patersongroup Consulting Engineers

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

Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

October 25, 2019
PH3878-LET.01

Inverness Homes
c/o The Stirling Group
69 Moore Street
Richmond, ON
K0A 2Z0

Attention: Ms. Alison Sterling

Subject: **Groundwater Impact Assessment**
Proposed Residential Development
147 Langstaff Drive - Ottawa

Dear Madam,

Paterson Group (Paterson) was commissioned by The Stirling Group on behalf of Inverness Homes to complete a groundwater impact assessment for the proposed residential development to be located at 147 Langstaff Drive in the City of Ottawa, Ontario (Refer to Drawing PH3878-1 - Site Plan attached to the current report).

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains a hydrogeological review and assessments pertaining to the proposed works as they are understood at the time of writing this report.

1.0 Proposed Development

Based on available conceptual drawings, it is understood that the proposed residential development will consist of townhouses and several low-rise apartment buildings. Access lanes, associated parking and landscaped areas are also anticipated for the development. It is understood that the site will be serviced by future municipal services.

2.0 Background Information

The field program for the current investigation was carried out on July 11 and 12, 2019. At that time, a total of 7 boreholes were advanced to a maximum depth of 9.1 m below ground surface (bgs). A previous field investigation was completed by Paterson on October 23 and 24, 2008. During that time a total of 6 boreholes were advanced to a maximum depth of 9.8 m bgs. The test hole locations were placed in a manner to provide general coverage of the subject site taking into consideration site features and underground utilities. The test hole locations for the current investigation are presented on Drawing PG4918-1 - Test Hole Location Plan attached to the current report.

3.0 Site Conditions

Physical Setting

The subject site consists of undeveloped, agricultural land. The site is approximately at grade with Langstaff Drive and slopes gradually downward to southwest. The subject site is grass covered with a treed area within the central and southern portion of the site as well as the western property boundary. A 3 to 5 m deep ravine runs in a north-south direction across the central portion of the site and a 4 to 5 m deep treed ravine runs along the west property boundary. The site is bordered to the north by vacant land, a recreational complex and the Carp Farmers Market, to the east by Langstaff Drive followed by residential dwellings and an institutional building, to the south by a commercial building and residential dwellings followed by Donald B. Munro Drive and to the west by a treed ravine, commercial buildings and residential dwellings followed by Carp Road.

According to available mapping, the subject site is located in the Ottawa Valley Clay Plains physiographic region.

3.1 Geology

Surficial Geology

Overburden soils identified during the geotechnical field investigations typically consisted of topsoil overlying a thin, compact silty sand layer and/or very stiff to stiff brown silty clay crust, which in turn is underlain by a stiff to firm grey silty clay deposit. The above noted layers are followed by a very dense to very loose grey silty sand underlain by an inferred glacial till deposit. Practical refusal to DCPT was encountered at depths ranging from 18.9 to 24.9 m bgs at BH 2 and BH 7-19, respectively.

Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets attached to the current report.

Based on surficial mapping prepared by the Ontario Geological Survey, the subject site is located in an area where surficial geology consists of a coarse-textured glaciomarine deposit with sand and gravel, and minor silt and clay.

Bedrock

Based on available geological mapping, the northeast half of the subject site is located in an area where bedrock consists of intrusive rocks of Precambrian age, while the southwest half of the site consists of interbedded limestone and shale of the Verulam Formation. The overburden drift thickness is estimated between 15 and 50 m.

Karst Features

The term “karst” refers to a geologic formation characterized by the dissolution of carbonate bedrock, such as limestone or dolostone. In order for karstification to occur, precipitation must be allowed to infiltrate the top of the bedrock to dissolutionally enlarge previously existing joints and bedding planes. Based on the given depth of surficial soils overlying the bedrock that are non-conductive to groundwater infiltration, it is highly unlikely that karstification is occurring. Based on karst mapping prepared by the Ontario Geological Survey, there is no potential, inferred or known karst within the subject site.

3.2 Hydrogeology

Existing Aquifer Systems

Aquifer systems may be defined as a geological media, either overburden soils or fractured bedrock, which permit the movement of groundwater under hydraulic gradients. Although groundwater has been observed within the silty clay layer at the subject site, the composition of materials does not allow for the development of significant water supply wells. Water supply wells in the vicinity are instead likely found in the silty sand, glacial till and bedrock aquifers.

Bedrock aquifer mapping, provided by Natural Resources Canada Urban Geology of the National Capital Region mapping, was reviewed as part of this assessment. Using this tool, the Verulam Formation and Precambrian rock aquifer systems were identified as the water supply aquifer systems in the vicinity of the study area, with the majority of the domestic wells extending into the bedrock aquifer.

Groundwater Levels

Groundwater was observed in the piezometers and monitoring wells installed in the overburden at the borehole locations. Based on a review of water well records, groundwater is also present in the bedrock at depth.

Groundwater levels in the overburden at the subject site were observed to vary from 2.1 to 7.0 m bgs following the completion of the geotechnical field investigations. It should be noted that groundwater levels may have been influenced by surface water infiltrating the backfilled boreholes. Groundwater levels are also influenced by precipitation events and seasonal variations. As such, long-term groundwater levels are also estimated based on other factors such as colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level at the subject site is expected to range from approximately 4.5 to 5.5 m bgs.

Groundwater infiltration into the excavations through the overburden materials is expected to be minimal during construction and dewatering may be required. It is anticipated that pumping from open sumps will be sufficient to control groundwater influx through the sides of the excavations.

Hydraulic Gradients

Vertical hydraulic gradients were not measured at the subject site as the previous studies completed did not warrant the installation of monitoring well nests.

With respect to horizontal hydraulic gradients, due to the nature of the water levels obtained from field work conducted at the site (piezometers and monitoring wells), the absolute direction of horizontal hydraulic gradients was not determined. However, using the available data, it was possible to approximate the horizontal hydraulic gradients in the overburden material given that the horizontal hydraulic gradient between any 2 points is the slope of the hydraulic head between those points:

$$i=(h_2-h_1)/L$$

Where: i=horizontal hydraulic gradient
h=water level (m asl)
L=horizontal distance between test hole locations

Using the above noted formula, the horizontal hydraulic gradient has been calculated to be approximately 0.018 in a southerly direction. Shallow groundwater flow in the vicinity of the subject site is expected to reflect local topography. Regional groundwater flow in the overburden and bedrock is considered to be in a southerly direction, towards the Carp River.

Hydraulic Conductivity

The hydraulic conductivity values were conservatively estimated based upon previous experience at similar sites in the area, information obtained from the results of the geotechnical field program and typical published values for similar stratigraphy. The values are interpreted to be in the order of 1×10^{-4} to 1×10^{-6} m/sec for silty sand, 1×10^{-5} to 1×10^{-10} m/sec for glacial till, 1×10^{-7} to 1×10^{-9} m/sec for brown silty clay, and 1×10^{-9} to 1×10^{-12} m/sec for grey silty clay. Based on the subsurface profile at the subject site and anticipated excavation depths for the proposed development, it is anticipated that 3 m of saturated silty clay material could be encountered at the excavation locations.

Groundwater Recharge and Discharge

In general, groundwater will follow the path of least resistance from areas of higher hydraulic head to areas of lower hydraulic head. While upward and downward hydraulic gradients may be indicative of discharge and recharge respectively, other factors must be considered.

Based on the hydraulic conductivity estimates obtained from published literature, the silty clay overburden is generally considered to act as a confining layer. It is our interpretation that groundwater will generally flow laterally through the silty sand and glacial till material, as opposed to vertically upwards through soils with lower hydraulic conductivity such as the silty clay. As such, the volume of recharge occurring within the site boundaries is expected to be minimal.

Groundwater at the subject site will generally flow laterally through the silty sand and glacial till towards topographically low areas, such as the ravines identified within the subject area. As such, it is our interpretation that the topographical and geological conditions are suitable for low to moderate discharge to be occurring at the subject site.

