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Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development
Eagleson Road at Terry Fox Drive
Ottawa, Ontario

Prepared For

Claridge Homes

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Report PG3411-2

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Claridge Homes to conduct a geotechnical investigation for the subject site to be located at Eagleson Road at Terry Fox Drive, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

❏ determine the subsoil and groundwater conditions at this site by means of boreholes.

❏ to provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as they are understood at the time of writing this report.

2.0 Proposed Project

Based on available design plans, it is understood that the proposed development will consist of a series of residential dwellings with associated driveways, roadways and landscaped areas. It is anticipated that the site will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on September 7 and 12, 2018. A total of three (3) boreholes were advanced to a maximum depth of 6.4 m. In addition, seven (7) test pits were excavated to a maximum depth of 2.4 below existing grade. It should be noted that previous investigations were conducted within the subject property in 2006 and 2015 consisting of a total of 10 boreholes advanced to a maximum depth of 11.3 m below existing grade. The borehole locations were distributed in a manner to provide general coverage of the subject site. The approximate locations of the boreholes are shown on Drawing PG3411-2 - Test Hole Location Plan included in Appendix 2.

The boreholes were advanced using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The drilling procedure consisted of advancing each test hole to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler or from the auger flights. The depths at which the auger and split spoon samples were recovered from the test holes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was carried out at regular depth intervals in cohesive soils using a vane apparatus.

All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for visual inspection.

The thickness of the overburden was evaluated during the course of the investigation by a dynamic cone penetration test (DCPT) at BH 3-18 and all boreholes from 2006. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

Subsurface conditions observed in the test holes were recorded in detail in the field. Reference should be made to the Soil Profile and Test Data sheets presented in Appendix 1 for specific details of the soil profile encountered at the test hole locations.

Groundwater

Flexible polyethylene standpipes were installed in all boreholes except BH 6 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The borehole locations were selected in the field by Paterson personnel to provide general coverage of the subject site taking into consideration existing site features. The borehole locations are presented on Drawing PG3411-2 - Test Hole Location Plan in Appendix 2. The ground surface elevation at each borehole location was surveyed and provided by Annis, O'Sullivan, Vollebekk Ltd.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging. Nine (9) atterberg limit tests were completed on selected soil samples. The results are presented in Table 1 under Subsection 4.2.

3.4 Analytical Testing

Two (2) soil samples were submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The samples were submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The majority of the subject site is currently undeveloped and grass/tree covered. The west and south portions of the site are mainly grass covered with hydro lines running along Terry fox Drive. Treed areas were observed along the north and east portions of the subject site. The ground surface is relatively flat and gradually slopes down towards the north portion of the site. A ditch was noted running east-west along the central portion of the site.

4.2 Subsurface Profile

Overburden

Generally, the soil conditions encountered at the test hole locations consists of topsoil overlying a loose to very loose silty sand/sandy silt layer mixed with some clay followed by stiff to firm silty clay crust. A deep firm to soft, grey silty clay deposit was encountered below the above noted layers. Practical refusal to DCPT was completed at BH 3-18 and BH 1 through BH 6 at depths varying between 30.5 to 36 m. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location.

The results of the atterberg limit testing on select silty clay samples are presented in Table 1 below:

Table 1 - Summary of Atterberg Limits Tests

Samples	Depth (m)	Initial Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %
BH1-18	2.3-2.9	35.0	34	15	19
BH2-18	3 - 3.7	31.0	27	16	11
BH3-18	1.5 - 2.2	34.0	34	16	17
TP1-18	2.3 - 2.5	28.0	28	16	12
TP2-18	1.5 - 1.7	45.0	40	16	24
TP3-18	2.3 - 2.5	32.0	30	14	16
TP4-18	1.5 - 1.7	26.0	31	15	16
TP5-18	2.3 - 2.5	53.0	55	17	38

Table 1 - Summary of Atterberg Limits Tests (Cont'd)

Samples	Depth (m)	Initial Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %
TP7-18	1.5 - 1.7	27.0	28	18	11
TP8-18	1.0 - 1.1	28.0	37	18	19
TP9-18	1.5 - 1.6	24.0	35	16	19
TP10-18	1.0 - 1.1	27.0	36	18	18

Bedrock

Based on available geological mapping, interbedded sandstone and dolomite bedrock of the March formation is present in this area with a drift thickness of 25 to 50 m.

4.3 Groundwater

Groundwater levels were measured in the standpipes installed in the boreholes on January 22, 2018. The observed groundwater levels are summarized in Table 2.

Table 2 - Summary of Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1-18	96.63	2.74	93.89	September 12, 2018
BH 2-18	96.62	3.30	93.32	September 12, 2018
BH 3-18	96.41	3.49	92.92	September 12, 2018
BH 1-15	96.20	1.69	94.51	February 6, 2015
BH 2-15	95.68	0.93	94.75	February 6, 2015
BH 3-15	96.04	1.39	94.65	February 6, 2015
BH 4-15	96.16	1.54	94.62	February 6, 2015
BH 1	95.15	Dry	-	January 12, 2006
BH 2	96.07	5.10	90.97	January 12, 2006
BH 3	96.40	dry	-	January 12, 2006
BH 4	95.85	dry	-	January 12, 2006

Table 2 - Summary of Groundwater Level Readings (Cont'd)

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 5	96.29	1.00	95.29	January 12, 2006
BH 6	95.72	Blocked at 1 m	-	January 12, 2006

Note: The ground surface elevation at each borehole location was surveyed and provided by Stantec Geomatics (2006, 2015) and Annis, O'Sullivan, Vollebekk Ltd (2018).

It should be noted that the groundwater levels could be influenced by surface water infiltrating the backfilled boreholes. It is important to note that groundwater readings at the piezometers can be influenced by water perched within the borehole backfill material. Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at approximately 1.5 to 2.5 m below ground surface. The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is expected that the proposed buildings will be founded over conventional shallow footings placed on an undisturbed, stiff to firm silty clay, silty sand or engineered fill bearing surface.

Due to the presence of a silty clay deposit, a permissible grade raise restriction is required for the subject site.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Preparation

Stripping Depth

Topsoil, and any deleterious fill, such as those containing organic materials, should be stripped from under any buildings and other settlement sensitive structures. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Disturbance of the subgrade may result in having to sub-excavate the disturbed material and the placement of additional fill.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II material. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If excavated stiff brown silty clay, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the silty clay, under dry conditions, should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

In-filling the existing ditches should be completed in a stepped fashion within the lateral support of the proposed buildings. The fill should consist of clean imported granular fill, such as OPSS Granular A or Granular B Type II material. The steps should have a minimum horizontal length of 1.5 m and minimum vertical height of 0.5 m and should be compacted using suitable compaction equipment to a minimum 98% of the material's SPMDD.

5.3 Foundation Design

Shallow Foundation

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, firm silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **60 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **120 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at SLS of **90 kPa** and a factored bearing resistance value at ULS of **150 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Footings placed on an undisturbed, compact silty sand to sandy silt bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **60 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **120 kPa.** A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Footings placed on a minimum 500 mm thick layer of engineered fill bearing surface over an undisturbed, firm to stiff silty clay bearing surface can be designed using a bearing resistance value at SLS of **90 kPa** and a factored bearing resistance value at ULS of **150 kPa.** A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Footings designed using the above noted bearing resistance value at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Settlement/Grade Raise

During a previous Paterson investigation, a total of 2 consolidation tests were completed within the subject site. The results of the consolidation tests from the previous investigations are presented in Table 3 and in Appendix 1.

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 3 - Summary of Consolidation Test Results (Paterson Investigation PG0881)

Borehole No.	Sample	Depth (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c	Q (*)
BH 5	TW4	4.28	87	61	0.012	0.706	A
BH 6	TW3	4.11	104	57	0.012	0.696	G

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests during the investigation are based on the long term groundwater level being at 0.5 m below the existing groundwater table. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

Permissible Grade Raise Recommendations

Based on the undrained shear strength values and consolidation testing results, the permissible grade raise areas are presented in Drawing PG3411-3 - Permissible Grade Raise Areas for housing and Drawing PG3411-4 - Permissible Grade Raise Areas for roadways.

Where proposed grade raises exceed our permissible grade raise recommendations, several options could be considered for the foundation support of the proposed buildings:

Scenario A

Where the grade raise is close to, but below, the maximum permissible grade raise, consideration should be given to using more reinforcement in the design of the foundation (footings and walls) to reduce the risks of cracking in the concrete foundation. The use of control joints within the brick work between the garage and basement area should also be considered.

Scenario B

Where the grade raise cannot be accommodated with soil fill, the following options could be used alone or in combination.

Option 1 - Use of Lightweight Fill

Lightweight fill (LWF) can be used, consisting of EPS (expanded polystyrene) Type 19 or 22 blocks or other light weight materials which allow for raising the grade without adding a significant load to the underlying soils. However, these materials are expensive and, in the case of the EPS, are more difficult to use under the groundwater level, as they are buoyant, and must be protected against potential hydrocarbon spills. Use lightweight fill within the interior of the garage and porch areas to reduce the fill-related loads.

Option 2 - Preloading or Surcharging

It is possible to preload or surcharge the proposed site in localized areas provided sufficient time is available to achieve the desired settlements based on theoretical values from the settlement analysis. If this option is considered, a monitoring program using settlement plates will have to be implemented. This program will determine the amount of settlement in the preloaded or surcharged areas. Obviously, preloading to proposed finished grades will allow for consolidation of the underlying clays over a longer time period. Surcharging the site with additional fill above the proposed finished grade will add additional load to the underlying clays accelerating the consolidation process and allowing for accelerated settlements. Once the desired settlements are achieved, the site can be unloaded and the fill can be used elsewhere on site.

Once the required grade raises are established, the above options could be further discussed along with further recommendations on specific requirements.

5.4 Design for Earthquakes

The proposed site can be taken as seismic site response **Class E** as defined in the Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A) for foundations considered at this site. Soil underlying the subject site is not susceptible to liquefaction.

5.5 Basement Slab/Slab on Grade Construction

With the removal of all topsoil and fill, containing deleterious or organic materials, the native soil or existing granular fill approved by the geotechnical consultant at the time of excavation will be considered to be an acceptable subgrade surface on which to commence backfilling for basement floor slab or slab on grade construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

It is recommended that the upper 200 mm of sub-floor fill for basement slab construction consist of 19 mm clear crushed stone. It is also recommended that the upper 300 mm sub-floor fill below slab on grade construction consist of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and local roadways.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas/Driveways

Thickness (mm)	Material Description
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soils or OPSS Granular B Type I or II material placed over in situ soil	

Table 5 - Recommended Pavement Structure - Local Roadways

Thickness mm	Material Description	Traffic Category
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete	B
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete	
150	**BASE** - OPSS Granular A Crushed Stone	
500	**SUBBASE** - OPSS Granular B Type II	
	SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this traffic category.

Table 6 - Recommended Pavement Structure - Minor/Major Collectors and Bus Lanes

Thickness mm	Material Description	Traffic Category
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete	D
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete	
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete	
150	**BASE** - OPSS Granular A Crushed Stone	
500	**SUBBASE** - OPSS Granular B Type II	
	SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil.	

Minimum Performance Graded (PG) 64-34 asphalt cement should be used for this traffic category.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Where silty clay is anticipated at subgrade level, consideration should be given to installing subdrains during the pavement construction. The subdrain inverts should be approximately 300 mm below subgrade level and run longitudinal along the curblines. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a composite drainage system, such as Delta Drain 6000 or an approved equivalent. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavations to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

Excavation Base Stability

The base of supported excavations can fail by three (3) general modes:

- ☐ Shear failure within the ground caused by inadequate resistance to loads imposed by grade difference inside and outside of the excavation,
- ☐ Piping from water seepage through granular soils, and
- ☐ Heave of layered soils due to water pressures confined by intervening low permeability soils.

