRAWING PE4212-4 - GROUNDWATER CONTOUR PLAN

DRAWING PE4212-5 – ANALYTICAL TESTING PLAN

DRAWING PE4212-6 – CROSS-SECTION A-A`

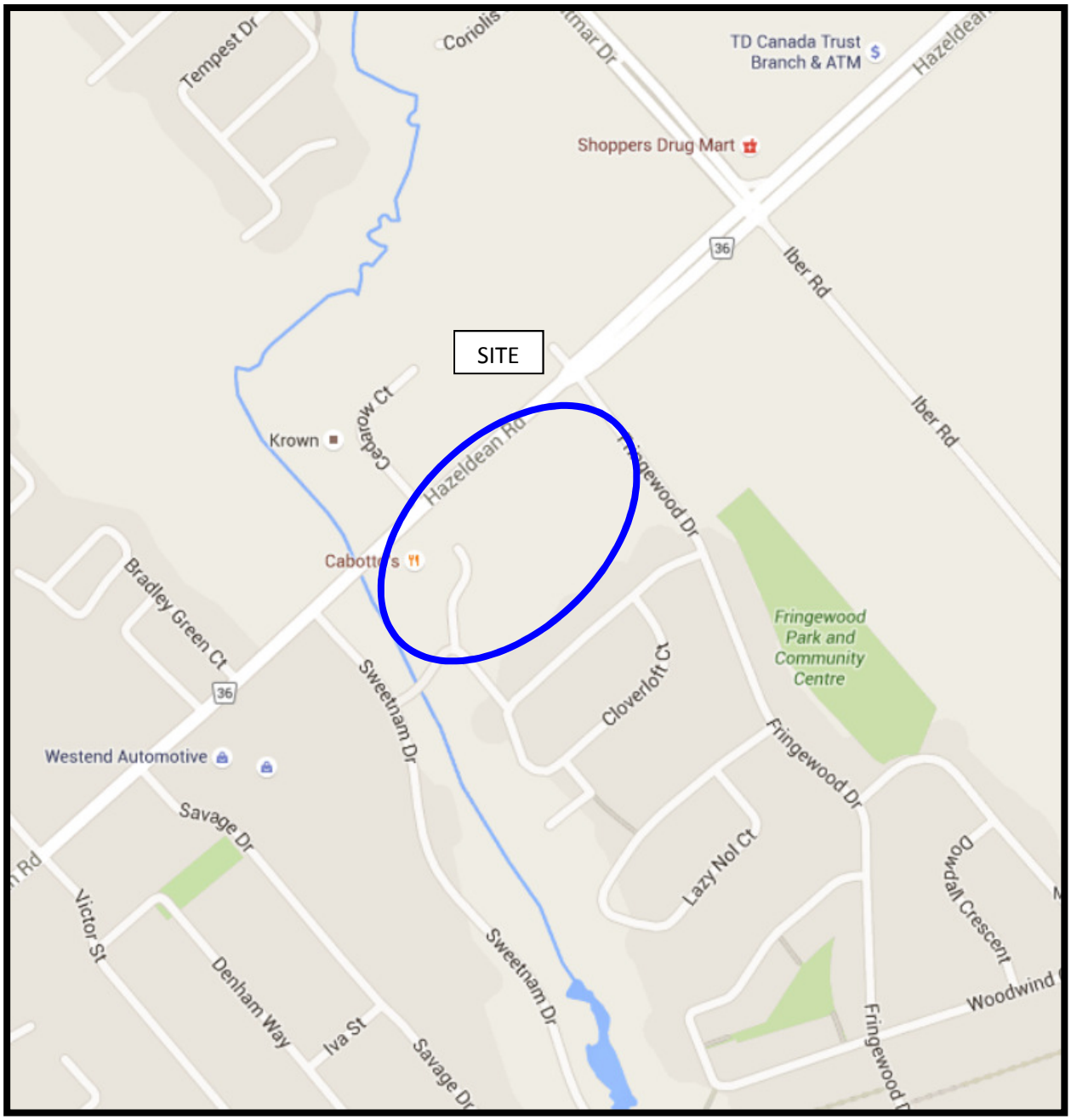
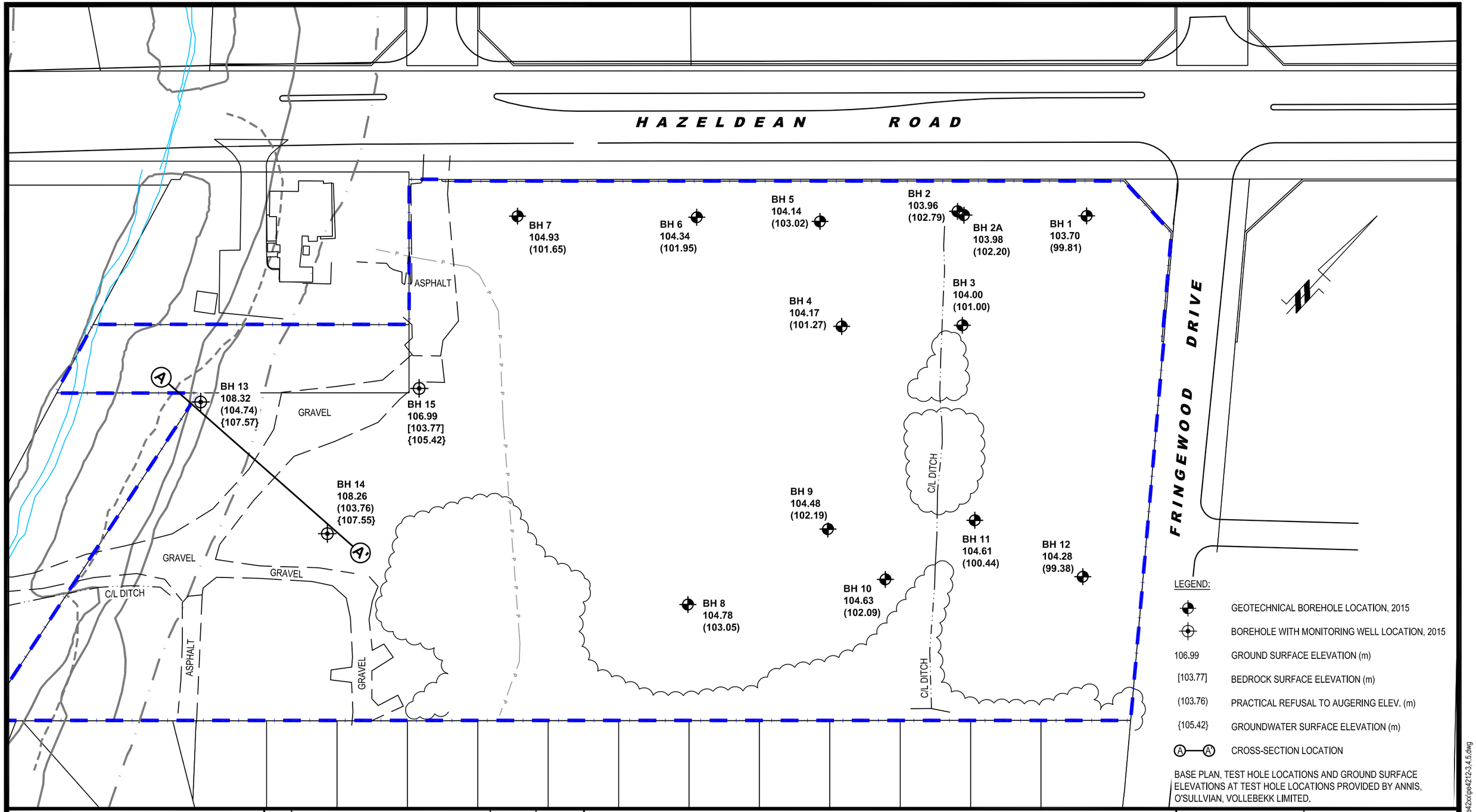


FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL
0			

CAMPANALE HOMES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
5 ORCHARD DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 1/2018
Drawn by: MPG	Report No.: PE4212-2
Checked by: MSD	Dwg. No.: PE4212-3
Approved by: MSD	Revision No.:

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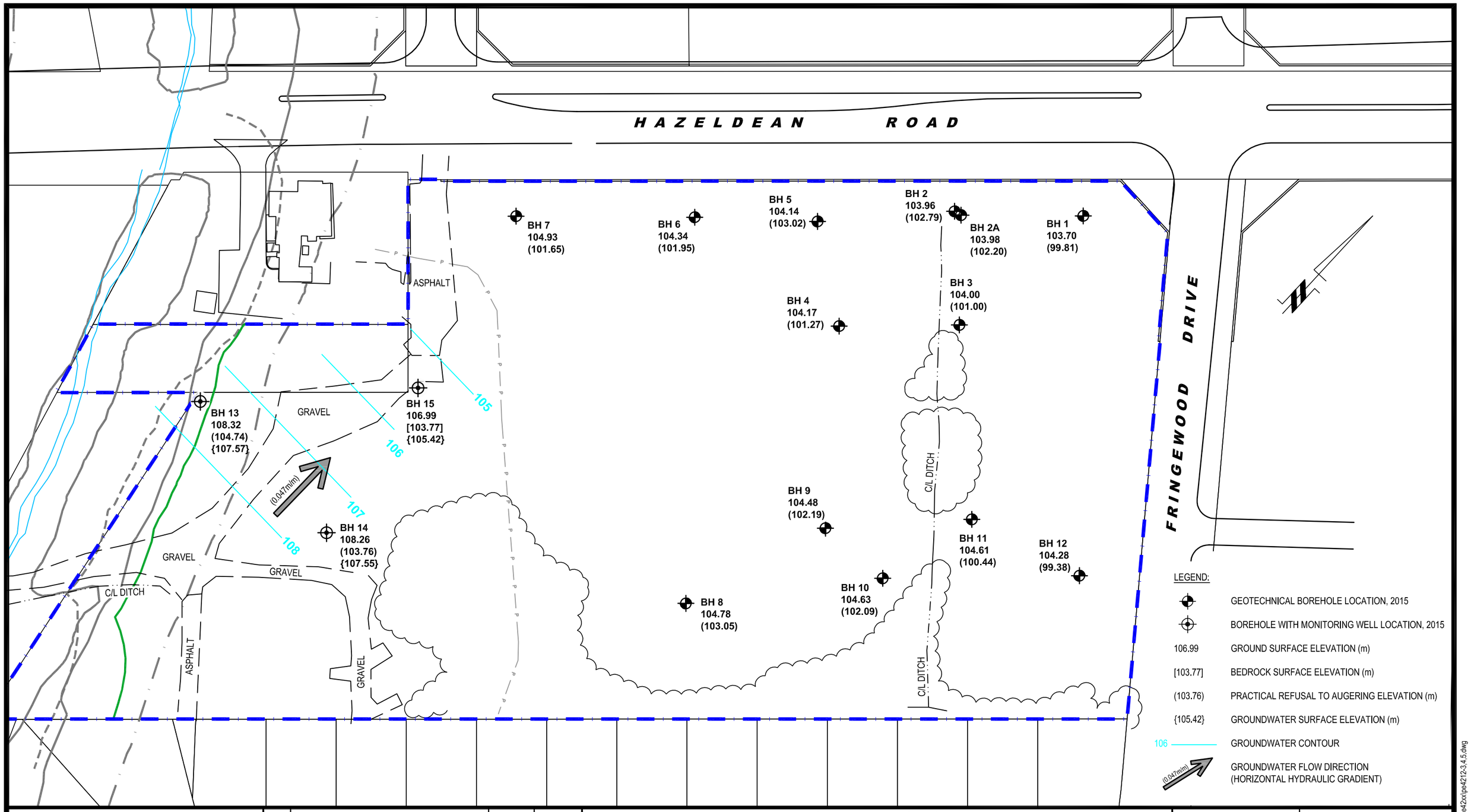

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CAMPANALE HOMES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
5 ORCHARD DRIVE

OTTAWA, ONTARIO

Title:

GROUNDWATER CONTOUR PLAN

Scale: 1:1000	Date: 1/2018
Drawn by: MPG	Report No.: PE4212-2
Checked by: AG	Dwg. No.: PE4212-4
Approved by: MSD	Revision No.:

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HAZELDEAN ROAD

FRINGEWOOD DRIVE

BH4-5-6 AU1 (0 - 0.6 m) - Nov. 5, 2015
No detectable concentrations of Herbicide/Pesticide

BH13-SS2/SS3 (107.54 m - 106.94 m) - Nov. 5, 2015
BTEX, PHCs and Metals complies with MOECC Table 9 Standards
BH13-GW1 (106.26 m - 104.74 m) - Nov. 16, 2015
PHCs & VOCs comply with MOECC Table 9 Standards

BH15-AU1 (106.99 m - 106.39 m) - Nov. 5, 2015
BTEX, PHCs and Metals complies with MOECC Table 9 Standards
BH15-GW1 (103.1 m - 101.58 m) - Nov. 16, 2015
PHCs & VOCs comply with MOECC Table 9 Standards

BH14-AU1 (108.26 m - 107.66 m) - Nov. 5, 2015
BTEX, PHCs and Metals complies with MOECC Table 9 Standards
BH14-GW1 (105.28 m - 103.76 m) - Nov. 16, 2015
PHCs & VOCs comply with MOECC Table 9 Standards

BH 1
103.70
(99.81)

BH 2
103.96
(102.79)

BH 2A
103.98
(102.20)

BH 3
104.00
(101.00)

BH 4
104.17
(101.27)

BH 5
104.14
(103.02)

BH 6
104.34
(101.95)

BH 7
104.93
(101.65)

BH 8
104.78
(103.05)

BH 9
104.48
(102.19)

BH 10
104.63
(102.09)

BH 11
104.61
(100.44)

BH 12
104.28
(99.38)

BH 13
108.32
(104.74)
{107.57}

BH 14
108.26
(103.76)
{107.55}

BH 15
106.99
[103.77]
{105.42}

ASPHALT
GRAVEL
GRAVEL
GRAVEL
ASPHALT
GRAVEL
C/L DITCH
C/L DITCH
C/L DITCH

LEGEND:

Soil Results in compliance with MOECC Table 3 Standards

Soil Result Exceeds MOECC Table 3 Standard

Groundwater Results in compliance with MOECC Standards

Groundwater Result Exceeds MOECC Standard

LEGEND:

- GEOTECHNICAL BOREHOLE LOCATION, 2015
- BOREHOLE WITH MONITORING WELL LOCATION, 2015
- 106.99 GROUND SURFACE ELEVATION (m)
- [103.77] BEDROCK SURFACE ELEVATION (m)
- (103.76) PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
- {105.42} GROUNDWATER SURFACE ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLVIAN, VOLLEBEKK LIMITED.