4.0 Potential Impacts

4.1 Adverse Effects on Adjacent Structures

The overburden in the area generally consists of topsoil overlying a silty sand layer and/or silty clay deposit. The above noted layers are followed by silty sand underlain by an inferred glacial till deposit. Practical refusal to DCPT was encountered at a depths ranging from of 8.1 to 24.9 m bgs. The potential dewatering volumes due to groundwater infiltration into the excavation footprints are anticipated to be minimal. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations. Additionally, given the nature of the development (low lying residential housing and associated servicing), the duration of any excavation on site is expected to be short term in duration. As such, any effects related to ground surface settlement due to the water taking activities during construction are expected to be negligible.

4.2 Adverse Effects on Neighbouring Water Wells

A search of the Ontario Water Well Records online mapping database indicates there are over 100 water wells within 500 m of the site as depicted on Drawing PH3878-2 - MECP Water Well Location Plan attached to the current report. The majority of the wells located in the vicinity were noted to be primarily domestic wells accessing an aquifer within the silty sand or glacial till below the silty clay layer or an aquifer within the bedrock. While some domestic wells remain in use in the area, it anticipated that the majority of the wells are no longer utilized due to the available municipal water supply.

The water supply wells noted to potentially remain in use generally extended well beyond the maximum depth of any excavation that may take place as part of the proposed development. Furthermore, dewatering activities related to the construction of the development will be short term in duration. Construction activities at the site are therefore not expected to cause any interference to the water supply of surrounding properties or other negative impacts.

A series of calculations were carried out on theoretical radii of influence for a maximum servicing trench excavation of 5 m deep and withdrawing water from the upper 2 to 4 m of the saturated zone. These calculations were completed based on Sichardt (1992) using the equation:

$$R = r_e + 3000*\Delta h(k^{0.5})$$

- R = radius of influence (m)
- r_e = equivalent radius of excavation (m)
- Δh = thickness of drawdown within the aquifer (m)
- k = hydraulic conductivity (m/sec)

For the purposes of completing the calculations, the following assumptions were made:

- ❏ r_e = 9.55 m
- ❏ $k = 1 \times 10^{-7}$, for brown silty clay
- ❏ Δh = 2 to 4 m, to review potential minimum/maximum variable conditions.

Using the above equation and assumptions, a radius of influence of approximately 1.9 to 3.8 m will develop as a steady state condition, extending from the edge of the excavation, in the area of the subject site.

Given the hydrogeological characteristics of the subject site, the theoretical radii of influence for the potential excavations related to the development and the depth of the water supply wells within 500 m, neither a long-term groundwater monitoring program or baseline subdivision water sampling program is required to be implemented based on our review.

Well Head Protection Area

An existing municipal well is located approximately 250 m southeast of the subject site. Based on the Source Protection Information Atlas mapping provided by the MECP, the northern portion of the subject site is located within a wellhead protection area D and the southern portion of the subject site is located within a wellhead protection area C. The subject site not considered a significant groundwater recharge area. However, it is classified as a highly vulnerable aquifer (vulnerability score of 6). Given that the subject site is considered a highly vulnerable aquifer, handling as well as storing of dense non aqueous phase liquids is considered a threat to the aquifer and is not recommended. As a result, construction activities may be considered a significant drinking water threat and a Risk Management Plan may be required by the MECP (Part IV, Section 58 of the Clean Water Act).

4.3 Soil, Surface Water and Groundwater

A search of the MECP Brownfields Environmental Site Registry was conducted as part of the assessment of the site, neighbouring properties and the general area. A total of 1 Brownfield site was located within 500 m of the subject site and has been identified as Registration numbers 211467. RSC number 211467 indicated that approximately 200 m^3 of soil was removed from 135 Rivington Street. The above noted Brownfield site indicated there were no groundwater controls under the Records of Site Condition (RSC), nor were there any groundwater remediations performed during the cleanup process. No concerns were identified in the review of the MECP Brownfields database. It should be noted that former landfills for domestic waste were identified immediately northwest and 200 m west of the subject site. Due to the potentially contaminating activity of the former landfills, a Phase II EAS was carried out for the subject site by Paterson to address. Based on Paterson Report PE4666-REP.02 dated September 24, 2019, all soil and groundwater results are in compliance with the MECP Table 2 standards.

It is anticipated that the material on site will be disposed of or re-used as per the MECP policy, *Management of Excess Soil - A Guide for Best Management Practices* dated January, 2014.

With respect to nearby surface water bodies, two unnamed tributaries have been identified transecting the central portion of the subject site and along western property boundary. The tributaries flow in a southerly direction where they both drain into the Carp River located approximately 200 m south of site. Additional unnamed tributaries to the Carp River have been identified surrounding the site within 500 m of the subject site. An unnamed tributary has been identified approximately 200 m north of the subject site and flows in a northeast direction towards the Carp Hills Wetland Complex. The Carp Hills Wetland Complex is located approximately 650 to 750 m north and northeast, respectively.

Due to the minimal groundwater influx anticipated through the sides of the excavation, the above noted surface water features are outside the theoretical radius of influence. As such, adverse effects to surface water features resulting from dewatering activities at the subject site are expected to be negligible.

The groundwater that is pumped from site excavations must be managed in an appropriate manner. The contractor will be required to implement a water management program to dispose of the pumped water.

4.4 Adjacent Permits to Take Water

A search of the MECP Permit to Take Water database provided 2 active PTTW within 500 m of the subject site. PTTW 7534-AKXN4M is registered to the City of Ottawa and is located approximately 250 m southeast of the subject site. The active permit contains 1 source and is provided as groundwater related to water supply with a maximum taking of 2,782,080 L/day. PTTW 4517-9ZHKXR is registered to 1514947 Ontario Inc. and is located approximately 220 m south of the subject site. The active permit contains 1 source and is provided as surface and groundwater related to construction dewatering with a maximum taking of 2,200,000 L/day. The locations of the existing permits places them outside the radius of influence of the subject site and it is not anticipated that there will be any negative effects related to potential takings.

A search of the MECP Environmental Activity and Sector Registry (EASR) database provided 1 registered water taking permit within 500 m radius of the subject site. Registration Number R-009-8110684943 is registered to CACE Construction (1991) Ltd. and is located approximately 250 m southeast of the subject site. The active registry is for water taking activities related to construction dewatering between 50,000 and 400,000 L/day. The location of the existing permit places it outside the radius of influence of the subject site and it is not anticipated that there will be any negative effects related to potential takings.

4.5 Existing Servicing

All existing wells at the subject site should be properly decommissioned by a licensed well contractor as per *O.Reg. 903.*

5.0 Recommendations

Further testing and site preparation is recommended for the detailed Hydrogeological Assessment. The following aspects of the program should be performed prior to commencing construction for the proposed residential development:

- ❑ All existing wells within the proposed residential development should be properly decommissioned as per *O.Reg. 903.*

- ❑ Prior to and during site development, it is recommended that construction best management practices with respect to fuels and chemical handling, spill prevention, and erosion and sediment control be followed.

- ❑ For any water taking of greater than 50,000 L/day, either an Environmental Activity and Sector Registration (EASR) or a Permit To Take Water (PTTW) is required from the MECP, dependant on dewatering requirements.

6.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project.

A hydrogeological review of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Inverness Homes, The Stirling Group or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Nicholas Zulinski, P.Geo.

Michael Laflamme, P.Geo.