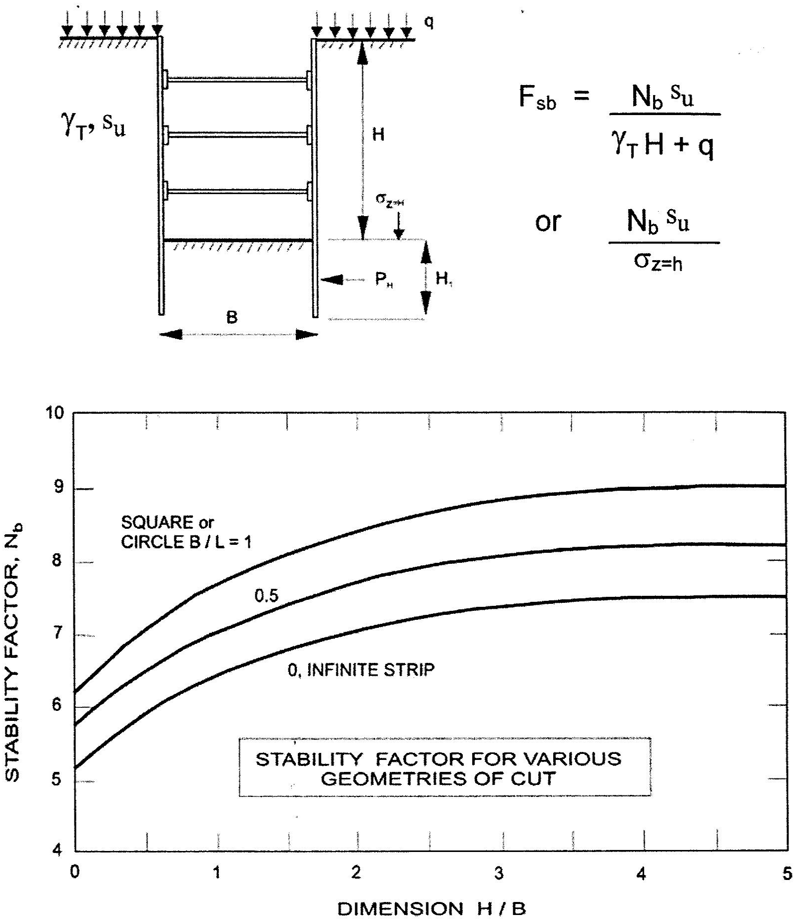
Shear failure of excavation bases is typically rare in granular soils if adequate lateral support is provided. Inadequate dewatering can cause instability in excavations made through granular or layered soils. The potential for base heave in cohesive soils should be determined for stability of flexible retaining systems.

The factor of safety with respect to base heave, FS_b, is:

$$FS_b = N_b s_u / \sigma_z$$

where:

N_b - stability factor dependent upon the geometry of the excavation and given in Figure 1 on the following page.
s_u - undrained shear strength of the soil below the base level
σ_z - total overburden and surcharge pressures at the bottom of the excavation



$$F_{sb} = \frac{N_b s_u}{\gamma_T H + q} \quad \text{or} \quad \frac{N_b s_u}{\sigma_{z=h}}$$

Figure 1 - Stability Factor for Various Geometries of Cut

In the case of soft to firm clays, a factor of safety of 2 is recommended for base stability.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

Generally, it should be possible to re-use the moist, not wet, silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

A temporary Ministry of the Environment and Climate Change (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride content, pH and resistivity indicate the presence of a non-aggressive to slightly aggressive environment for exposed ferrous metals at this site.

6.8 Landscaping Considerations

Tree Planting Restrictions

The proposed development is located in an area of low to medium sensitive silty clay deposits for tree planting. Based on our Atterberg Limits test results, the modified plasticity limit generally does not exceed 40%. The following tree planting setbacks are recommended for the subject site. Large trees (mature height over 14 m) can be planted within the site provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the following conditions are met:

- ☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

- ☐ A small tree must be provided with a minimum of 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ☐ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ☐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ☐ Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed at least 4 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Installation of Decks or Additions

Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

☐ Grading plan review from a geotechnical perspective, once the final grading plan is available.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials used.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to determine the level of compaction achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available and our recommendations when the drawings and specifications are complete.

A geotechnical investigation 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. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. 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 Claridge Homes 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.

Faisal I. Abou-Seido, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Oct. 25, 2018
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

Report Distribution:

☐ Claridge Homes (3 copies)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMIT TESTING RESULTS

CONSOLIDATION TESTING RESULTS (PG0881)

ANALYTICAL TESTING RESULTS (PG0881)

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 7, 2018

FILE NO. PG3411

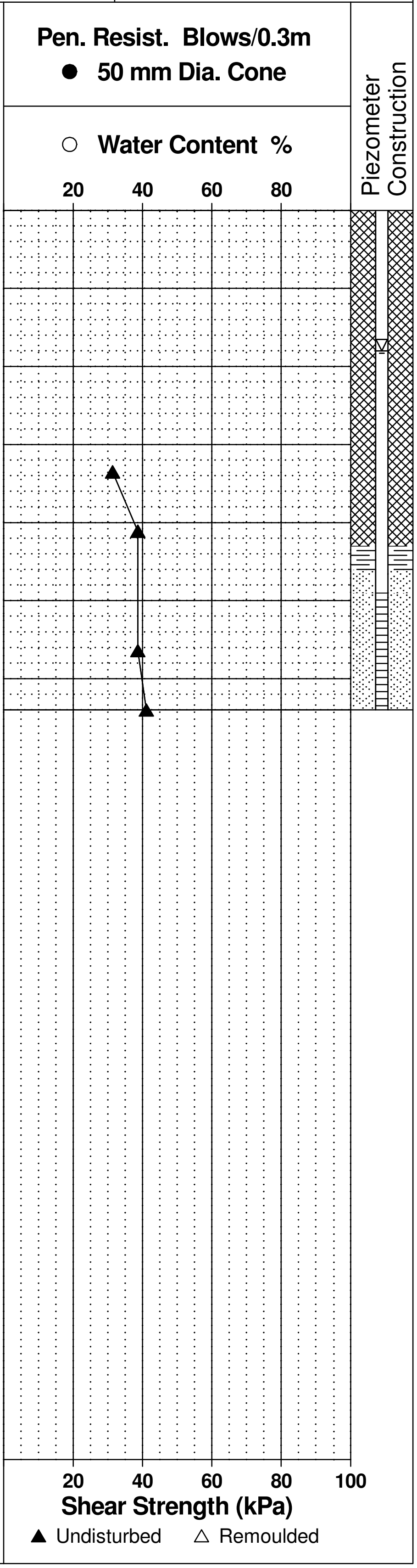
HOLE NO. BH 1-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	96.63
TOPSOIL 0.30	AU	1				
Brown **SILTY SAND,** trace clay and organics 0.91						
Loose, brown **SILTY SAND** 1.37	SS	2	96	7	1	95.63
Firm, brown **SILTY CLAY,** trace sand	SS	3	54	4	2	94.63
	SS	4	58	2		
- grey by 2.3m depth					3	93.63
					4	92.63
	SS	5		W	5	91.63
6.40					6	90.63

End of Borehole

(Piezometer blocked at 2.74m depth - Sept. 12, 2018)

(Long term groundwater level at 1.8m depth based on field observations)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

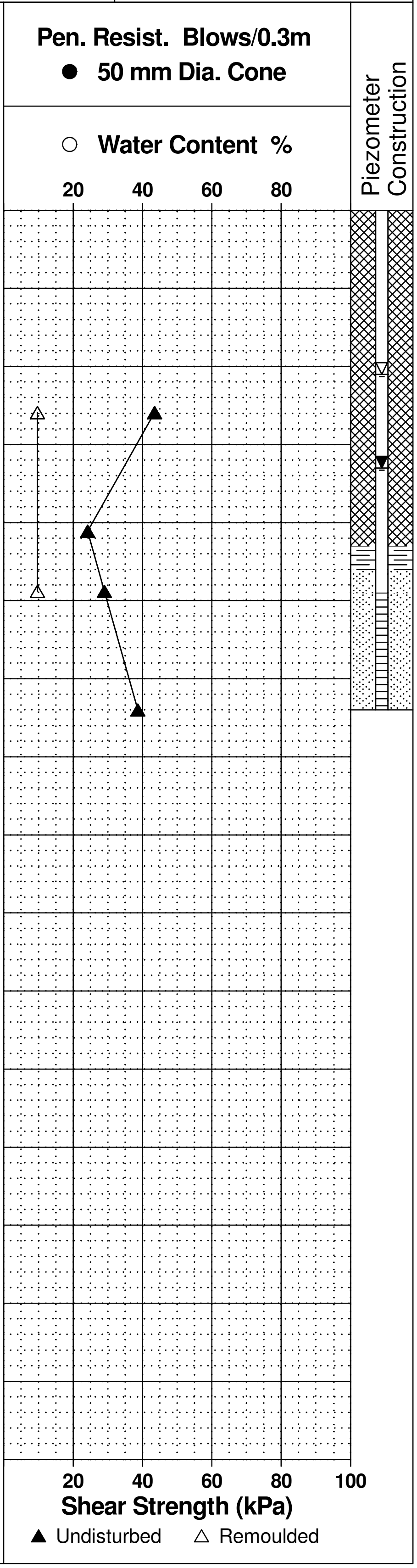
DATE September 7, 2018

FILE NO. PG3411

HOLE NO. BH 2-18

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.41	AU	1		
Loose, brown **SANDY SILT**	1.52	SS	2	46	8
Brown **SILTY CLAY,** trace shells	2.13	SS	3	50	3
Firm, brown **SILTY CLAY** - grey by 2.6m depth	6.40	SS	4	96	W
		SS	5	21	W
Dynamic Cone Penetration Test commenced at 6.40m depth. Cone pushed to 23.7m depth.					

DEPTH (m)	ELEV. (m)
0	96.62
1	95.62
2	94.62
3	93.62
4	92.62
5	91.62
6	90.62
7	89.62
8	88.62
9	87.62
10	86.62
11	85.62
12	84.62
13	83.62
14	82.62
15	81.62
16	80.62



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 7, 2018

FILE NO. PG3411

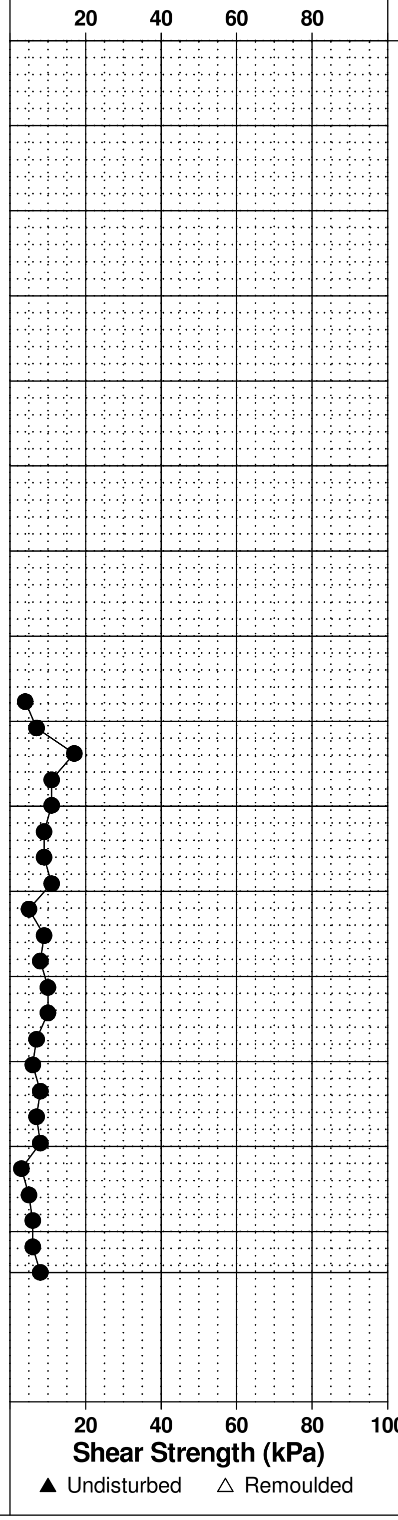
HOLE NO. BH 2-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						16	80.62
						17	79.62
						18	78.62
						19	77.62
						20	76.62
						21	75.62
						22	74.62
						23	73.62
						24	72.62
						25	71.62
						26	70.62
						27	69.62
						28	68.62
						29	67.62
						30	66.62
30.48							
End of Borehole (GWL @ 3.30m - Sept. 12, 2018) (Long term groundwater level at 1.8m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 7, 2018