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CAMPANALE HOMES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
5 ORCHARD DRIVE

OTTAWA, ONTARIO

Title:

ANALYTICAL TESTING PLAN

Scale: 1:1000	Date: 1/2018
Drawn by: MPG	Report No.: PE4212-2
Checked by: AG	Dwg. No.: PE4212-5
Approved by: MSD	Revision No.:

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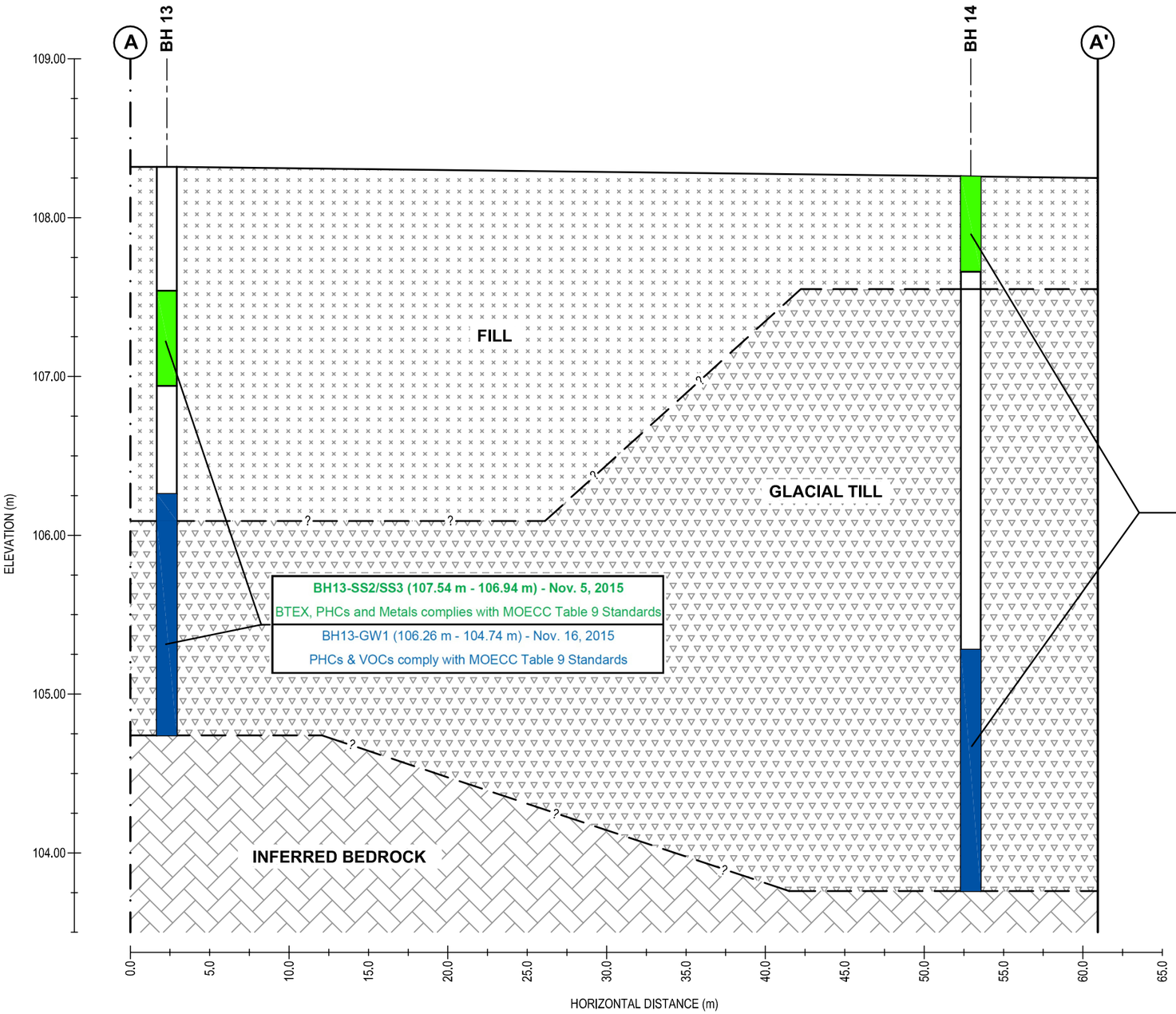

LEGEND:

Soil Results in compliance with MOECC Table 3 Standards

Soil Result Exceeds MOECC Table 3 Standard

Groundwater Results in compliance with MOECC Standards

Groundwater Result Exceeds MOECC Standard

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CAMPANALE HOMES

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
5 ORCHARD DRIVE

OTTAWA, ONTARIO

Title:

CROSS-SECTION A-A'

Scale: AS SHOWN	Date: 1/2018
Drawn by: MPG	Report No.: PE4212-2
Checked by: AG	Dwg. No.: PE4212-6
Approved by: MSD	Revision No.:

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APPENDIX 1

SAMPLING AND ANALYSIS PLAN

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LABORATORY CERTIFICATES OF ANALYSIS

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Studies

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Sampling & Analysis Plan

5 Orchard Drive
Ottawa, Ontario

Prepared For

Campanale Homes

October 30, 2015

Report: PE4212-SAP

Table of Contents

1.0 SAMPLING PROGRAM

Paterson Group Inc. (Paterson) was commissioned to conduct a Phase II-Environmental Site Assessment (ESA) for the property at 5 Orchard Drive, in the City of Ottawa, Ontario. Based on the Phase I-ESA completed by Paterson for the subject property, the following subsurface investigation program was developed:

Borehole	Location & Rationale	Proposed Depth & Rationale
BH1-BH12	To investigate subsurface conditions for geotechnical investigation.	Terminate at refusal to augering
BH13	To investigate soil and groundwater contamination within the footprint of the former barn.	Terminate below water table to install groundwater monitoring well
BH14	To investigate soil and groundwater contamination within the footprint of the former storage building.	Terminate below water table to install groundwater monitoring well
BH15	To investigate soil and groundwater contamination within the footprint of the former drive shed used to store farm equipment	Core into limestone bedrock to intercept groundwater table

Test hole locations are shown on the Test Hole Location Plan appended to the main report.

At each borehole, split-spoon samples of overburden soils will be obtained at 0.76 m (2'6") intervals until five feet below the water table. All soil samples will be retained, and samples will be selected for submission following a preliminary screening analysis.

If it is considered necessary to drill into bedrock to intercept the groundwater table, boreholes will be advanced into bedrock as required using diamond coring equipment. Rock core samples will be retained for review, but not submitted for analysis.

Following borehole drilling, monitoring wells will be installed in selected boreholes for the measurement of water levels and the collection of groundwater samples.

2.0 ANALYTICAL TESTING PROGRAM

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

- In boreholes where there is visual or olfactory evidence of contamination, or where organic vapour meter or photoionization detector (PID) readings indicate the presence of contamination, the 'worst-case' sample from each borehole should be submitted for comparison with MOE 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.
- At least one sample from each borehole should be submitted, in order to delineate the horizontal extent of contamination across the site.
- Parameters analyzed should be consistent with the Contaminants of Potential Concern identified in the Phase I ESA.

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

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

3.0 STANDARD OPERATING PROCEDURES

3.1 Environmental Drilling Procedure

Purpose

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

Equipment

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

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

Determining Borehole Locations

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

After drilling is completed a plan with the borehole locations must be provided. Distances 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 a geodetic benchmark, if one is available, or a temporary site benchmark which can be tied in at a later date if necessary.