Attachments

- ❏ Drawing PH3878-1 - Site Plan
- ❏ Drawing PH3878-2 - MECP Well Location Plan
- ❏ Soil Profile and Test Data Sheets
- ❏ Drawing PG4918-1 - Test Hole Location Plan

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consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

INVERNESS HOMES

GROUND WATER IMPACT ASSESSMENT
PROPOSED RESIDENTIAL DEVELOPMENT - 147 LANGSTAFF DRIVE
OTTAWA, ONTARIO

Title:

SITE PLAN

Scale: 1:2000	Date: 08/2019
Drawn by: YA	Report No.: PH3878-REP.01
Checked by: KP	Dwg. No.: PH3878-1
Approved by: CDS	Revision No.:

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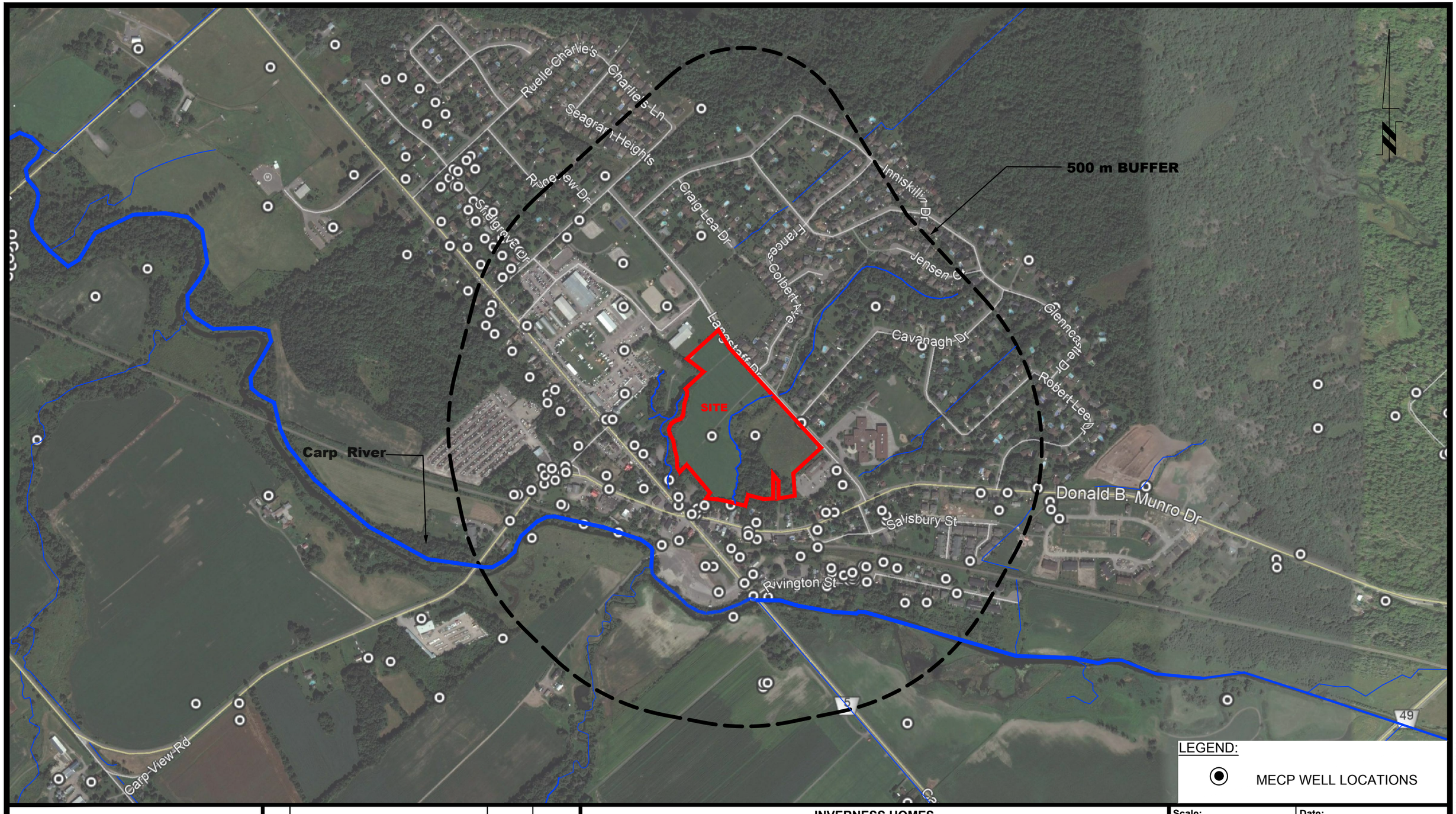

LEGEND:

MECP WELL LOCATIONS

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

INVERNESS HOMES

GROUNDWATER IMPACT ASSESSMENT
PROPOSED RESIDENTIAL DEVELOPMENT - 147 LANGSTAFF DRIVE
OTTAWA, ONTARIO

Title:

MECP WATER WELL LOCATION PLAN

Scale: 1:8000	Date: 08/2019
Drawn by: YA	Report No.: PH3878-REP.01
Checked by: KP	Dwg. No.: PH3878-2
Approved by: CDS	Revision No.:

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

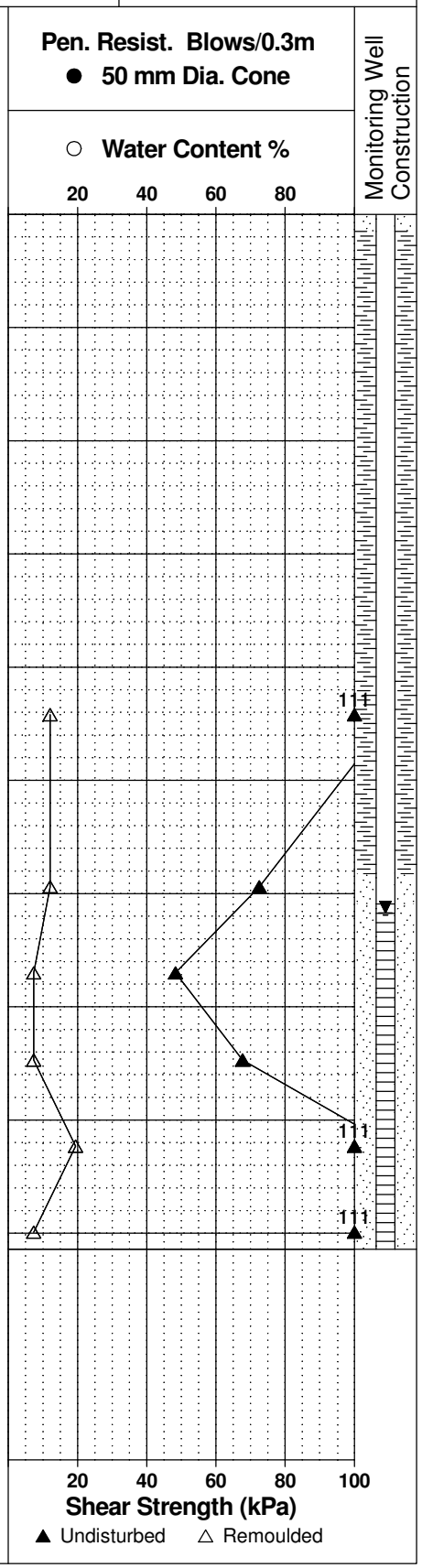
FILE NO. PG4918

REMARKS

HOLE NO. BH 1-19

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

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.71
TOPSOIL 0.20		AU	1				
		SS	2	58	13	1	105.71
		SS	3	100	10	2	104.71
		SS	4	100	8		
Very stiff to stiff, brown **SILTY CLAY**		SS	5	100	5	3	103.71
						4	102.71
		SS	6	100	4	5	101.71
- firm to very stiff and grey by 6.1m depth						6	100.71
						7	99.71
						8	98.71
9.14						9	97.71
End of Borehole							
(GWL @ 6.17m - July 18, 2019)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