FILE NO. PG3411

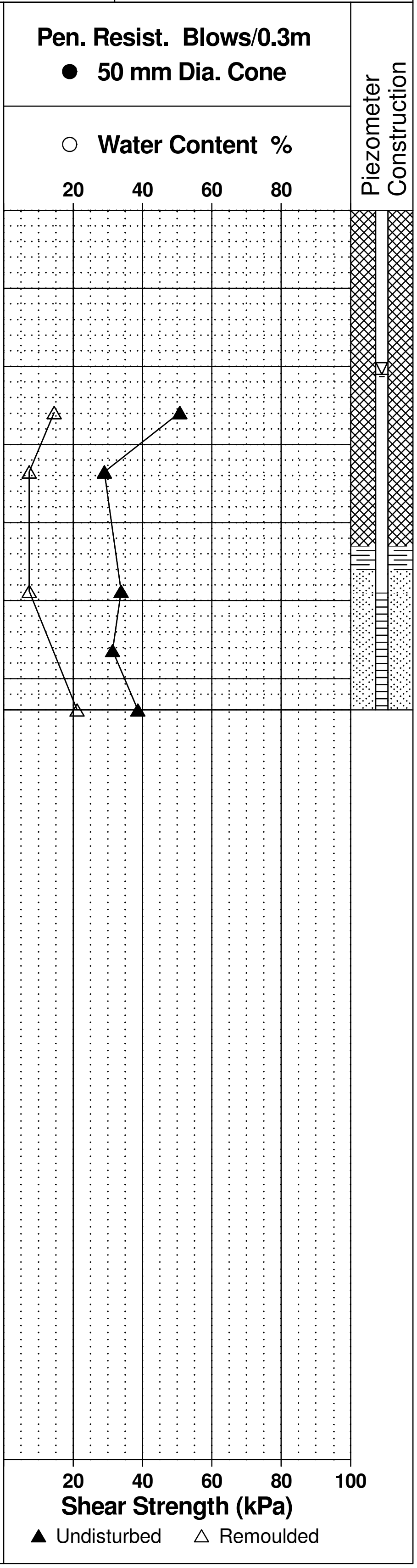
HOLE NO. BH 3-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	96.41
TOPSOIL 0.15	AU	1				
Loose, brown **SILTY SAND,** trace clay - clay content increasing with depth 1.37	SS	2	96	7	1	95.41
	SS	3	29	4	2	94.41
Stiff to firm, brown **SILTY CLAY**					3	93.41
- grey by 3.1m depth	SS	4	79	2	4	92.41
					5	91.41
6.40					6	90.41

End of Borehole

(Piezometer blocked at 3.49m depth - Sept. 12, 2018)

(Long term groundwater level at 2.1m depth based on field observations)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG3411**

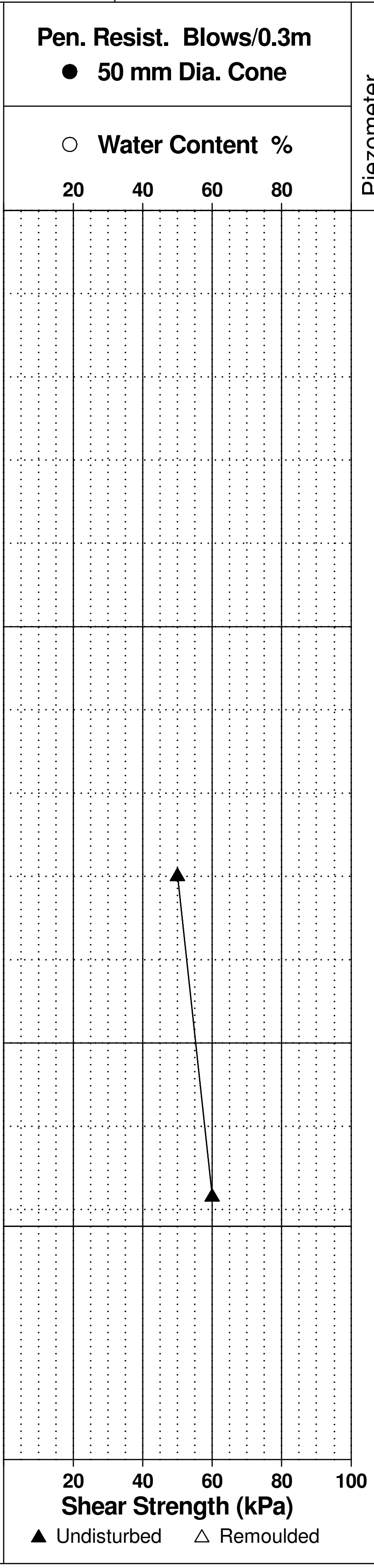
REMARKS

HOLE NO. **TP 1-18**

BORINGS BY Backhoe

DATE September 12, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.19
TOPSOIL 0.18		G	1				
Brown **SILTY SAND,** trace clay 1.22		G	2			1	95.19
Stiff, grey **SILTY CLAY** 2.44		G	3			2	94.19
		G	4				
End of Test Pit (TP dry upon completion)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG3411

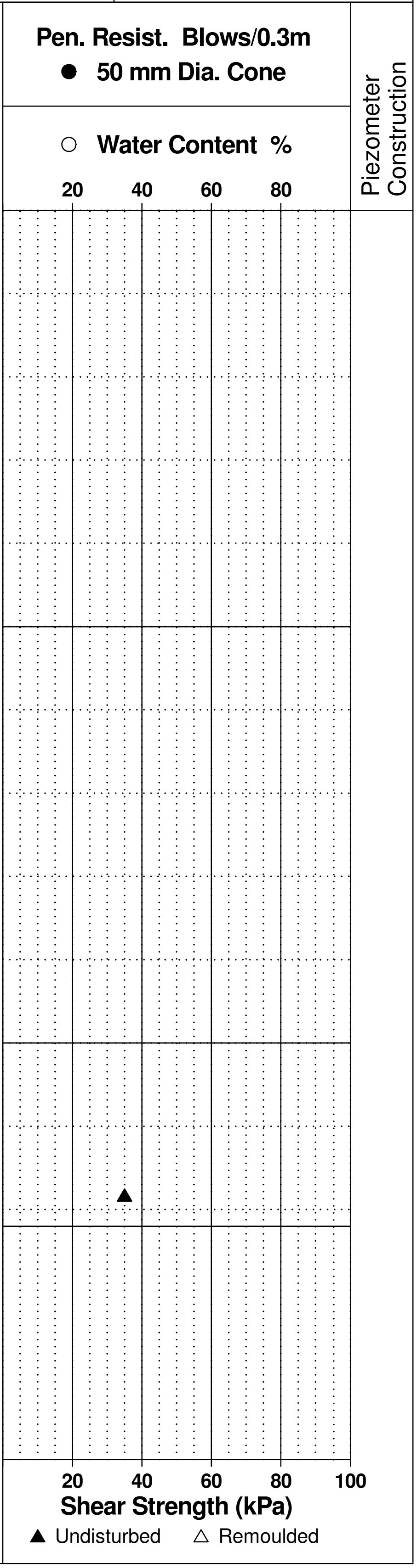
REMARKS

HOLE NO. TP 2-18

BORINGS BY Backhoe

DATE September 12, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.09
TOPSOIL 0.18	■	G	1				
Brown **SILTY SAND,** trace clay		G	2				
1.22						1	95.09
Firm, grey **SILTY CLAY**	▨	G	3				
						2	94.09
2.44		G	4				
End of Test Pit (TP dry upon completion)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

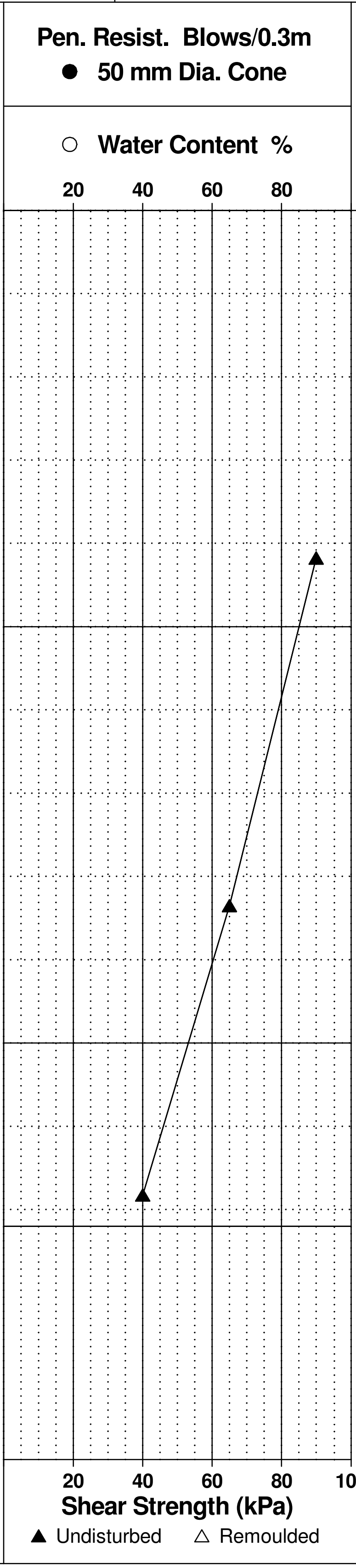
BORINGS BY Backhoe

DATE September 12, 2018

FILE NO. PG3411

HOLE NO. TP 3-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	95.31	
TOPSOIL		G	1					
0.28								
Brown **SILTY SAND,** trace clay		G	2					
						1	94.31	
1.07								
Stiff to firm, grey **SILTY CLAY**		G	3					
						2	93.31	
		G	4					
2.44								
End of Test Pit (TP dry upon completion)								



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Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE September 12, 2018

FILE NO. PG3411

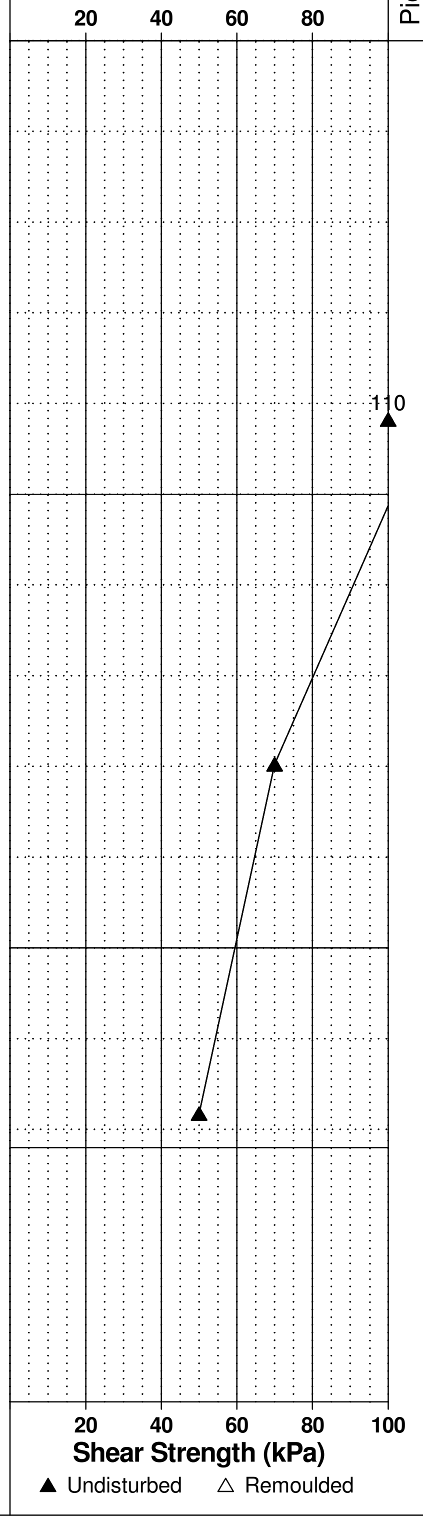
HOLE NO. TP 4-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	94.79
TOPSOIL	■	G	1				
0.25							
Very stiff to stiff, grey-brown **SILTY CLAY**	▨	G	2				
						1	93.79
		G	3				
						2	92.79
		G	4				
2.44							
End of Test Pit (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