Drilling Procedure

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

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

- 1.5 m x 5 cm threaded sections of Schedule 40 PVC slotted well screen (1.5 m x 3.2 cm if installing in cored hole in bedrock)
- 1.5 m x 5 cm threaded sections of Schedule 40 PVC riser pipe (1.5 m x 3.2 cm 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
- Portable pH/Temperature/Conductivity analyzer
- 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 possible.
- Where multi-parameter analyzers 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 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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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
5 Orchard Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Limited.

FILE NO. PE3576

REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.70
TOPSOIL							
0.20		AU	1				
Loose to very loose, brown **SILTY SAND**		SS	2	67	5	1	102.70
1.78		SS	3	88	3		
GLACIAL TILL: Very loose to compact, brown silty sand with gravel, occasional cobbles		SS	4	67	22	2	101.70
- dense by 3.2m depth							
- grey by 3.6m depth		SS	5	79	38	3	100.70
3.89		SS	6	100	50+		
End of Borehole							
Practical refusal to augering at 3.89m 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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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									
TOPSOIL 0.20		AU	1			0	103.96		
Dense, brown **SILTY SAND**		SS	2	44	50+	1	102.96		
1.17									
End of Borehole									
Practical refusal to augering at 1.17m 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
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FILE NO. PE3576

REMARKS

HOLE NO. BH 2A

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.98
TOPSOIL 0.20							
Dense, brown **SILTY SAND**						1	102.98
1.17							
GLACIAL TILL: Dense, brown silty sand, occasional cobbles		SS	1	55	50+		
1.78							
End of Borehole							
Practical refusal to augering at 1.78m 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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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	104.00		
TOPSOIL 0.18		AU	1						
Loose to compact, brown **SILTY SAND**		SS	2	83	4	1	103.00		
1.65		SS	3	58	15	2	102.00		
GLACIAL TILL: Compact, brown silty sand, some gravel, cobbles and boulders		SS	4	42	25				
3.00						3	101.00		
End of Borehole									
Practical refusal to augering at 3.00m depth									

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

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

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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									
TOPSOIL 0.15						0	104.17		
Dense, brown **SILTY SAND,** trace gravel 0.51		AU	1						
GLACIAL TILL: Dense to very dense, brown silty sand, some gravel, cobbles and boulders		SS	2	83	34	1	103.17		
		SS	3	100	35	2	102.17		
		SS	4	65	50+				
2.90 End of Borehole									
Practical refusal to augering at 2.90m depth									

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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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									
TOPSOIL 0.18						0	104.14		
Dense, brown **SILTY SAND,** trace gravel		AU	1						
		SS	2	70	50+				
1.12						1	103.14		
End of Borehole									
Practical refusal to augering at 1.12m 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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FILE NO. PE3576

REMARKS

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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	104.34		
TOPSOIL 0.28		AU	1						
Compact, brown **SILTY SAND,** trace gravel 1.04		SS	2	88	25	1	103.34		
GLACIAL TILL: Dense, brown silty sand with gravel, occasional cobbles		SS	3	100	31	2	102.34		
2.39		SS	4	50	50+				
End of Borehole									
Practical refusal to augering at 2.39m depth									

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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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									
TOPSOIL 0.15						0	104.93		
Compact, brown **SILTY SAND,** trace gravel 0.60		AU	1						
		SS	2	67	18	1	103.93		
GLACIAL TILL: Compact to dense, brown silty sand, some gravel, cobbles and boulders		SS	3	92	69	2	102.93		
		SS	4	100	47				
3.28		SS	5	67	50+	3	101.93		
End of Borehole Practical refusal to augering at 3.28m 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

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FILE NO. PE3576

REMARKS

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger **DATE** November 4, 2015

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									
TOPSOIL 0.18						0	104.78		
Loose, brown **SILTY SAND,** trace gravel 0.66		AU	1						
GLACIAL TILL: Loose to dense, brown silty sand, some gravel, cobbles and boulders		SS	2	48	8	1	103.78		
1.73		SS	3	86	50+				
End of Borehole									
Practical refusal to augering at 1.73m depth									

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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

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	104.48		
TOPSOIL 0.18									
Compact, brown **SILTY SAND,** trace gravel 0.60		AU	1						
		SS	2	67	12	1	103.48		
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders		SS	3	88	47	2	102.48		
2.29									
End of Borehole									
Practical refusal to augering at 2.29m depth									
(GWL @ 0.34m-Nov. 18, 2015)									

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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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH10

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

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									
TOPSOIL 0.20						0	104.63		
Compact, brown **SILTY SAND,** trace gravel 0.66		AU	1						
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles and boulders		SS	2	71	11	1	103.63		
		SS	3	83	10	2	102.63		
2.54		SS	4	75	50+				
End of Borehole Practical refusal to augering at 2.54m depth									

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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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
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FILE NO. PE3576

REMARKS

HOLE NO. BH11

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

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									
TOPSOIL 0.13						0	104.61		
Loose, brown **SILTY SAND,** trace gravel 0.33		AU	1						
		SS	2	4	7	1	103.61		
		SS	3	58	20	2	102.61		
GLACIAL TILL: Loose to dense, brown silty sand with gravel, cobbles, boulders		SS	4	83	9				
		SS	5	79	48	3	101.61		
- grey by 3.6m depth		SS	6	78	50+				
4.17						4	100.61		
End of Borehole									
Practical refusal to augering at 4.17m 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
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FILE NO. PE3576

REMARKS

HOLE NO. BH12

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

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									
TOPSOIL 0.20		AU	1			0	104.28		
Loose, brown **SILTY SAND,** trace gravel 1.27		SS	2	25	4	1	103.28		
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders		SS	3	75	10	2	102.28		
		SS	4	67	21	3	101.28		
- grey by 3.6m depth		SS	5	67	16				
4.90		SS	6	88	33	4	100.28		
End of Borehole Practical refusal to augering at 4.90m depth									

Photo Ionization Detector scale: 20 40 60 80

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

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

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FILE NO. PE3576

REMARKS

HOLE NO. BH13

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.32
FILL: Dark brown silty sand with crushed stone and cobbles		AU	1				
		SS	2	21	10	1	107.32
1.42							
FILL: Crushed stone with silty sand, some cobbles		SS	3	33	14	2	106.32
2.23							
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders		SS	4	83	54	3	105.32
		SS	5	92	50+		
3.58							
End of Borehole							
Practical refusal to augering at 3.58m depth							
(GWL @ 0.75m-Nov. 16, 2015)							

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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FILE NO. PE3576

REMARKS

HOLE NO. BH14

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.26
FILL: Crushed stone with silty sand		AU	1				
0.71							
		SS	2	100	24	1	107.26
		SS	3	100	47	2	106.26
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders		SS	4	100	19	3	105.26
		SS	5	55	32		
						4	104.26
4.50							
End of Borehole							
Practical refusal to augering at 4.50m depth							
(GWL @ 0.71m-Nov. 16, 2015)							

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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FILE NO. PE3576

REMARKS

HOLE NO. BH15

BORINGS BY CME 55 Power Auger **DATE** November 5, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.99
FILL: Dark brown sandy silt with gravel, some cobbles		AU	1				
0.66							
		SS	2	83	12	1	105.99
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles, boulders		SS	3	88	26	2	104.99
		SS	4	100	38		
3.22		SS	5	71	50+	3	103.99
		RC	1	88	77		
BEDROCK: Grey limestone						4	102.99
		RC	2	100	97		
						5	101.99
5.41							
End of Borehole							
(GWL @ 1.57m-Nov. 16, 2015)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