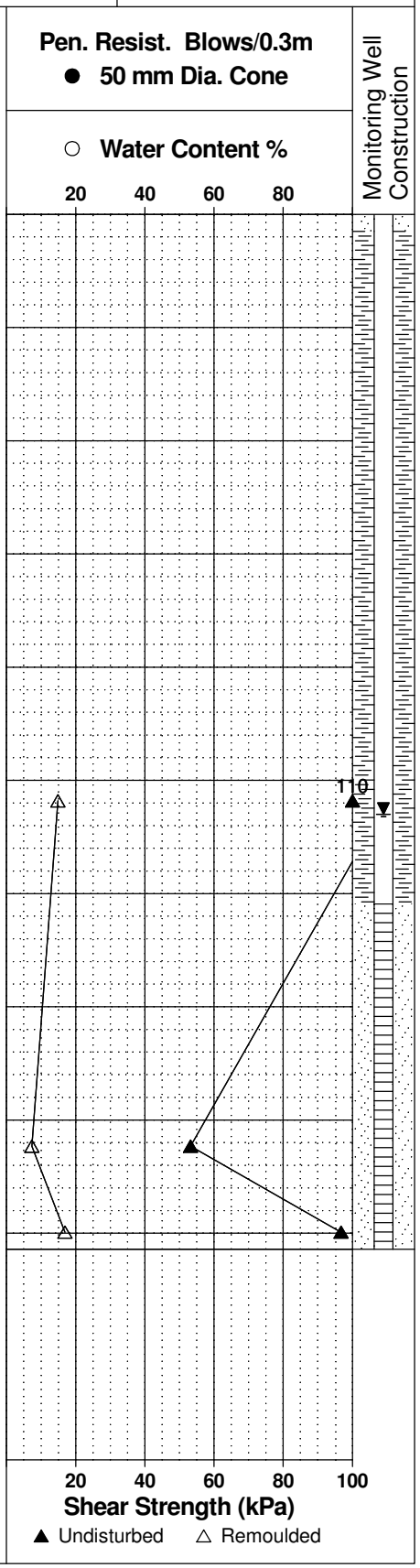
FILE NO. PG4918

REMARKS

HOLE NO. BH 2-19

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

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.86
TOPSOIL 0.23		AU	1				
		SS	2	100	15	1	105.86
		SS	3	100	14	2	104.86
Very stiff to stiff, brown **SILTY CLAY**							
		SS	4	100	11	3	103.86
- grey by 3.0m depth							
		SS	5	100	8	4	102.86
		SS	6	79	6		
5.30						5	101.86
Brown **SILTY CLAY** trace sand						6	100.86
		SS	7	62	9		
6.90						7	99.86
		SS	8	100	2		
Stiff, grey **SILTY CLAY** with sand						8	98.86
9.14						9	97.86
End of Borehole							
(GWL @ 5.30m - July 18, 2019)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

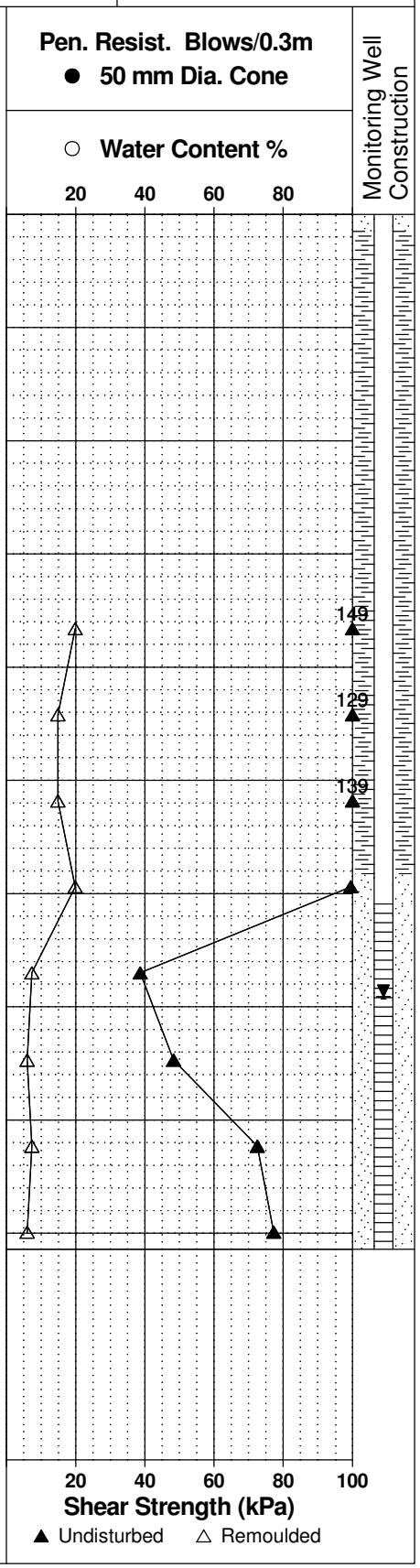
FILE NO. PG4918

REMARKS

HOLE NO. BH 3-19

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

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.94
TOPSOIL 0.18		AU	1				
		SS	2	12	11	1	104.94
		SS	3	79	7	2	103.94
		SS	4	83	5		
		SS	5	100	4	3	102.94
Very stiff to stiff, brown **SILTY CLAY**		SS	6	100	5	4	101.94
		SS	7	100	4	5	100.94
		SS	8	100	2	6	99.94
- firm to stiff and grey by 6.1m depth		SS	9	100	W		
		SS	10	100	W	7	98.94
		SS	11	100	W	8	97.94
		SS	12	0	W	9	96.94
9.14							
End of Borehole							
(GWL @ 6.91m - July 18, 2019)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

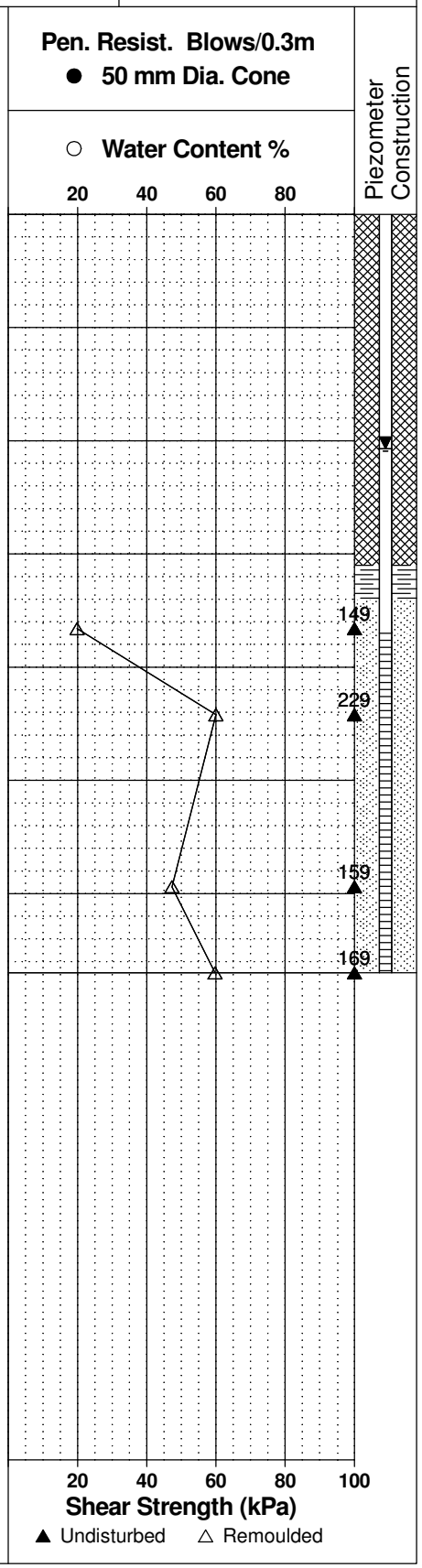
FILE NO. PG4918

REMARKS

HOLE NO. BH 4-19

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

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	104.31
TOPSOIL 0.20		AU	1				
		SS	2	100	14	1	103.31
		SS	3	100	9	2	102.31
		SS	4	100	6		
Very stiff, brown **SILTY CLAY,** trace sand						3	101.31
						4	100.31
- grey by 4.6m depth		SS	5	100	4	5	99.31
						6	98.31
6.70							
End of Borehole							
(GWL @ 2.07m - July 18, 2019)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