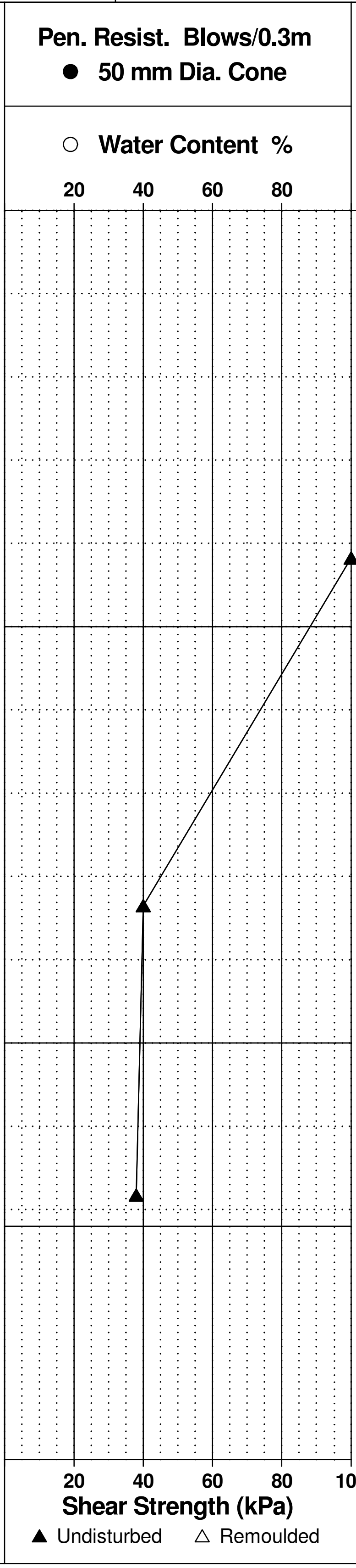
BORINGS BY Backhoe

DATE September 12, 2018

FILE NO. PG3411

HOLE NO. TP 5-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	96.32	
TOPSOIL 0.20		G	1					
Brown **SILTY SAND,** trace clay 0.99		G	2					
						1	95.32	
Very stiff to firm, brown **SILTY CLAY**		G	3					
						2	94.32	
2.44		G	4					
End of Test Pit (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG3411**

REMARKS

HOLE NO. **TP 6-18**

BORINGS BY Backhoe

DATE September 12, 2018

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	96.13		
TOPSOIL		G	1						
0.28									
Brown **SILTY SAND,** trace clay		G	2						
						1	95.13		
		G	3						
1.98									
Grey **SANDY SILT,** trace clay						2	94.13		
		G	4						
2.44									
End of Borehole (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY Backhoe

DATE September 12, 2018

FILE NO. PG3411

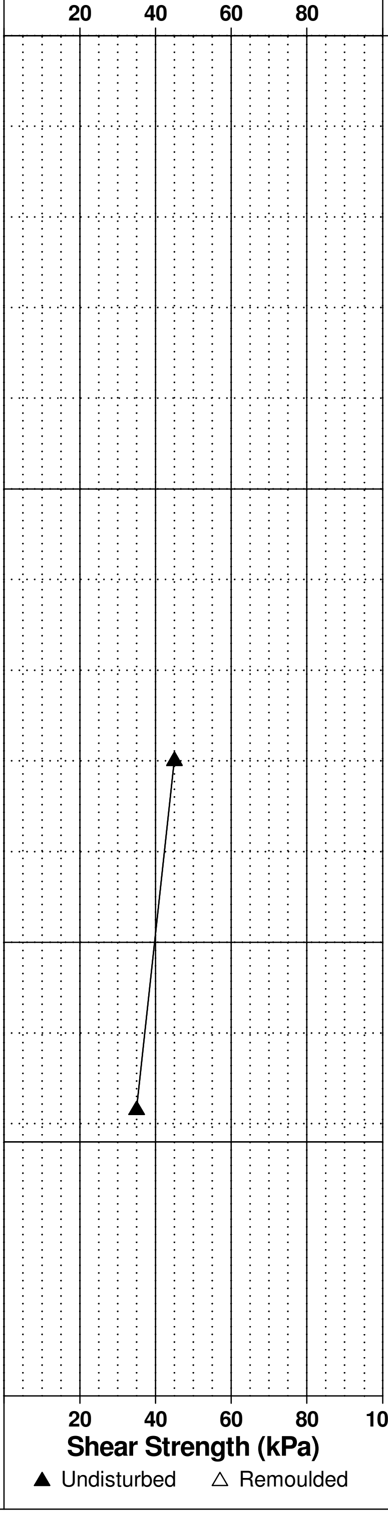
HOLE NO. TP 7-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.16
TOPSOIL		G	1				
0.25							
Brown **SILTY SAND,** trace clay		G	2				
						1	95.16
1.37							
Firm, brown **CLAYEY SILT**		G	3				
1.83							
Firm, brown **SILTY CLAY** - grey by 2.0m depth						2	94.16
		G	4				
2.44							
End of Test Pit (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG3411

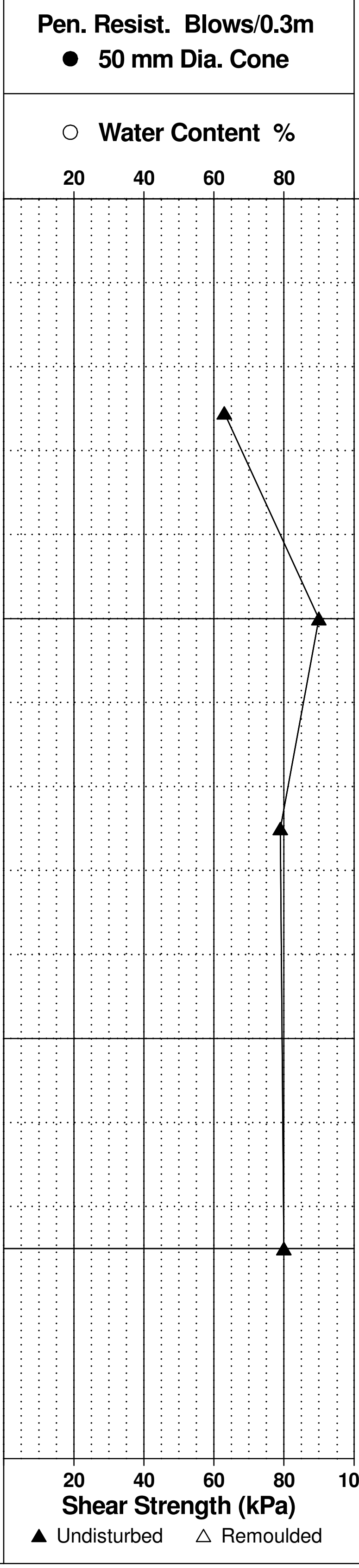
REMARKS

HOLE NO. TP 8-18

BORINGS BY Backhoe

DATE October 9, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	96.09	
TOPSOIL 0.20	■							
Stiff, brown **CLAYEY SILT** - trace rootlets by 0.6m depth 1.10	▨	G G	1 2			1	95.09	
Stiff, brown SILTY CLAY, **some seashells** 2.50	▨	G	3			2	94.09	
End of Test Pit (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

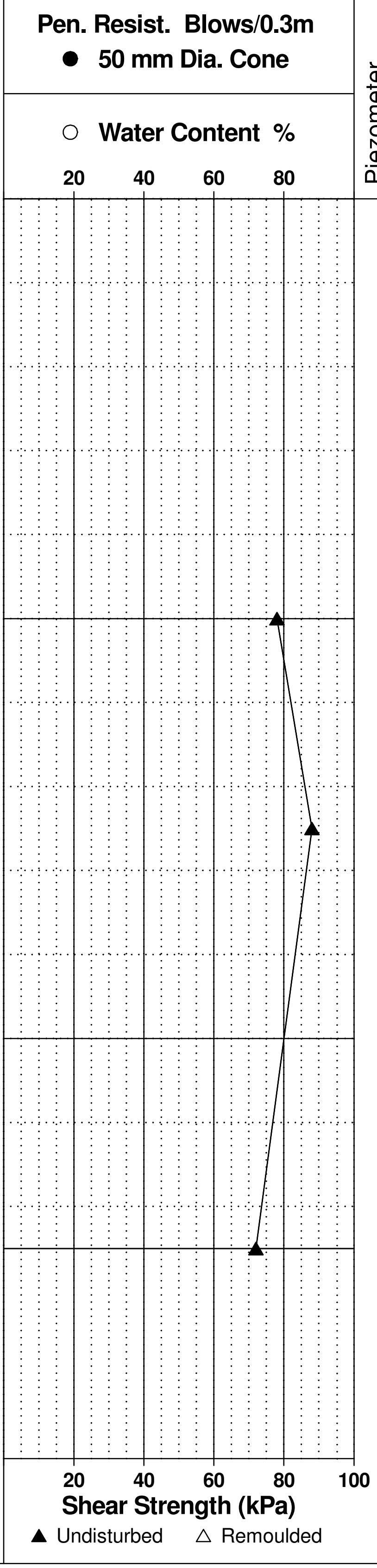
BORINGS BY Backhoe

DATE October 9, 2018

FILE NO. PG3411

HOLE NO. TP 9-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	96.38	
FILL: Brown silty clay with roots	▨							
0.60								
TOPSOIL	■							
0.95								
Stiff, brown **SILTY CLAY,** trace seashells	▨					1	95.38	
		G	1					
		G	2					
						2	94.38	
2.50								
End of Test Pit (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Eagleson Road at Terry Fox Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

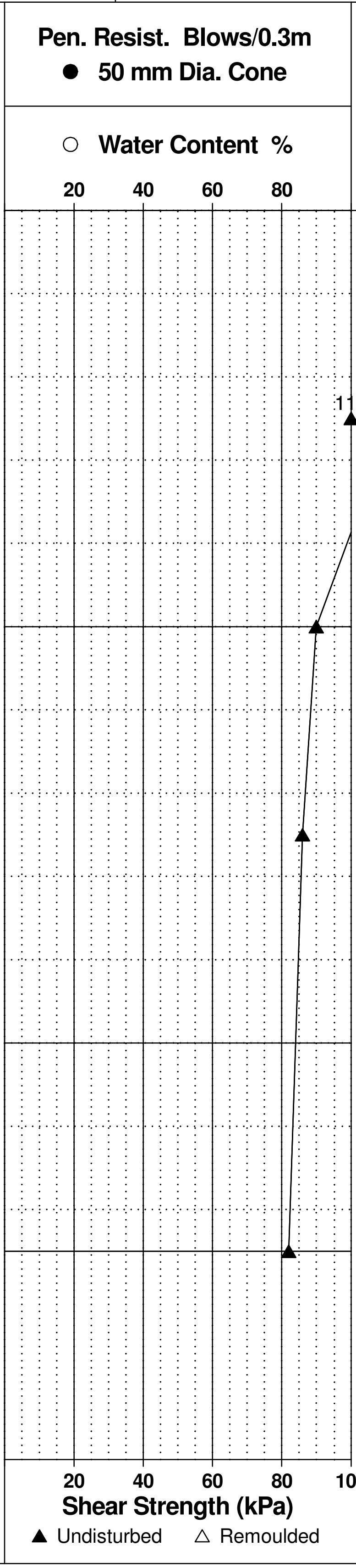
BORINGS BY Backhoe

DATE October 9, 2018

FILE NO. PG3411

HOLE NO. TP10-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	95.63
TOPSOIL 0.30	■						
Very stiff, brown **SILTY CLAY** 0.90	▨	G	1				
Stiff, brown **SILTY CLAY/CLAYEY SILT,** trace seashells 2.50	▨	G	2			1	94.63
		G	3			2	93.63
End of Test Pit (TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Eagleson Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