CONSOLIDATION TEST

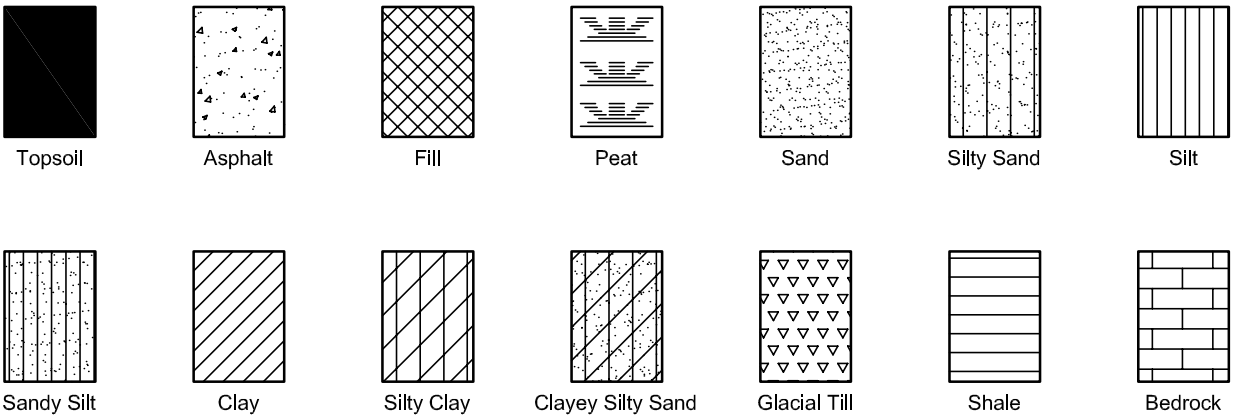
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

PERMEABILITY TEST

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

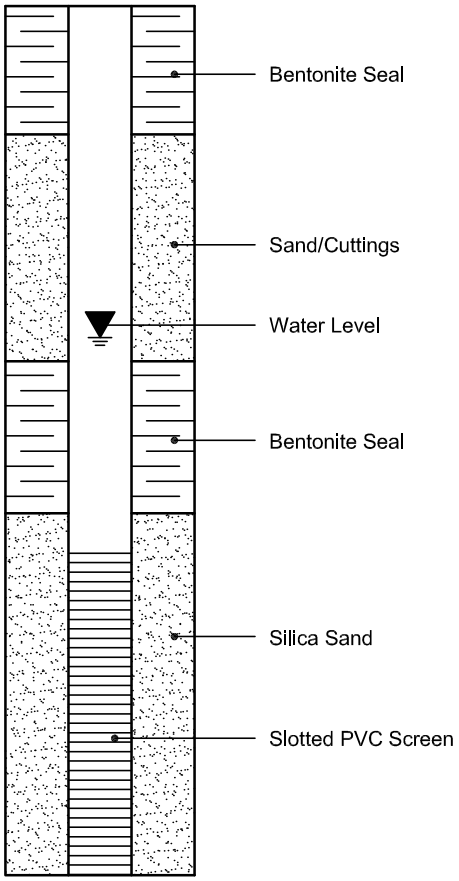
SYMBOLS AND TERMS (continued)

STRATA PLOT

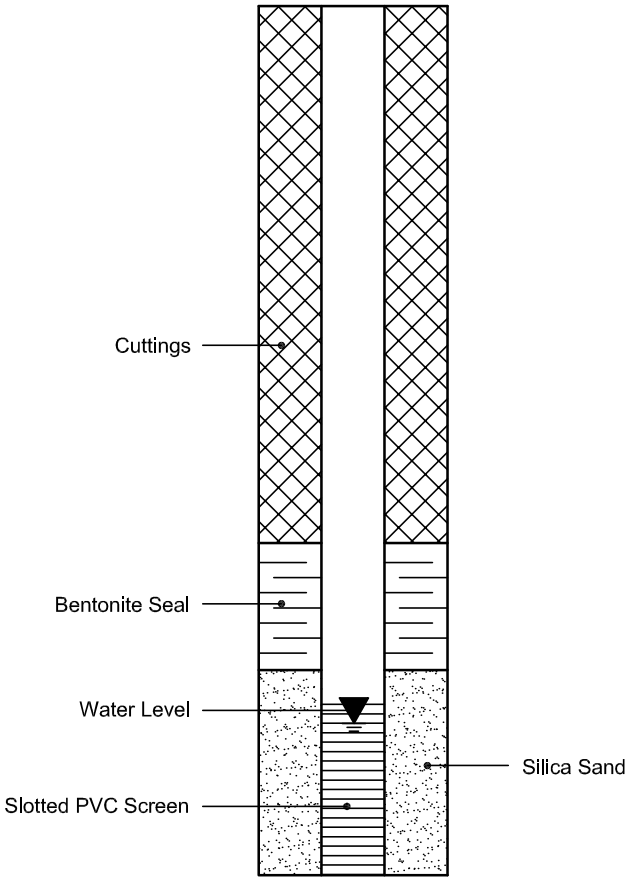


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



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Certificate of Analysis

Paterson Group Consulting Engineers

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

Client PO: 18992
Project: PE3576
Custody: 106261

Report Date: 12-Nov-2015
Order Date: 6-Nov-2015

Order #: 1545411

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

Paracel ID	Client ID
1545411-01	BH13-SS2/SS3
1545411-02	BH14-AU1
1545411-03	BH15-AU1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis
Report Date: 12-Nov-2015
Client: **Paterson Group Consulting Engineers**
Order Date:6-Nov-2015
Client PO: 18992
Project Description: PE3576

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Boron, available	MOE (HWE), EPA 200.7 - ICP-OES	11-Nov-15	11-Nov-15
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	7-Nov-15	12-Nov-15
Chromium, hexavalent	MOE E3056 - Extraction, colourimetric	7-Nov-15	11-Nov-15
Mercury by CVAA	EPA 7471B - CVAA, digestion	12-Nov-15	12-Nov-15
PHC F1	CWS Tier 1 - P&T GC-FID	7-Nov-15	12-Nov-15
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	9-Nov-15	10-Nov-15
REG 153: Metals by ICP/OES, soil	based on MOE E3470, ICP-OES	12-Nov-15	12-Nov-15
Solids, %	Gravimetric, calculation	7-Nov-15	7-Nov-15