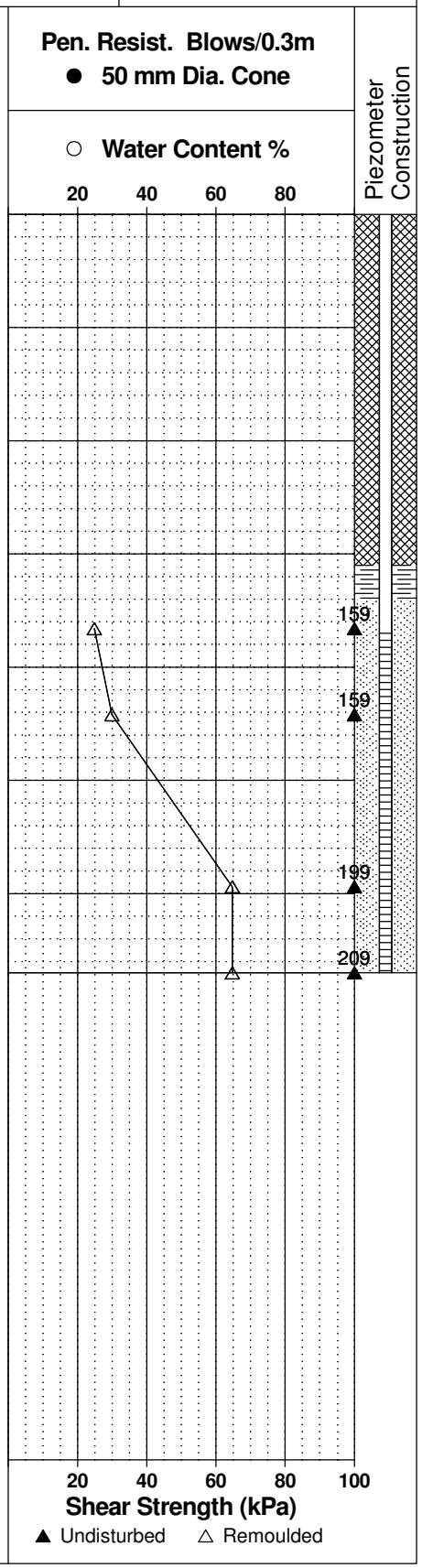
FILE NO. PG4918

REMARKS

HOLE NO. BH 5-19

BORINGS BY CME 55 Power Auger **DATE** 2019 July 12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.75
TOPSOIL 0.20		AU	1				
		SS	2	88	11	1	99.75
		SS	3	100	10	2	98.75
		SS	4	100	9	3	97.75
Very stiff, brown **SILTY CLAY**						4	96.75
- grey by 4.6m depth		SS	5	100	7	5	95.75
6.70						6	94.75
End of Borehole							
(Piezometer blocked - July 18, 2019)							



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SOIL PROFILE AND TEST DATA

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147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

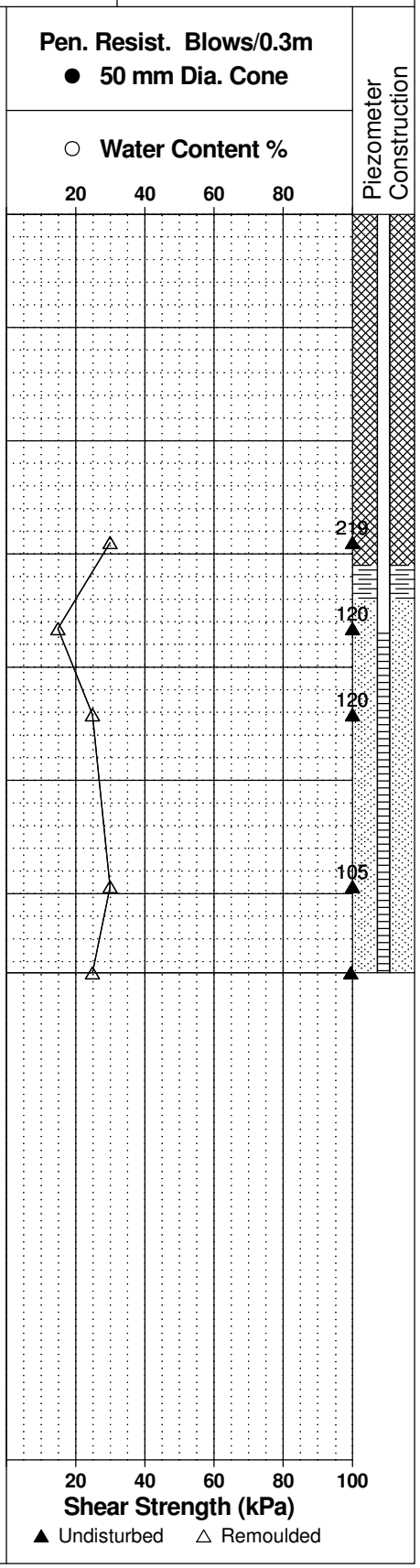
FILE NO. PG4918

REMARKS

HOLE NO. BH 6-19

BORINGS BY CME 55 Power Auger **DATE** 2019 July 12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.81
TOPSOIL 0.15		AU	1				
		SS	2	58	8	1	99.81
		SS	3	75	9	2	98.81
Hard to stiff, brown **SILTY CLAY**						3	97.81
						4	96.81
- grey by 4.6m depth		SS	4	100	2	5	95.81
						6	94.81
6.70 End of Borehole							
(Piezometer blocked - July 18, 2019)							



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147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

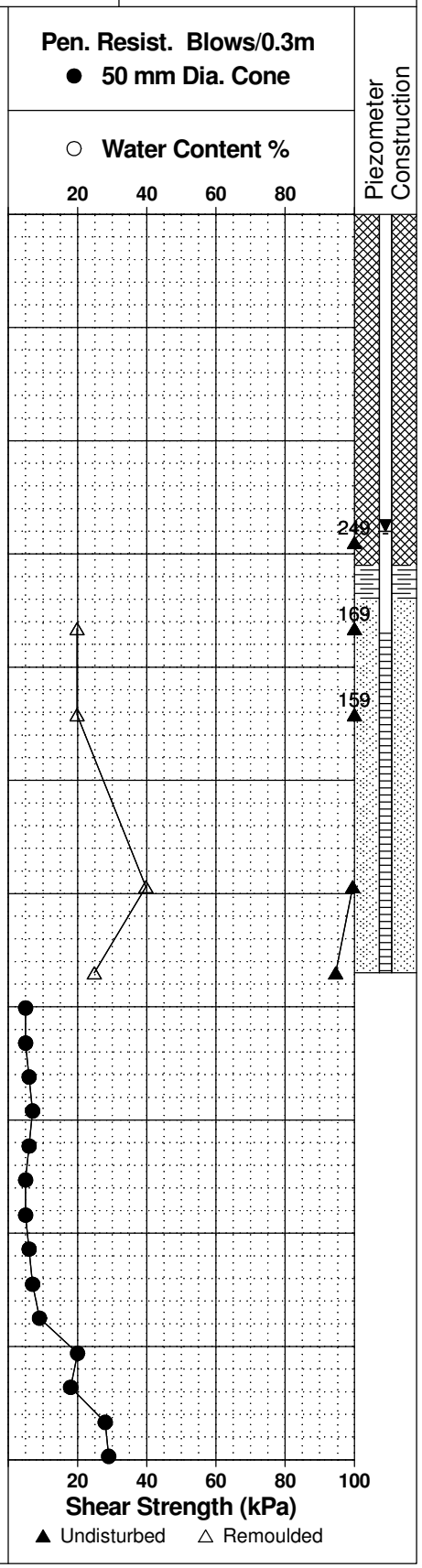
FILE NO. PG4918

REMARKS

HOLE NO. BH 7-19

BORINGS BY CME 55 Power Auger **DATE** 2019 July 12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.86
TOPSOIL 0.18		AU	1				
		SS	2	100	13	1	101.86
		SS	3	100	13	2	100.86
Very stiff to stiff, brown **SILTY CLAY**						3	99.86
						4	98.86
- grey by 4.6m depth		SS	4	88	5	5	97.86
6.70						6	96.86
Dynamic Cone Penetration Test commenced at 6.70m depth.						7	95.86
						8	94.86
						9	93.86
						10	92.86
						11	91.86