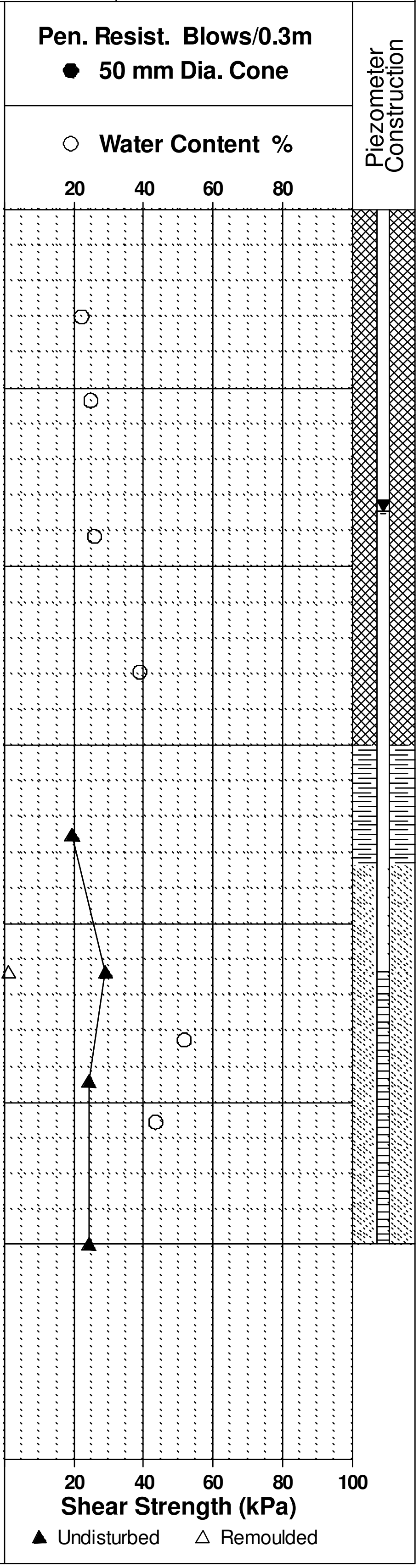
BORINGS BY CME 55 Power Auger

DATE January 15, 2015

FILE NO. PG3411

HOLE NO. BH 1-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	96.20
TOPSOIL 0.05							
Brown **CLAYEY SILT** 0.76		AU	1				
Loose, brown **SILTY SAND,** some clay 1.75		SS	2	50	5	1	95.20
Soft to firm, brown **SILTY CLAY,** trace sand - grey-brown by 2.1m depth - grey by 2.5m depth 5.79		SS	3	75	3	2	94.20
		SS	4		W		
						3	93.20
						4	92.20
						5	91.20
End of Borehole (GWL @ 1.69m-Feb. 6, 2015)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Eagleson Road
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

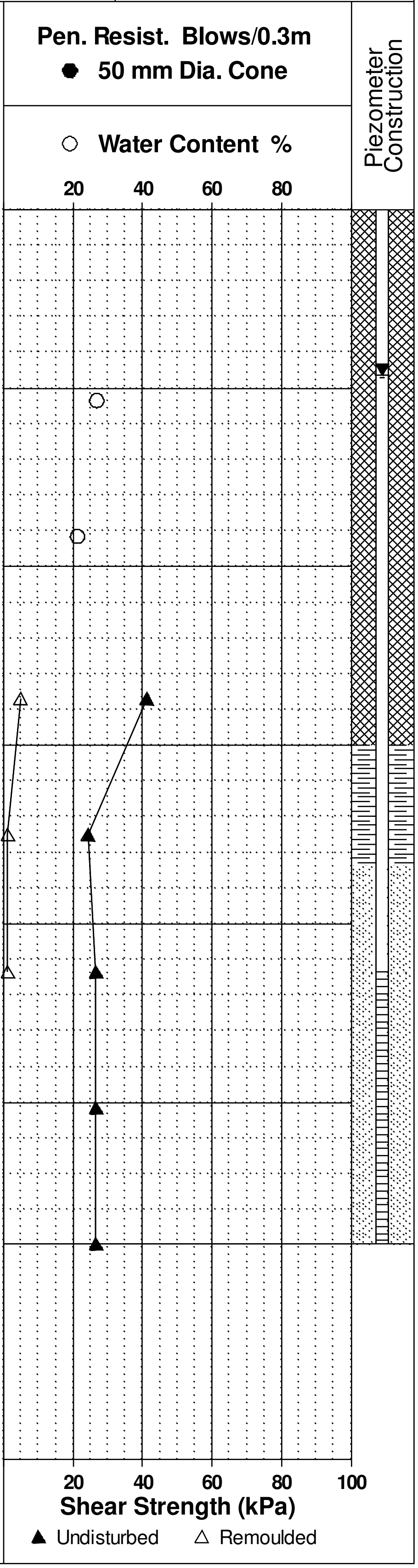
DATE January 15, 2015

FILE NO. **PG3411**

HOLE NO. **BH 2-15**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.08				
Loose, brown **SILTY SAND,** some clay	SS	1	33	7
	SS	2	50	6
2.13				
Firm, grey **SILTY CLAY**				
5.79				
End of Borehole (GWL @ 0.93m-Feb. 6, 2015)				

DEPTH (m)	ELEV. (m)
0	95.68
1	94.68
2	93.68
3	92.68
4	91.68
5	90.68



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Eagleson Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

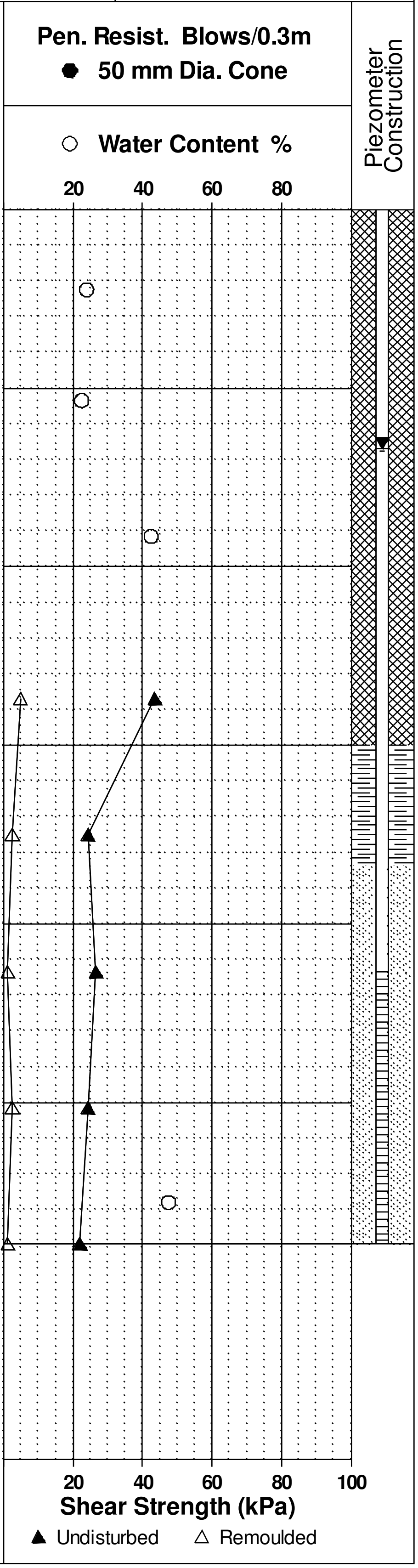
DATE January 15, 2015

FILE NO. PG3411

HOLE NO. BH 3-15

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.05				
Very loose, brown **SILTY SAND,** some clay		AU	1		
		SS	2	17	2
	1.75	SS	3	58	1
Firm to soft, brown **SILTY CLAY** - grey by 2.1m depth	5.79				
End of Borehole (GWL @ 1.34m-Feb. 6, 2015)					

DEPTH (m)	ELEV. (m)
0	96.04
1	95.04
2	94.04
3	93.04
4	92.04
5	91.04



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Eagleson Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG3411**

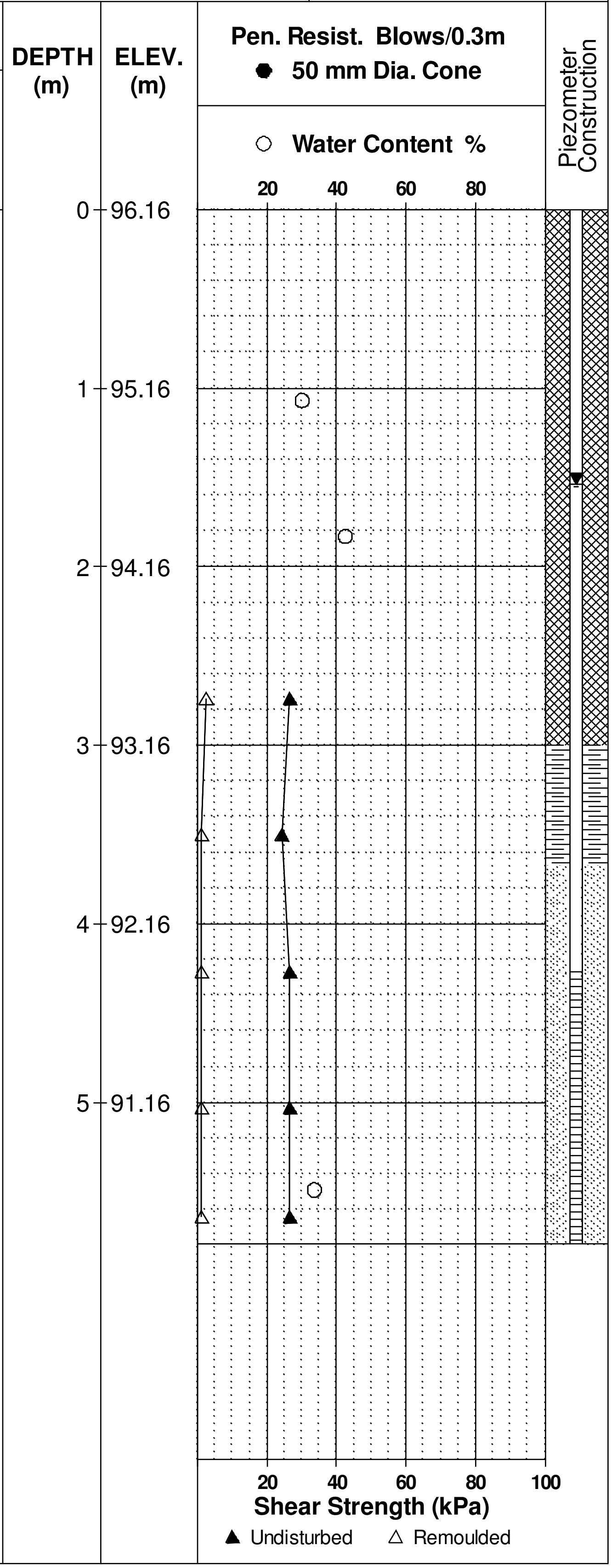
REMARKS

HOLE NO. **BH 4-15**

BORINGS BY CME 55 Power Auger

DATE January 15, 2015

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.10				
Very loose, brown **SANDY SILT**	0.76				
Very loose, brown **SILTY SAND**, trace clay	1.37	SS	1		3
Firm, grey **SILTY CLAY**		SS	2		W
	5.79				
End of Borehole (GWL @ 1.54m-Feb. 6, 2015)					



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

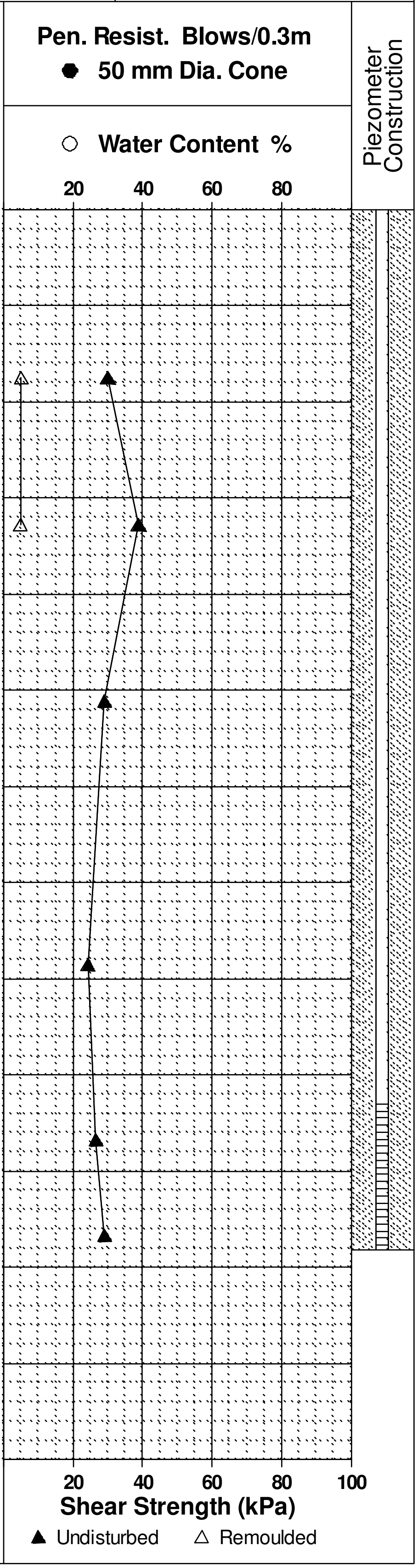
BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