Certificate of Analysis

Report Date: 12-Nov-2015

Client: **Paterson Group Consulting Engineers**

Order Date:6-Nov-2015

Client PO: 18992

Project Description: PE3576

	Client ID:	BH13-SS2/SS3	BH14-AU1	BH15-AU1	-
	Sample Date:	05-Nov-15	05-Nov-15	05-Nov-15	-
	Sample ID:	1545411-01	1545411-02	1545411-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	86.8	92.9	83.1	-
Metals					
Antimony	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Arsenic	1.0 ug/g dry	2.2	2.6	2.0	-
Barium	1.0 ug/g dry	68.1	75.5	79.3	-
Beryllium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Boron	1.0 ug/g dry	6.1	5.3	5.9	-
Boron, available	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Cadmium	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Chromium	1.0 ug/g dry	16.7	19.5	21.8	-
Chromium (VI)	0.2 ug/g dry	<0.2	<0.2	<0.2	-
Cobalt	1.0 ug/g dry	4.3	6.6	5.8	-
Copper	1.0 ug/g dry	13.3	11.4	12.5	-
Lead	1.0 ug/g dry	22.6	7.6	12.8	-
Mercury	0.1 ug/g dry	<0.1	<0.1	0.1	-
Molybdenum	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Nickel	1.0 ug/g dry	8.8	13.0	12.5	-
Selenium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Silver	0.5 ug/g dry	<0.5	<0.5	<0.5	-
Thallium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Uranium	1.0 ug/g dry	<1.0	<1.0	<1.0	-
Vanadium	1.0 ug/g dry	18.3	27.6	24.4	-
Zinc	1.0 ug/g dry	66.6	30.0	38.3	-
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	108%	110%	109%	-
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	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g						
F2 PHCs (C10-C16)	ND	4	ug/g						
F3 PHCs (C16-C34)	ND	8	ug/g						
F4 PHCs (C34-C50)	ND	6	ug/g						
Metals									
Antimony	ND	1.0	ug/g						
Arsenic	ND	1.0	ug/g						
Barium	ND	1.0	ug/g						
Beryllium	ND	1.0	ug/g						
Boron, available	ND	0.5	ug/g						
Boron	ND	1.0	ug/g						
Cadmium	ND	0.5	ug/g						
Chromium (VI)	ND	0.2	ug/g						
Chromium	ND	1.0	ug/g						
Cobalt	ND	1.0	ug/g						
Copper	ND	1.0	ug/g						
Lead	ND	1.0	ug/g						
Mercury	ND	0.1	ug/g						
Molybdenum	ND	1.0	ug/g						
Nickel	ND	1.0	ug/g						
Selenium	ND	1.0	ug/g						
Silver	ND	0.5	ug/g						
Thallium	ND	1.0	ug/g						
Uranium	ND	1.0	ug/g						
Vanadium	ND	1.0	ug/g						
Zinc	ND	1.0	ug/g						
Volatiles									
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	*7.92*		*ug/g*		*99.0*	*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	
Metals									
Antimony	ND	1.0	ug/g dry	ND			0.0	30	
Arsenic	2.98	1.0	ug/g dry	3.67			20.8	30	
Barium	42.2	1.0	ug/g dry	42.0			0.5	30	
Beryllium	ND	1.0	ug/g dry	ND			0.0	30	
Boron, available	ND	0.5	ug/g dry	ND			0.0	35	
Boron	4.40	1.0	ug/g dry	4.25			3.6	30	
Cadmium	ND	0.5	ug/g dry	ND			0.0	30	
Chromium (VI)	ND	0.2	ug/g dry	ND				35	
Chromium	14.5	1.0	ug/g dry	14.5			0.2	30	
Cobalt	5.21	1.0	ug/g dry	5.19			0.3	30	
Copper	16.8	1.0	ug/g dry	16.8			0.1	30	
Lead	11.8	1.0	ug/g dry	11.4			3.1	30	
Mercury	ND	0.1	ug/g dry	ND			0.0	35	
Molybdenum	ND	1.0	ug/g dry	ND			0.0	30	
Nickel	10.6	1.0	ug/g dry	9.92			6.3	30	
Selenium	ND	1.0	ug/g dry	ND			0.0	30	
Silver	ND	0.5	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				30	
Vanadium	26.3	1.0	ug/g dry	26.1			0.8	30	
Zinc	26.0	1.0	ug/g dry	26.0			0.1	30	
Physical Characteristics									
% Solids	73.6	0.1	% by Wt.	75.0			1.9	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	*5.46*		*ug/g dry*	*ND*	*105*	*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)	193	7	ug/g	ND	96.6	80-120			
F2 PHCs (C10-C16)	123	4	ug/g	ND	120	60-140			
F3 PHCs (C16-C34)	213	8	ug/g	ND	100	60-140			
F4 PHCs (C34-C50)	129	6	ug/g	ND	90.8	60-140			
Metals									
Antimony	276		ug/L	13.5	105	70-130			
Arsenic	329		ug/L	73.4	102	70-130			
Barium	1080		ug/L	840	94.9	70-130			
Beryllium	252		ug/L	ND	101	70-130			
Boron, available	5.70	0.5	ug/g	ND	114	70-122			
Boron	345		ug/L	85.0	104	70-130			
Cadmium	253		ug/L	3.64	99.7	70-130			
Chromium (VI)	4.7	0.2	ug/g	ND	94.0	70-130			
Chromium	532		ug/L	290	96.6	70-130			
Cobalt	348		ug/L	104	97.6	70-130			
Copper	566		ug/L	336	92.0	70-130			
Lead	442		ug/L	229	85.3	70-130			
Mercury	1.73	0.1	ug/g	ND	116	72-128			
Molybdenum	258		ug/L	4.04	102	70-130			
Nickel	423		ug/L	198	89.9	70-130			
Selenium	233		ug/L	ND	95.2	70-130			
Silver	247		ug/L	0.04	98.7	70-130			
Thallium	224		ug/L	9.49	85.9	70-130			
Uranium	247		ug/L	14.2	93.2	70-130			
Vanadium	742		ug/L	522	87.8	70-130			
Zinc	731		ug/L	520	84.3	70-130			
Volatiles									
Benzene	3.83	0.02	ug/g	ND	95.7	60-130			
Ethylbenzene	3.30	0.05	ug/g	ND	82.5	60-130			
Toluene	3.38	0.05	ug/g	ND	84.6	60-130			
m,p-Xylenes	6.79	0.05	ug/g	ND	84.9	60-130			
o-Xylene	3.29	0.05	ug/g	ND	82.3	60-130			
Surrogate: Toluene-d8	*8.32*		*ug/g*		*104*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

CCME PHC additional information:

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

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Chain of Custody
(Lab Use Only)
№ 106261

Page __ of __

Client Name: Paterson Group	Project Reference: PE3576	TAT: [X] Regular [ ] 3 Day
Contact Name: Marie D'Arcy	Quote #	[ ] 2 Day [ ] 1 Day
Address: 154 Colonnade	PO # 18992	Date Required:
Telephone: 613-226-7381	Email Address: mdarcy@patersongroup.ca	

Criteria: [X] 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: 1545411

	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	BH13-SS2/SS3	S		2	Nov 5/15		X			X	X	X	X				250mL + 1 Vial			X
2	BH14-AU1	S		2	↓		X			X	X	X	X				↓			X
3	BH15-AU1	S		2	↓		X			X	X	X	X				↓			X
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Comments:

Method of Delivery: Paracel

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Relinquished By (Print):	Date/Time: 06/11/15 4:15 PM	Date/Time: NOV 06 2015 05:07	Date/Time: Nov 6, 15 5:22
Date/Time:	Temperature: _____ °C	Temperature: 4.1 °C	pH Verified [ ] By:

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Certificate of Analysis

Paterson Group Consulting Engineers

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

Client PO: 18970
Project: PE3576
Custody: 106260

Report Date: 23-Nov-2015
Order Date: 16-Nov-2015

Order #: 1547081

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

Paracel ID	Client ID
1547081-01	BH13-GW1
1547081-02	BH14-GW1
1547081-03	BH15-GW1

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
PHC F1	CWS Tier 1 - P&T GC-FID	19-Nov-15	20-Nov-15
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	18-Nov-15	18-Nov-15
REG 153: VOCs by P&T GC/MS	EPA 624 - P&T GC-MS	19-Nov-15	20-Nov-15