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

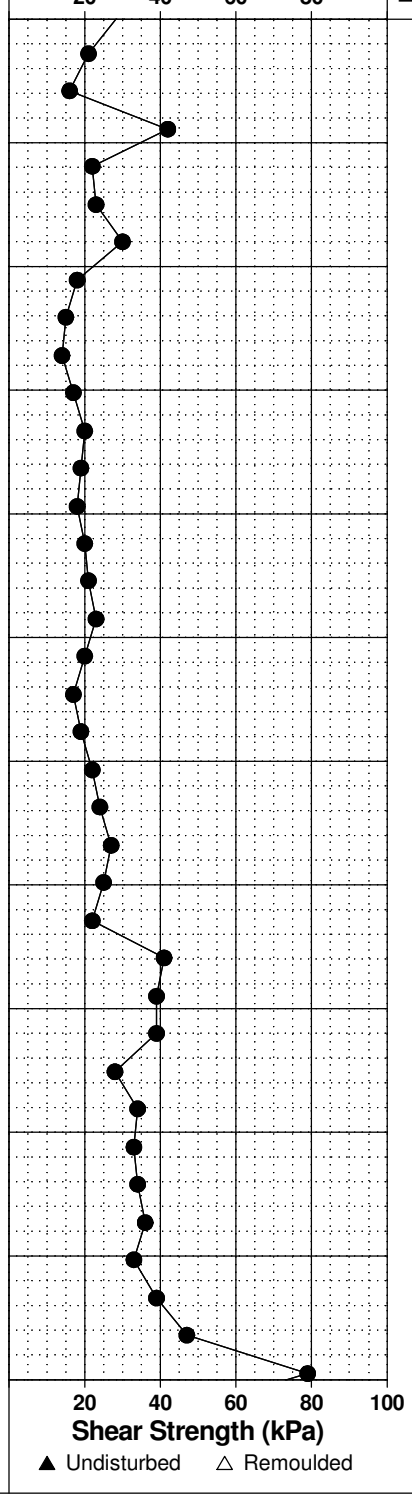
FILE NO. PG4918

REMARKS

HOLE NO. BH 7-19

BORINGS BY CME 55 Power Auger **DATE** 2019 July 12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						11	91.86		
						12	90.86		
						13	89.86		
						14	88.86		
						15	87.86		
						16	86.86		
						17	85.86		
						18	84.86		
						19	83.86		
						20	82.86		
						21	81.86		
						22	80.86		



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
147 Langstaff Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Robinson Land Development.

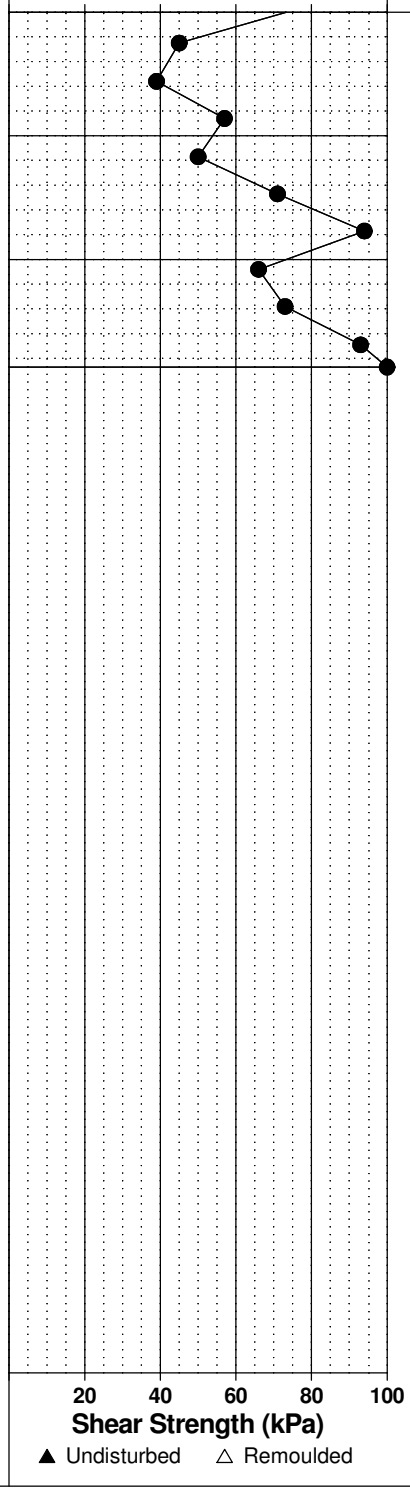
FILE NO. PG4918

REMARKS

HOLE NO. BH 7-19

BORINGS BY CME 55 Power Auger **DATE** 2019 July 12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
						22	80.86		
						23	79.86		
						24	78.86		
24.87									
End of Borehole Practical DCPT refusal at 24.87m depth (GWL @ 2.80m - July 18, 2019)									



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. **PG1773**

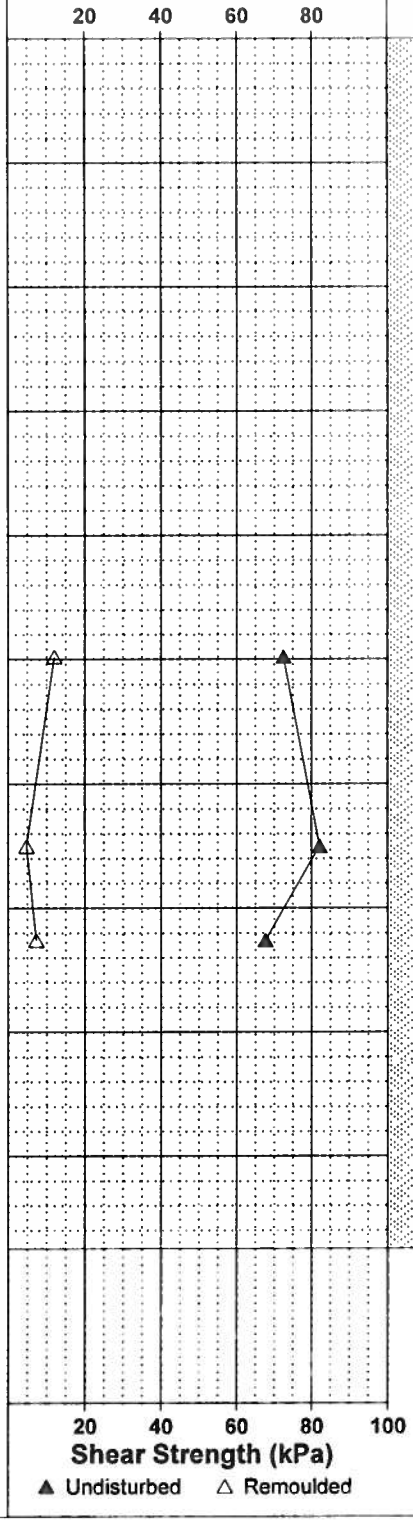
REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 55 Power Auger DATE 23 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.20
25mm Topsoil over compact, brown **SILTY SAND**		AU	1				
0.60							
		SS	2	92	13	1	96.20
		SS	3	100	8	2	95.20
		SS	4	100	4		
						3	94.20
Very stiff to stiff, brown **SILTY CLAY**, trace to some sand		SS	5	100	4		
		SS	6	100	4	4	93.20
- grey by 4.4m depth						5	92.20
		SS	7	100	2	6	91.20
						7	90.20
		SS	8	100	3	8	89.20
8.38							
Very loose, grey **SILTY SAND**, trace clay		SS	9	75	2	9	88.20
		SS	10	100	3		
9.75							
End of Borehole							
(GWL @ 5.75m-Nov. 3/08)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. PG1773

REMARKS

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger DATE 23 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	97.30		
38mm Topsoil over compact, brown **SILTY SAND** with clay		AU	1						
0.60									
		SS	2	71	13	1	96.30		
		SS	3	83	8	2	95.30		
		SS	4	100	7				
		SS	5	100	4	3	94.30		
		SS	6	100	4	4	93.30		
Very stiff to stiff, brown **SILTY CLAY**, some sand		SS	7	100	2	5	92.30		
- grey by 5.2m depth		SS	8	100	2	6	91.30		
		SS	9	100	3				
		SS	10	100	3	7	90.30		
		SS	11	100	2	8	89.30		
		SS	12	100	2	9	88.30		
9.45		SS	13	100	3				
Very loose, grey **SANDY SILT**, trace clay						10	87.30		
9.75									
Dynamic Cone Penetration Test commenced @ 9.75m depth									
Inferred **SANDY SILT**						11	86.30		
10.70									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. PG1773