FILE NO. PG0881

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	95.15
TOPSOIL 0.25							
Firm, brown **SILTY CLAY**, with sand seams - firm to soft and grey by 1.5m depth		SS	1	50	4	1	94.15
						2	93.15
		TW	1				
						3	92.15
		SS	2	100	1	4	91.15
						5	90.15
						6	89.15
		TW	2				
						7	88.15
						8	87.15
						9	86.15
						10	85.15
10.82							
Dynamic Cone Penetration Test commenced @ 10.82m depth. Cone pushed to 31.2m depth Inferred **SILTY CLAY**						11	84.15
						12	83.15
						13	82.15



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG0881**

REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

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 % 20 40 60 80	Piezometer Construction
Inferred **SILTY CLAY**	▨					13	82.15		
						14	81.15		
						15	80.15		
						16	79.15		
						17	78.15		
						18	77.15		
						19	76.15		
						20	75.15		
						21	74.15		
						22	73.15		
						23	72.15		
						24	71.15		
						25	70.15		
						26	69.15		

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

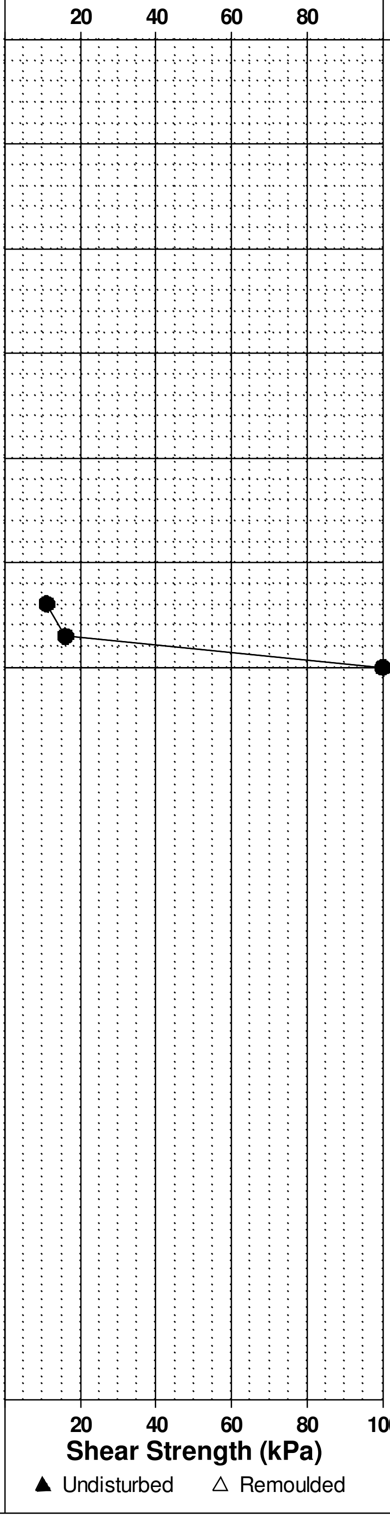
BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

FILE NO. PG0881

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
						26	69.15
						27	68.15
						28	67.15
Inferred **SILTY CLAY**	▨					29	66.15
						30	65.15
31.25						31	64.15
Inferred **GLACIAL TILL**							
32.00						32	63.15
End of Borehole DCPT refusal @ 32.00m depth (BH dry-Sept. 20/06)							



Piezometer Construction

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

FILE NO. PG0881

HOLE NO. BH 2

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.25

Firm, brown **SILTY CLAY**

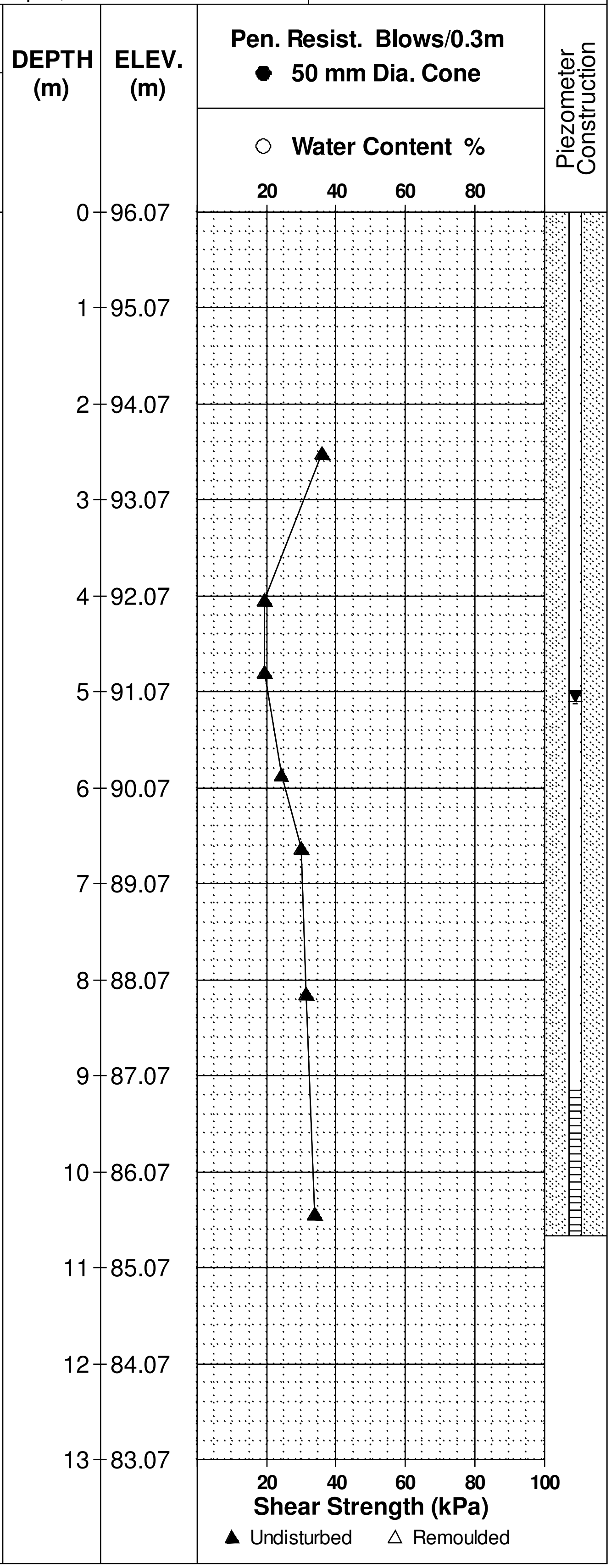
- firm to soft and grey by 1.2m depth

10.67

Dynamic Cone Penetration Test commenced @ 10.67m depth. Cone pushed to 31.8m depth

Inferred **SILTY CLAY**

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	0	4
TW	1		
SS	2	100	1
TW	2		



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG0881**

REMARKS

HOLE NO. **BH 2**

BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

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 % 20 40 60 80	Piezometer Construction
	▨					13	83.07		
	▨					14	82.07		
	▨					15	81.07		
	▨					16	80.07		
	▨					17	79.07		
	▨					18	78.07		
Inferred **SILTY CLAY**	▨					19	77.07		
	▨					20	76.07		
	▨					21	75.07		
	▨					22	74.07		
	▨					23	73.07		
	▨					24	72.07		
	▨					25	71.07		
						26	70.07		

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

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

FILE NO. PG0881

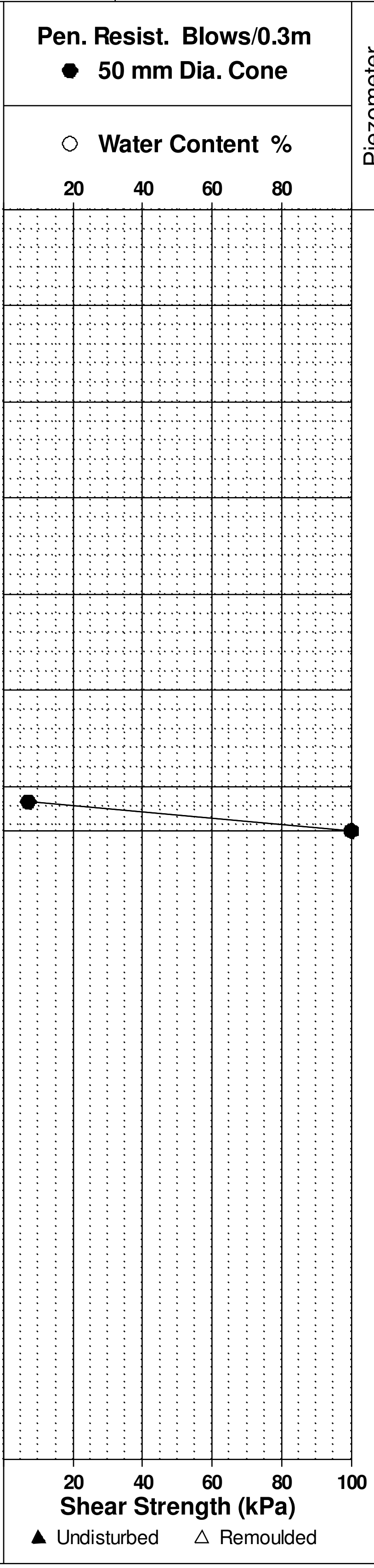
HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
						26	70.07
						27	69.07
						28	68.07
Inferred **SILTY CLAY**						29	67.07
						30	66.07
						31	65.07
31.80							
Inferred **GLACIAL TILL**						32	64.07
32.46							

End of Borehole

DCPT refusal @ 32.46m depth

(GWL @ 5.10m-Sept. 20/06)



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

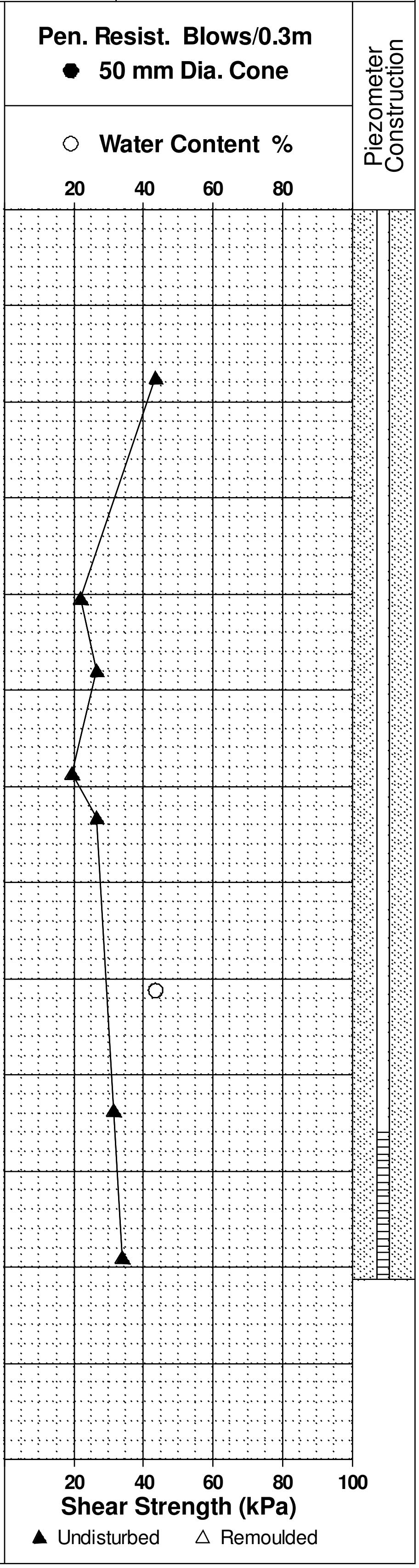
FILE NO. PG0881

HOLE NO. BH 3

SOIL DESCRIPTION	Depth of base (m)
GROUND SURFACE	
TOPSOIL	0.30
Loose, brown **SANDY SILT**, some clay	1.07
Firm, brown **SILTY CLAY** - soft and grey by 2.6m depth	11.13
Dynamic Cone Penetration Test commenced @ 11.13m depth. Cone pushed to 31.7m depth Inferred **SILTY CLAY**	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	38	7
SS	2	0	2
TW	1	33	
TW	2		