Certificate of Analysis

Report Date: 23-Nov-2015

Client: **Paterson Group Consulting Engineers**

Order Date:16-Nov-2015

Client PO: 18970

Project Description: PE3576

	Client ID:	BH13-GW1	BH14-GW1	BH15-GW1	-
	Sample Date:	16-Nov-15	16-Nov-15	16-Nov-15	-
	Sample ID:	1547081-01	1547081-02	1547081-03	-
	MDL/Units	Water	Water	Water	-
Volatiles					
Acetone	5.0 ug/L	<5.0	<5.0	17.0	-
Benzene	0.5 ug/L	<0.5	<0.5	0.6	-
Bromodichloromethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Bromoform	0.5 ug/L	<0.5	<0.5	<0.5	-
Bromomethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Carbon Tetrachloride	0.2 ug/L	<0.2	<0.2	<0.2	-
Chlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
Chloroform	0.5 ug/L	<0.5	<0.5	<0.5	-
Dibromochloromethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Dichlorodifluoromethane	1.0 ug/L	<1.0	<1.0	<1.0	-
1,2-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,3-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,4-Dichlorobenzene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1-Dichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,2-Dichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
cis-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
trans-1,2-Dichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,2-Dichloropropane	0.5 ug/L	<0.5	<0.5	<0.5	-
cis-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	<0.5	-
trans-1,3-Dichloropropylene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,3-Dichloropropene, total	0.5 ug/L	<0.5	<0.5	<0.5	-
Ethylbenzene	0.5 ug/L	<0.5	<0.5	0.8	-
Ethylene dibromide (dibromoethan	0.2 ug/L	<0.2	<0.2	<0.2	-
Hexane	1.0 ug/L	<1.0	<1.0	<1.0	-
Methyl Ethyl Ketone (2-Butanone)	5.0 ug/L	<5.0	<5.0	<5.0	-
Methyl Isobutyl Ketone	5.0 ug/L	<5.0	<5.0	<5.0	-
Methyl tert-butyl ether	2.0 ug/L	<2.0	<2.0	<2.0	-
Methylene Chloride	5.0 ug/L	<5.0	<5.0	<5.0	-
Styrene	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,1,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
1,1,2,2-Tetrachloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Tetrachloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Toluene	0.5 ug/L	<0.5	<0.5	1.4	-
1,1,1-Trichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-

Certificate of Analysis

Report Date: 23-Nov-2015

Client: **Paterson Group Consulting Engineers**

Order Date:16-Nov-2015

Client PO: 18970

Project Description: PE3576

	Client ID:	BH13-GW1	BH14-GW1	BH15-GW1	-
	Sample Date:	16-Nov-15	16-Nov-15	16-Nov-15	-
	Sample ID:	1547081-01	1547081-02	1547081-03	-
	MDL/Units	Water	Water	Water	-
1,1,2-Trichloroethane	0.5 ug/L	<0.5	<0.5	<0.5	-
Trichloroethylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Trichlorofluoromethane	1.0 ug/L	<1.0	<1.0	<1.0	-
Vinyl chloride	0.5 ug/L	<0.5	<0.5	<0.5	-
m,p-Xylenes	0.5 ug/L	<0.5	<0.5	0.8	-
o-Xylene	0.5 ug/L	<0.5	<0.5	<0.5	-
Xylenes, total	0.5 ug/L	<0.5	<0.5	0.8	-
4-Bromofluorobenzene	Surrogate	90.7%	89.1%	90.2%	-
Dibromofluoromethane	Surrogate	88.0%	124%	123%	-
Toluene-d8	Surrogate	97.8%	98.9%	98.8%	-
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	-
F1 + F2 PHCs	125 ug/L	<125	<125	<125	-
F3 + F4 PHCs	200 ug/L	<200	<200	<200	-

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L						
F2 PHCs (C10-C16)	ND	100	ug/L						
F3 PHCs (C16-C34)	ND	100	ug/L						
F4 PHCs (C34-C50)	ND	100	ug/L						
Volatiles									
Acetone	ND	5.0	ug/L						
Benzene	ND	0.5	ug/L						
Bromodichloromethane	ND	0.5	ug/L						
Bromoform	ND	0.5	ug/L						
Bromomethane	ND	0.5	ug/L						
Carbon Tetrachloride	ND	0.2	ug/L						
Chlorobenzene	ND	0.5	ug/L						
Chloroform	ND	0.5	ug/L						
Dibromochloromethane	ND	0.5	ug/L						
Dichlorodifluoromethane	ND	1.0	ug/L						
1,2-Dichlorobenzene	ND	0.5	ug/L						
1,3-Dichlorobenzene	ND	0.5	ug/L						
1,4-Dichlorobenzene	ND	0.5	ug/L						
1,1-Dichloroethane	ND	0.5	ug/L						
1,2-Dichloroethane	ND	0.5	ug/L						
1,1-Dichloroethylene	ND	0.5	ug/L						
cis-1,2-Dichloroethylene	ND	0.5	ug/L						
trans-1,2-Dichloroethylene	ND	0.5	ug/L						
1,2-Dichloropropane	ND	0.5	ug/L						
cis-1,3-Dichloropropylene	ND	0.5	ug/L						
trans-1,3-Dichloropropylene	ND	0.5	ug/L						
1,3-Dichloropropene, total	ND	0.5	ug/L						
Ethylbenzene	ND	0.5	ug/L						
Ethylene dibromide (dibromoethane,	ND	0.2	ug/L						
Hexane	ND	1.0	ug/L						
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L						
Methyl Isobutyl Ketone	ND	5.0	ug/L						
Methyl tert-butyl ether	ND	2.0	ug/L						
Methylene Chloride	ND	5.0	ug/L						
Styrene	ND	0.5	ug/L						
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L						
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L						
Tetrachloroethylene	ND	0.5	ug/L						
Toluene	ND	0.5	ug/L						
1,1,1-Trichloroethane	ND	0.5	ug/L						
1,1,2-Trichloroethane	ND	0.5	ug/L						
Trichloroethylene	ND	0.5	ug/L						
Trichlorofluoromethane	ND	1.0	ug/L						
Vinyl chloride	ND	0.5	ug/L						
m,p-Xylenes	ND	0.5	ug/L						
o-Xylene	ND	0.5	ug/L						
Xylenes, total	ND	0.5	ug/L						
Surrogate: 4-Bromofluorobenzene	*72.2*		*ug/L*		*90.3*	*50-140*			
Surrogate: Dibromofluoromethane	*90.8*		*ug/L*		*113*	*50-140*			
Surrogate: Toluene-d8	*78.6*		*ug/L*		*98.3*	*50-140*			