REMARKS

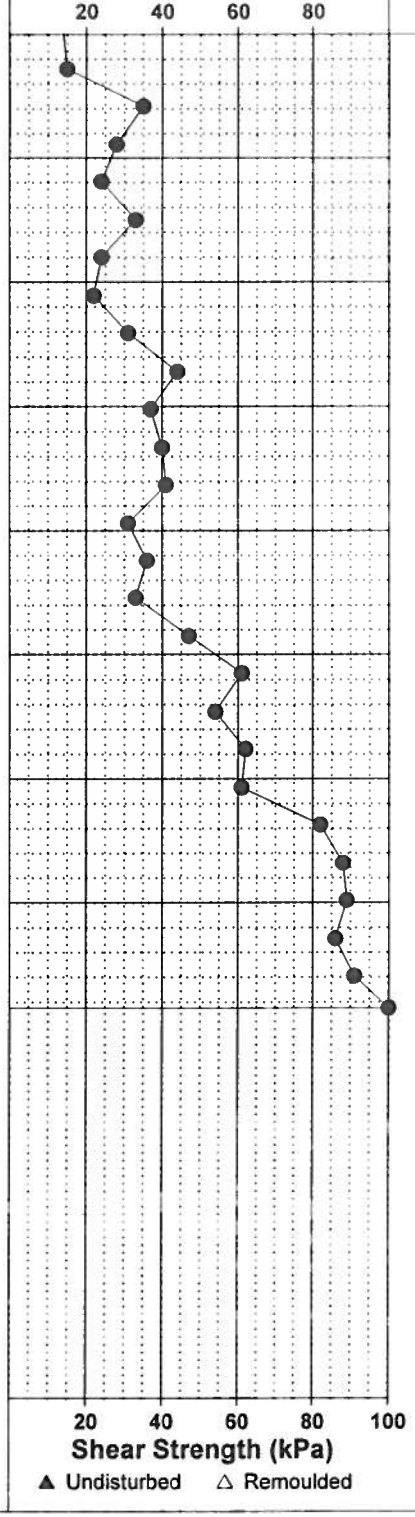
HOLE NO. BH 2

BORINGS BY CME 55 Power Auger DATE 23 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
						11	86.30		
						12	85.30		
						13	84.30		
						14	83.30		
Inferred GLACIAL TILL						15	82.30		
						16	81.30		
						17	80.30		
						18	79.30		
18.85									
End of Borehole									

Practical DCPT refusal @ 18.85m depth

(GWL @ 4.76m-Nov. 3/08)



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. PG1773

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger DATE 23 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	95.62		
TOPSOIL 0.25		AU	1						
Compact, brown SANDY SILTY, trace clay 1.37		SS	2	100	12	1	94.62		
		SS	3	100	9	2	93.62		
		SS	4	100	5				
		SS	5	100	5	3	92.62		
		SS	6	100	4	4	91.62		
Very stiff to stiff, brown SILTY CLAY		SS	7	100	5	5	90.62		
- firm and grey by 5.9m depth		SS	8	100	4	6	89.62		
		SS	9	100	2				
		SS	10	100	2	7	88.62		
8.00		SS	11	100	2	8	87.62		
Grey CLAYEY SILT		SS	12	100	2	9	86.62		
9.75		SS	13	100	2				
End of Borehole									
(GWL @ 6.31m-Nov. 3/08)									

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. PG1773

REMARKS

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger DATE 23 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	95.74		
TOPSOIL 0.25		AU	1						
		SS	2	100	11	1	94.74		
		SS	3	100	10	2	93.74		
		SS	4	100	6				
Very stiff to stiff, brown SILTY CLAY with sand		SS	5	100	4	3	92.74		
		SS	6	100	5	4	91.74		
		SS	7	100	10	5	90.74		
5.94		SS	8	100	6	6	89.74		
		SS	9	100	31				
		SS	10	25	36	7	88.74		
Dense to compact, grey SILTY SAND		SS	11	25	26	8	87.74		
		SS	12	33	25	9	86.74		
9.75		SS	13	42	22				
End of Borehole									
(GWL @ 6.95m-Nov. 3/08)									

Pen. Resist. Blows/0.3m: ● 50 mm Dia. Cone; ○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

FILE NO. PG1773

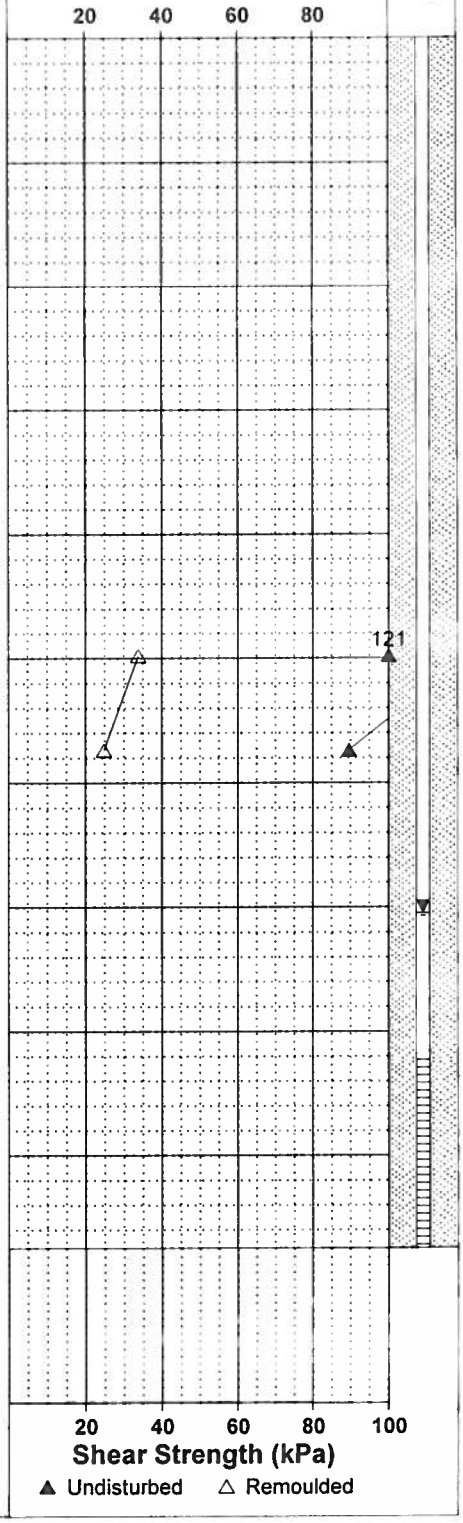
REMARKS

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger DATE 24 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.11
25mm Topsoil over compact, brown SILTY SAND		AU	1				
0.60							
		SS	2	67	15	1	97.11
		SS	3	58	11	2	96.11
		SS	4	100	5		
		SS	5	100	5	3	95.11
Very stiff to stiff, brown SILTY CLAY, trace sand		SS	6	100	6	4	94.11
						5	93.11
		SS	7	100	5	6	92.11
		SS	8	100	5	7	91.11
7.77							
		SS	9	83	32	8	90.11
Very dense to dense, grey SILTY SAND		SS	10	33	77	9	89.11
		SS	11	50	41		
9.75							
End of Borehole							
(GWL @ 7.05m-Nov. 5/08)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Langstaff Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located in the northwest corner of hte subject site. Assumed elevation = 100.00m.