DEPTH (m)	ELEV. (m)
0	96.40
1	95.40
2	94.40
3	93.40
4	92.40
5	91.40
6	90.40
7	89.40
8	88.40
9	87.40
10	86.40
11	85.40
12	84.40
13	83.40



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0881

REMARKS

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** Sep 8, 06

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 % 20 40 60 80	Piezometer Construction
Inferred **SILTY CLAY**	▨					13	83.40		
						14	82.40		
						15	81.40		
						16	80.40		
						17	79.40		
						18	78.40		
						19	77.40		
						20	76.40		
						21	75.40		
						22	74.40		
						23	73.40		
						24	72.40		
						25	71.40		
						26	70.40		

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

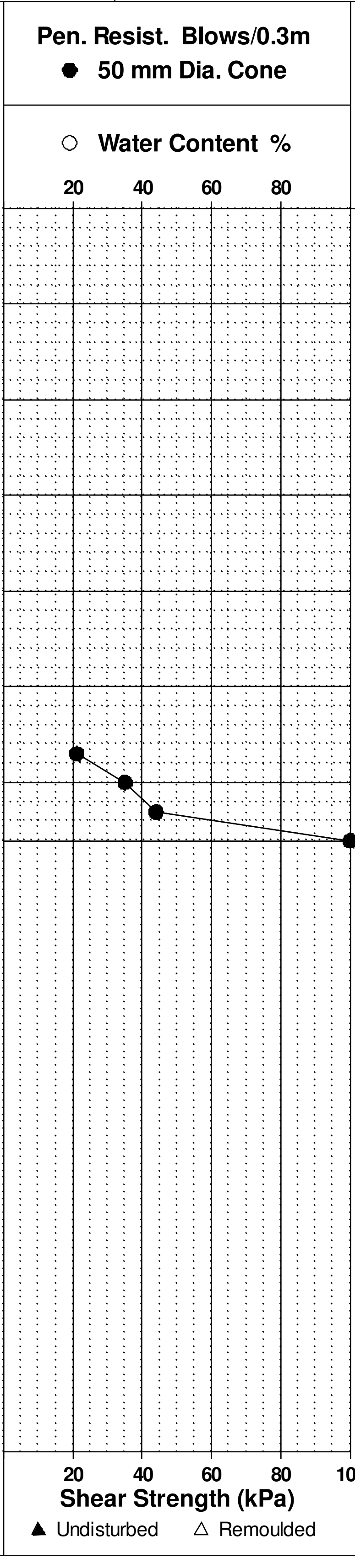
BORINGS BY CME 55 Power Auger

DATE Sep 8, 06

FILE NO. PG0881

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
						26	70.40
						27	69.40
						28	68.40
Inferred **SILTY CLAY**						29	67.40
						30	66.40
						31	65.40
31.80							
Inferred **GLACIAL TILL**						32	64.40
32.61							
End of Borehole DCPT refusal @ 32.61m depth (BH dry-Sept. 20/06)							



Piezometer Construction

SOIL PROFILE AND TEST DATA

**Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario**

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

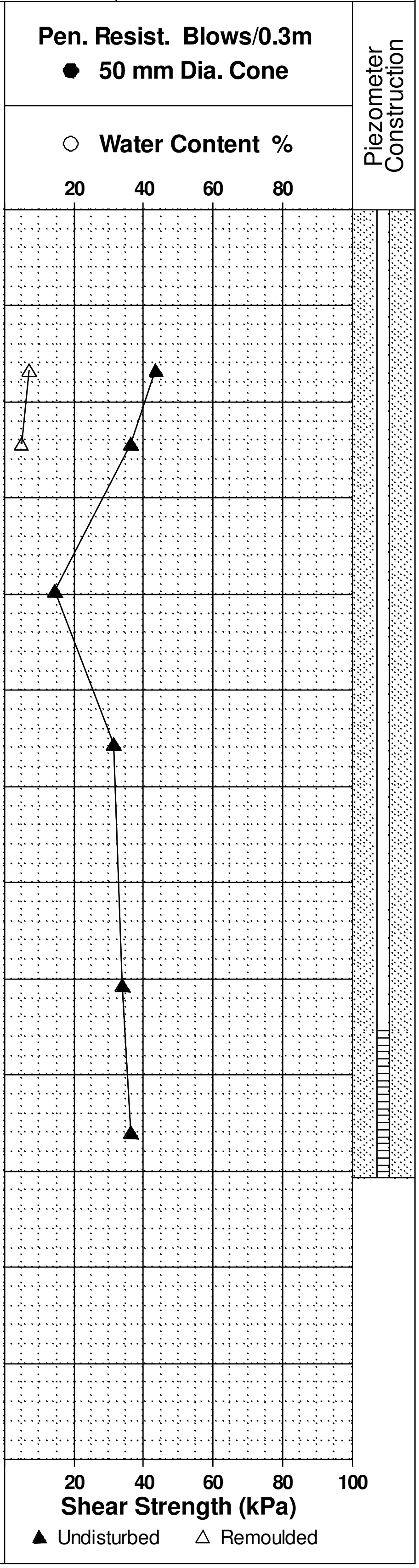
DATE Sep 11, 06

FILE NO. **PG0881**

HOLE NO. **BH 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.30					
Loose, brown **SANDY SILT**, trace clay 0.46		AU	1		
		SS	2	79	4
Firm, brown **SILTY CLAY** - soft and grey by 2.7m depth		TW	3	88	
		TW	4	100	
10.06 Dynamic Cone Penetration Test commenced @ 10.06m depth. Cone pushed to 33.2m depth Inferred **SILTY CLAY**					

DEPTH (m)	ELEV. (m)
0	95.85
1	94.85
2	93.85
3	92.85
4	91.85
5	90.85
6	89.85
7	88.85
8	87.85
9	86.85
10	85.85
11	84.85
12	83.85
13	82.85



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

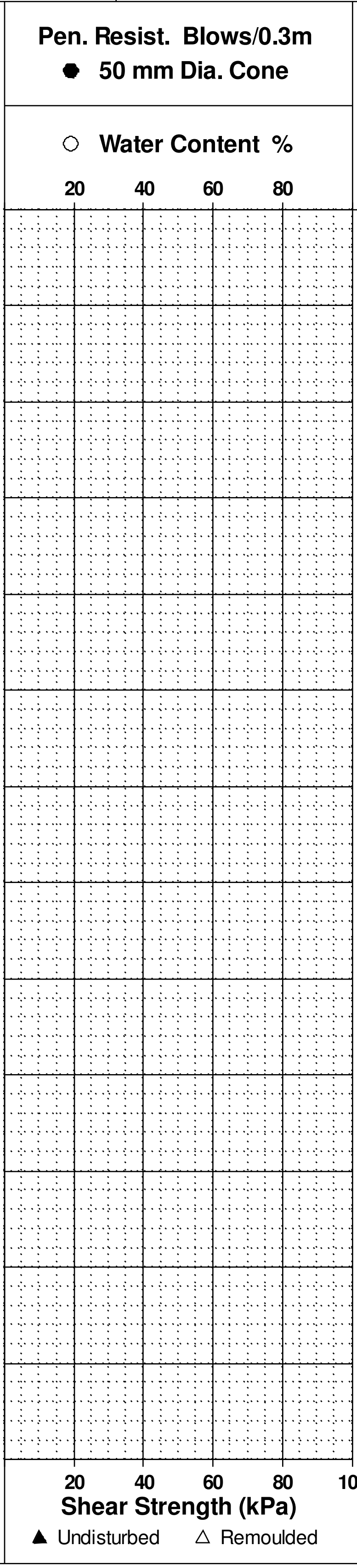
BORINGS BY CME 55 Power Auger

DATE Sep 11, 06

FILE NO. PG0881

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
	▨					13	82.85	
	▨					14	81.85	
	▨					15	80.85	
	▨					16	79.85	
	▨					17	78.85	
	▨					18	77.85	
Inferred **SILTY CLAY**	▨					19	76.85	
	▨					20	75.85	
	▨					21	74.85	
	▨					22	73.85	
	▨					23	72.85	
	▨					24	71.85	
	▨					25	70.85	
						26	69.85	



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 11, 06

FILE NO. PG0881

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
						26	69.85
						27	68.85
						28	67.85
Inferred **SILTY CLAY**						29	66.85
						30	65.85
						31	64.85
						32	63.85
						33	62.85
33.20							
Inferred **GLACIAL TILL**						34	61.85
34.44							

End of Borehole

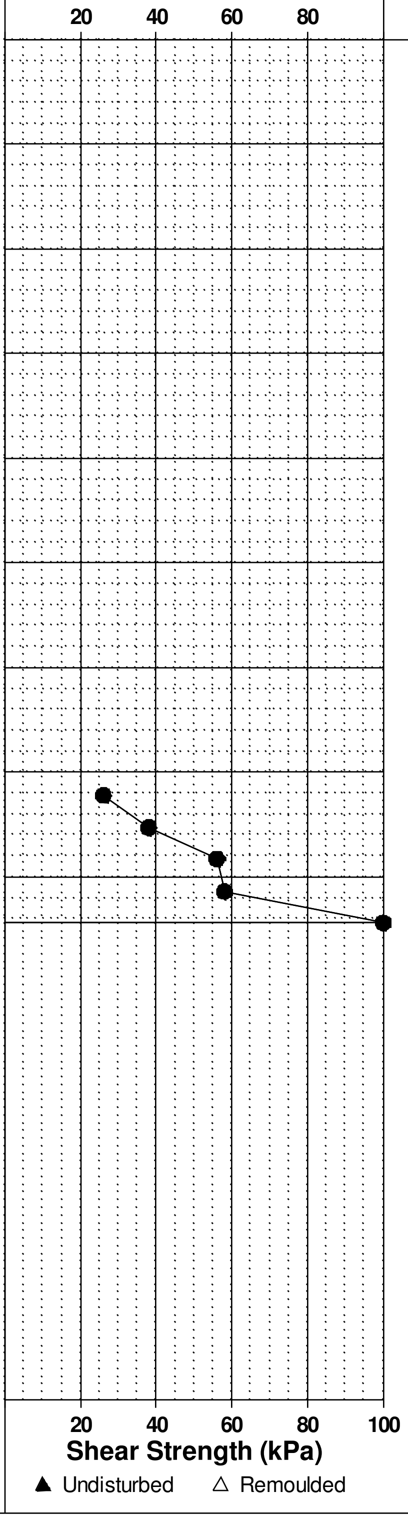
DCPT refusal @ 34.44m depth

(BH dry-Sept. 20/06)

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**

Piezometer Construction



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 12, 06

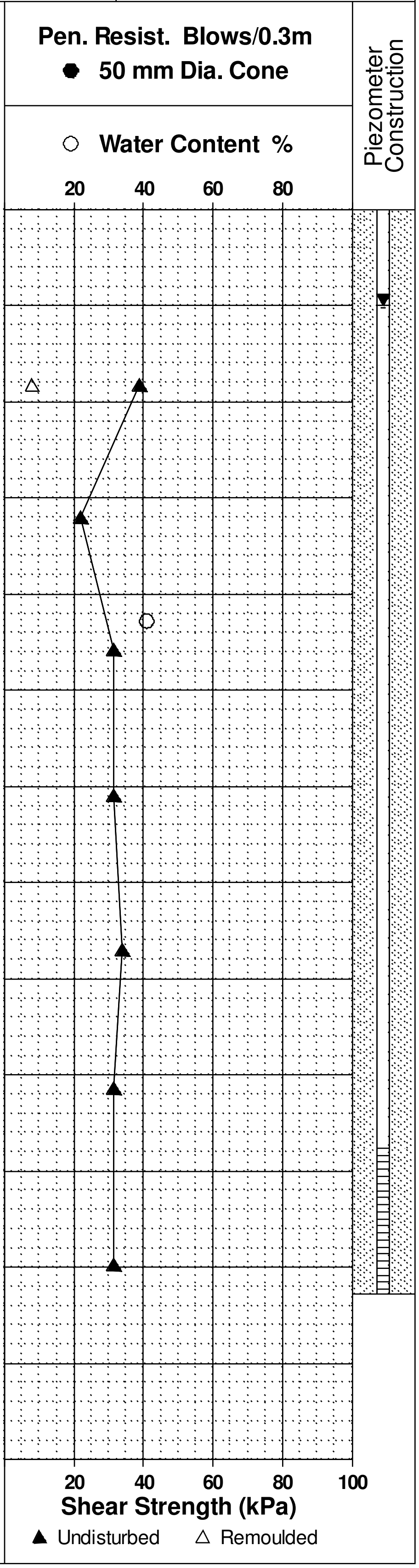
FILE NO. PG0881

HOLE NO. BH 5

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.33
Brown **SANDY SILT**, trace clay	0.46
Firm to soft, brown **SILTY CLAY** - grey by 2.7m depth	11.28
Dynamic Cone Penetration Test commenced @ 11.28m depth. Cone pushed to 33.5m depth Inferred **SILTY CLAY**	