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Hydrocarbons									
F1 PHCs (C6-C10)	ND	25	ug/L	ND				30	
Volatiles									
Acetone	ND	5.0	ug/L	ND				30	
Benzene	ND	0.5	ug/L	ND				30	
Bromodichloromethane	ND	0.5	ug/L	ND				30	
Bromoform	ND	0.5	ug/L	ND				30	
Bromomethane	ND	0.5	ug/L	ND				30	
Carbon Tetrachloride	ND	0.2	ug/L	ND				30	
Chlorobenzene	ND	0.5	ug/L	ND				30	
Chloroform	ND	0.5	ug/L	ND				30	
Dibromochloromethane	ND	0.5	ug/L	ND				30	
Dichlorodifluoromethane	ND	1.0	ug/L	ND				30	
1,2-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,3-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,4-Dichlorobenzene	ND	0.5	ug/L	ND				30	
1,1-Dichloroethane	ND	0.5	ug/L	ND				30	
1,2-Dichloroethane	ND	0.5	ug/L	ND				30	
1,1-Dichloroethylene	ND	0.5	ug/L	ND				30	
cis-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
trans-1,2-Dichloroethylene	ND	0.5	ug/L	ND				30	
1,2-Dichloropropane	ND	0.5	ug/L	ND				30	
cis-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
trans-1,3-Dichloropropylene	ND	0.5	ug/L	ND				30	
Ethylbenzene	ND	0.5	ug/L	ND				30	
Ethylene dibromide (dibromoethane,	ND	0.2	ug/L	ND				30	
Hexane	ND	1.0	ug/L	ND				30	
Methyl Ethyl Ketone (2-Butanone)	ND	5.0	ug/L	ND				30	
Methyl Isobutyl Ketone	ND	5.0	ug/L	ND				30	
Methyl tert-butyl ether	ND	2.0	ug/L	ND				30	
Methylene Chloride	ND	5.0	ug/L	ND				30	
Styrene	ND	0.5	ug/L	ND				30	
1,1,1,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L	ND				30	
Tetrachloroethylene	ND	0.5	ug/L	ND				30	
Toluene	ND	0.5	ug/L	ND				30	
1,1,1-Trichloroethane	ND	0.5	ug/L	ND				30	
1,1,2-Trichloroethane	ND	0.5	ug/L	ND				30	
Trichloroethylene	ND	0.5	ug/L	ND				30	
Trichlorofluoromethane	ND	1.0	ug/L	ND				30	
Vinyl chloride	ND	0.5	ug/L	ND				30	
m,p-Xylenes	ND	0.5	ug/L	ND				30	
o-Xylene	ND	0.5	ug/L	ND				30	
Surrogate: 4-Bromofluorobenzene	*72.2*		*ug/L*	*ND*	*90.2*	*50-140*			
Surrogate: Dibromofluoromethane	*96.1*		*ug/L*	*ND*	*120*	*50-140*			
Surrogate: Toluene-d8	*79.6*		*ug/L*	*ND*	*99.5*	*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)	2010	25	ug/L	ND	101	68-117			
F2 PHCs (C10-C16)	1730	100	ug/L	ND	96.1	60-140			
F3 PHCs (C16-C34)	3530	100	ug/L	ND	94.9	60-140			
F4 PHCs (C34-C50)	2610	100	ug/L	ND	105	60-140			
Volatiles									
Acetone	82.4	5.0	ug/L	ND	82.4	50-140			
Benzene	42.0	0.5	ug/L	ND	105	60-130			
Bromodichloromethane	44.9	0.5	ug/L	ND	112	60-130			
Bromoform	33.2	0.5	ug/L	ND	83.1	60-130			
Bromomethane	23.3	0.5	ug/L	ND	58.4	50-140			
Carbon Tetrachloride	37.1	0.2	ug/L	ND	92.7	60-130			
Chlorobenzene	37.5	0.5	ug/L	ND	93.8	60-130			
Chloroform	39.4	0.5	ug/L	ND	98.4	60-130			
Dibromochloromethane	36.2	0.5	ug/L	ND	90.4	60-130			
Dichlorodifluoromethane	30.0	1.0	ug/L	ND	74.9	50-140			
1,2-Dichlorobenzene	34.0	0.5	ug/L	ND	84.9	60-130			
1,3-Dichlorobenzene	34.4	0.5	ug/L	ND	86.0	60-130			
1,4-Dichlorobenzene	32.5	0.5	ug/L	ND	81.3	60-130			
1,1-Dichloroethane	40.2	0.5	ug/L	ND	100	60-130			
1,2-Dichloroethane	36.6	0.5	ug/L	ND	91.4	60-130			
1,1-Dichloroethylene	41.3	0.5	ug/L	ND	103	60-130			
cis-1,2-Dichloroethylene	42.4	0.5	ug/L	ND	106	60-130			
trans-1,2-Dichloroethylene	43.0	0.5	ug/L	ND	108	60-130			
1,2-Dichloropropane	40.4	0.5	ug/L	ND	101	60-130			
cis-1,3-Dichloropropylene	34.4	0.5	ug/L	ND	85.9	60-130			
trans-1,3-Dichloropropylene	27.7	0.5	ug/L	ND	69.2	60-130			
Ethylbenzene	43.0	0.5	ug/L	ND	107	60-130			
Ethylene dibromide (dibromoethane,	40.7	0.2	ug/L	ND	102	60-130			
Hexane	26.4	1.0	ug/L	ND	66.0	60-130			
Methyl Ethyl Ketone (2-Butanone)	76.0	5.0	ug/L	ND	76.0	50-140			
Methyl Isobutyl Ketone	97.6	5.0	ug/L	ND	97.6	50-140			
Methyl tert-butyl ether	103	2.0	ug/L	ND	103	50-140			
Methylene Chloride	39.3	5.0	ug/L	ND	98.3	60-130			
Styrene	42.8	0.5	ug/L	ND	107	60-130			
1,1,1,2-Tetrachloroethane	35.7	0.5	ug/L	ND	89.2	60-130			
1,1,2,2-Tetrachloroethane	38.9	0.5	ug/L	ND	97.4	60-130			
Tetrachloroethylene	32.9	0.5	ug/L	ND	82.3	60-130			
Toluene	40.2	0.5	ug/L	ND	101	60-130			
1,1,1-Trichloroethane	37.6	0.5	ug/L	ND	94.1	60-130			
1,1,2-Trichloroethane	47.8	0.5	ug/L	ND	120	60-130			
Trichloroethylene	45.0	0.5	ug/L	ND	112	60-130			
Trichlorofluoromethane	31.4	1.0	ug/L	ND	78.5	60-130			
Vinyl chloride	48.1	0.5	ug/L	ND	120	50-140			
m,p-Xylenes	82.9	0.5	ug/L	ND	104	60-130			
o-Xylene	38.8	0.5	ug/L	ND	96.9	60-130			
Surrogate: 4-Bromofluorobenzene	*67.2*		*ug/L*		*84.0*	*50-140*			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

CCME PHC additional information:

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

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Chain of Custody
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№ 106260

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Client Name: Paterson Group	Project Reference: PE3576	TAT: [X] Regular [ ] 3 Day	
Contact Name: Mark D'Arcy	Quote #	[ ] 2 Day [ ] 1 Day	
Address: 154 Colonnade Rd	PO # 15970	Date Required:	
Telephone: 613-226-7381	Email Address: mdarcy@patersongroup.ca		

Criteria: [X] 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: 1547081

	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	BH13-GW1	GW		3	Nov 16/15	AM	X	X					
2	BH14-GW1	GW		3	"	"	X	X					
3	BH15-GW1	GW		3	"	"	X	X					
4													
5													
6													
7													
8													
9													
10													

Comments:

Method of Delivery: Paracel

Relinquished By (Sign): MJB.	Received by Driver/Depot: T. Vouse	Received at Lab: SUNEET DORMAT	Verified By:
Relinquished By (Print):	Date/Time: 16/11/15 4:15pm	Date/Time: NOV 16 2015 05:12	Date/Time: NOV 17/15 7:57a
Date/Time:	Temperature: ____ °C	Temperature: 12.9 °C	pH Verified [ ] By: NJ