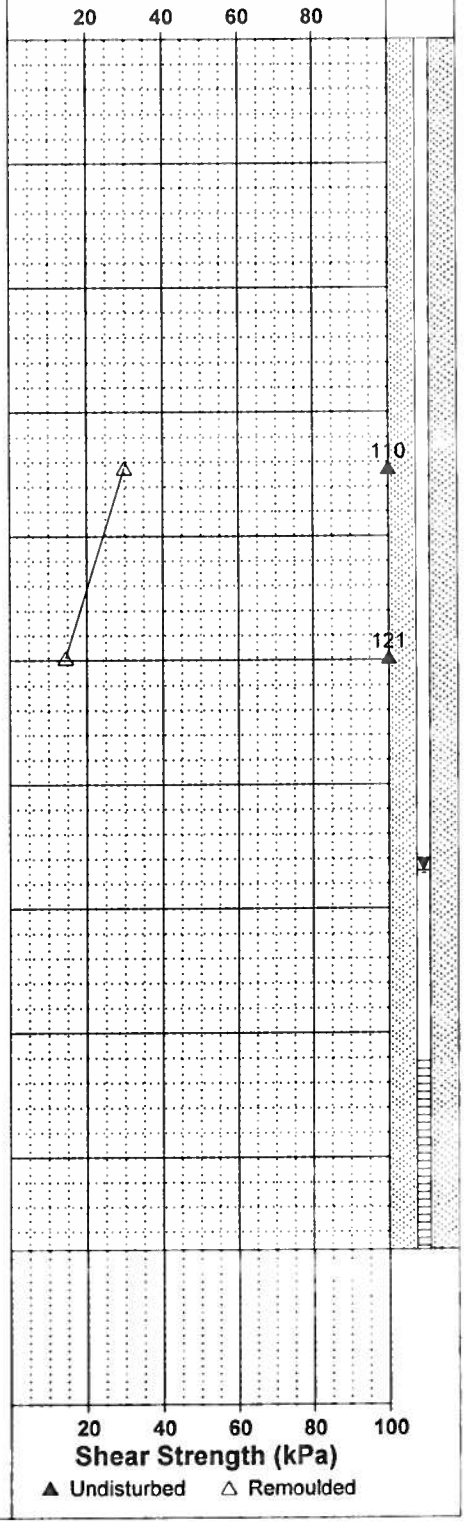
FILE NO. **PG1773**

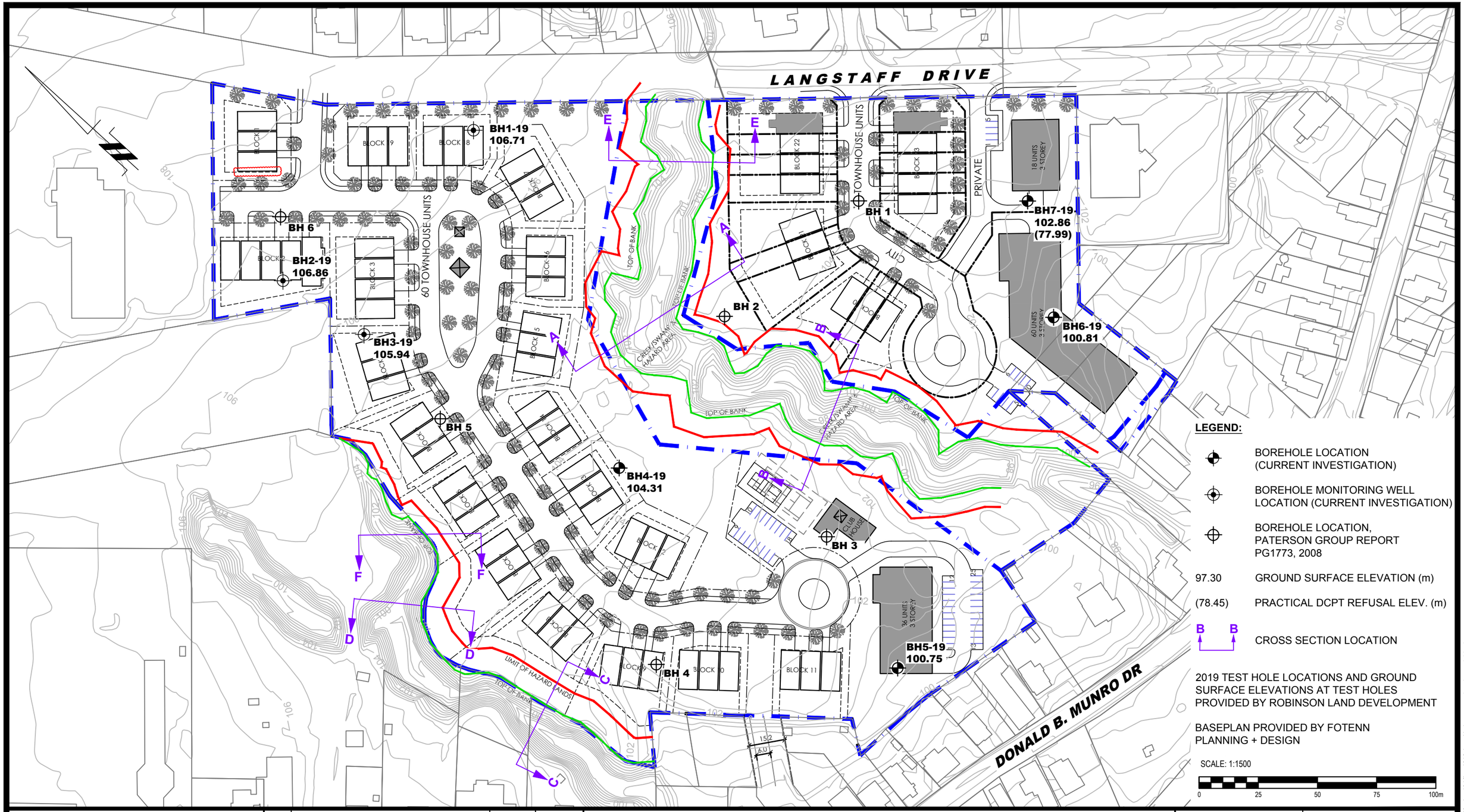
REMARKS

HOLE NO. **BH 6**

BORINGS BY CME 55 Power Auger DATE 24 Oct 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	98.20		
25mm Topsoil over compact, brown **SILTY SAND** with clay		AU	1						
0.60									
		SS	2	100	20	1	97.20		
		SS	3	100	20	2	96.20		
		SS	4	100	7	3	95.20		
Very stiff to stiff, brown **SILTY CLAY** with sand		SS	5	100	4	4	94.20		
		SS	6	100	3	5	93.20		
		SS	7	100	11	6	92.20		
		SS	8	100	6	7	91.20		
8.08		SS	9	100	2	8	90.20		
		SS	10	100	2	9	89.20		
Very loose, grey **SANDY SILT** with clay		SS	11	100	4				
9.75									
End of Borehole									
(GWL @ 6.70m-Nov. 3/08)									





LEGEND:

- BOREHOLE LOCATION (CURRENT INVESTIGATION)
- BOREHOLE MONITORING WELL LOCATION (CURRENT INVESTIGATION)
- BOREHOLE LOCATION, PATERSON GROUP REPORT PG1773, 2008
- 97.30 GROUND SURFACE ELEVATION (m)
- (78.45) PRACTICAL DCPT REFUSAL ELEV. (m)
- B B CROSS SECTION LOCATION

2019 TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLES PROVIDED BY ROBINSON LAND DEVELOPMENT

BASEPLAN PROVIDED BY FOTENN PLANNING + DESIGN

SCALE: 1:1500

0 25 50 75 100m

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
4	UPDATED CONCEPTUAL PLAN	23/10/2019	SD
3	REVISED LIMIT OF HAZARD LANDS	11/10/2019	SD
2	UPDATED CONCEPTUAL PLAN	30/07/2019	SD
1	RAVINE AND TOP OF SLOPE TOPOGRAPHY ADDED TO PLAN	06/06/2019	RG

INVERNESS HOMES

GEOTECHNICAL INVESTIGATION - PROPOSED RESIDENTIAL DEVELOPMENT
147 LANGSTAFF DRIVE

CARP, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500	Date: 08/2019
Drawn by: RCG	Report No.: PG4918-LET.01
Checked by: SD	Dwg. No.: PG4918-1
Approved by: DJG	Revision No.: 4

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