SAMPLE			
TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	0	3
SS	3	100	1
TW	4	96	
TW	5	58	
TW	6	100	
TW	7	92	

DEPTH (m)	ELEV. (m)
0	96.29
1	95.29
2	94.29
3	93.29
4	92.29
5	91.29
6	90.29
7	89.29
8	88.29
9	87.29
10	86.29
11	85.29
12	84.29
13	83.29



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

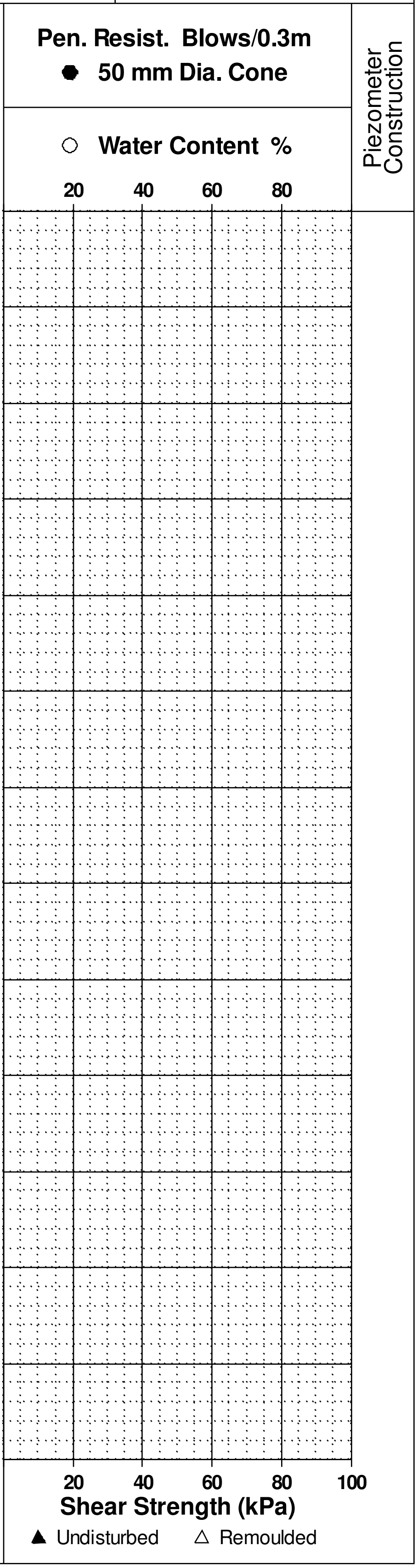
BORINGS BY CME 55 Power Auger

DATE Sep 12, 06

FILE NO. PG0881

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
Inferred **SILTY CLAY**	▨					13	83.29
						14	82.29
						15	81.29
						16	80.29
						17	79.29
						18	78.29
						19	77.29
						20	76.29
						21	75.29
						22	74.29
						23	73.29
						24	72.29
						25	71.29
						26	70.29



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE Sep 12, 06

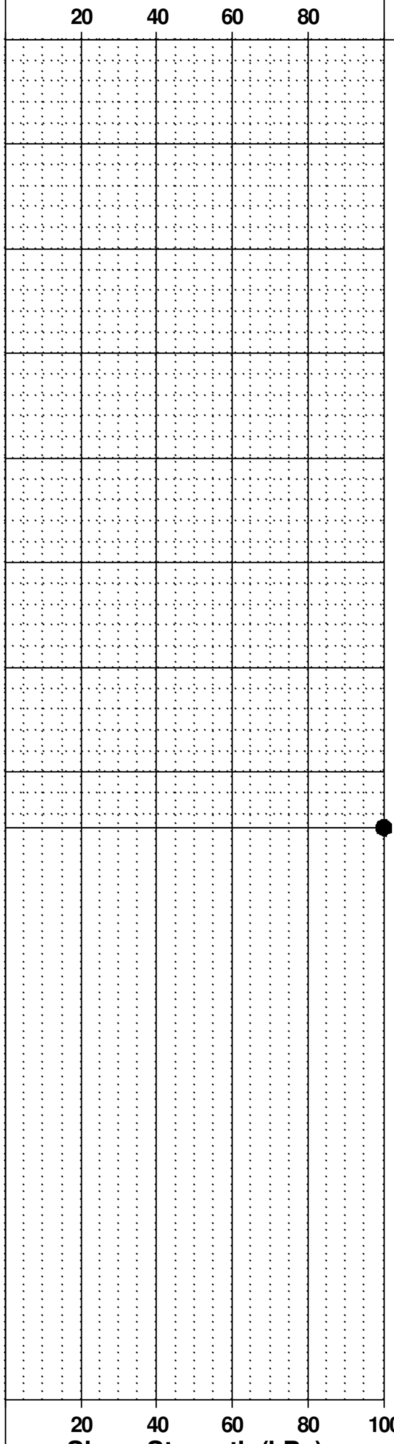
FILE NO. PG0881

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
	▨					26	70.29
	▨					27	69.29
	▨					28	68.29
Inferred **SILTY CLAY**	▨					29	67.29
	▨					30	66.29
	▨					31	65.29
	▨					32	64.29
	▨					33	63.29
33.53							
End of Borehole DCPT refusal @ 33.53m depth (GWL @ 1.00m-Sept. 20/06. BH drilled with water)							

Pen. Resist. Blows/0.3m
● **50 mm Dia. Cone**

○ **Water Content %**



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
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REMARKS

BORINGS BY CME 55 Power Auger

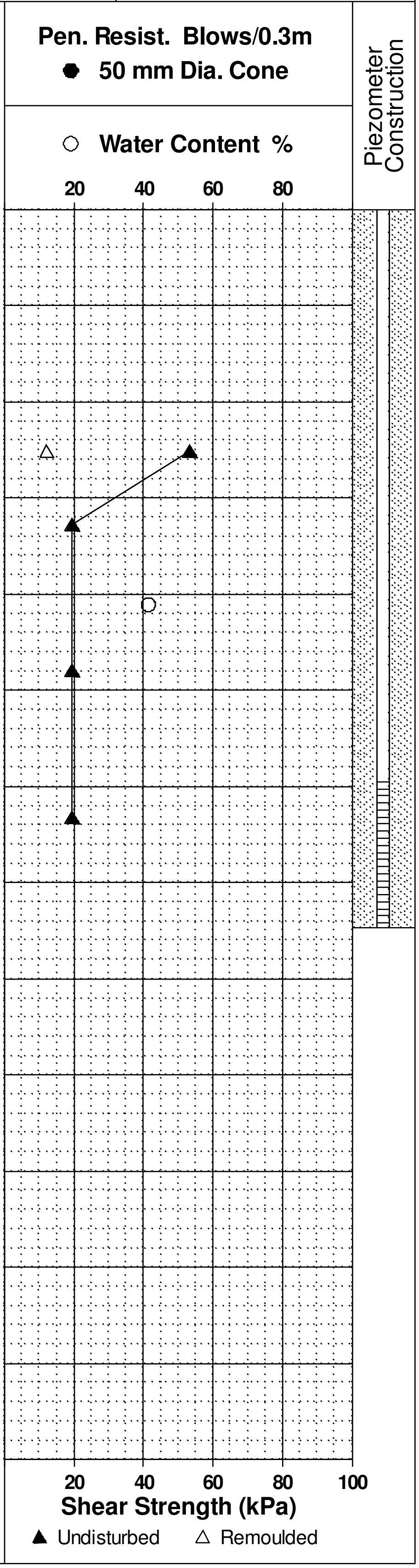
DATE Sep 11, 06

FILE NO. PG0881

HOLE NO. BH 6

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30				
Very loose, brown **SANDY SILT**, trace clay	0.91	AU	1		
		SS	1	58	3
Firm, brown **SILTY CLAY**		SS	2	21	2
- soft and grey by 2.9m depth					
		TW	3	100	
		TW	4		
		TW	5		
	9.14				
Dynamic Cone Penetration Test commenced @ 9.14m depth. Cone pushed to 35.3m depth					
Inferred **SILTY CLAY**					

DEPTH (m)	ELEV. (m)
0	95.72
1	94.72
2	93.72
3	92.72
4	91.72
5	90.72
6	89.72
7	88.72
8	87.72
9	86.72
10	85.72
11	84.72
12	83.72
13	82.72



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG0881**

REMARKS

HOLE NO. **BH 6**

BORINGS BY CME 55 Power Auger

DATE Sep 11, 06

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
Inferred **SILTY CLAY**	▨					13	82.72		
						14	81.72		
						15	80.72		
						16	79.72		
						17	78.72		
						18	77.72		
						19	76.72		
						20	75.72		
						21	74.72		
						22	73.72		
						23	72.72		
						24	71.72		
						25	70.72		
						26	69.72		

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Eagleson Road @ Terry Fox Drive Extension
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

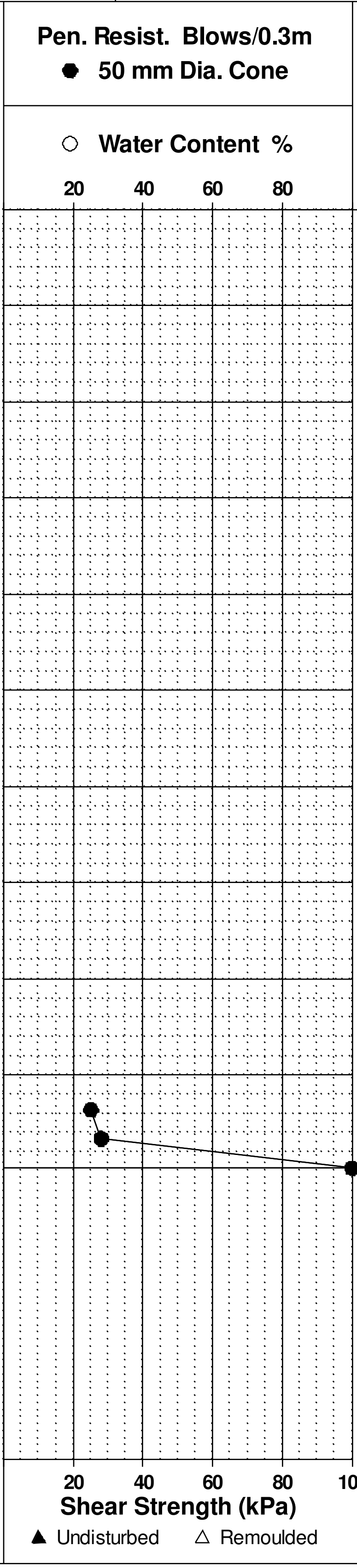
BORINGS BY CME 55 Power Auger

DATE Sep 11, 06

FILE NO. PG0881

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			
						26	69.72	
						27	68.72	
						28	67.72	
						29	66.72	
Inferred **SILTY CLAY**						30	65.72	
						31	64.72	
						32	63.72	
						33	62.72	
						34	61.72	
						35	60.72	
35.30								
Inferred **GLACIAL TILL**								
35.97								
End of Borehole DCPT refusal @ 35.97m depth (Standpipe blocked - Sept. 20/06)								



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)

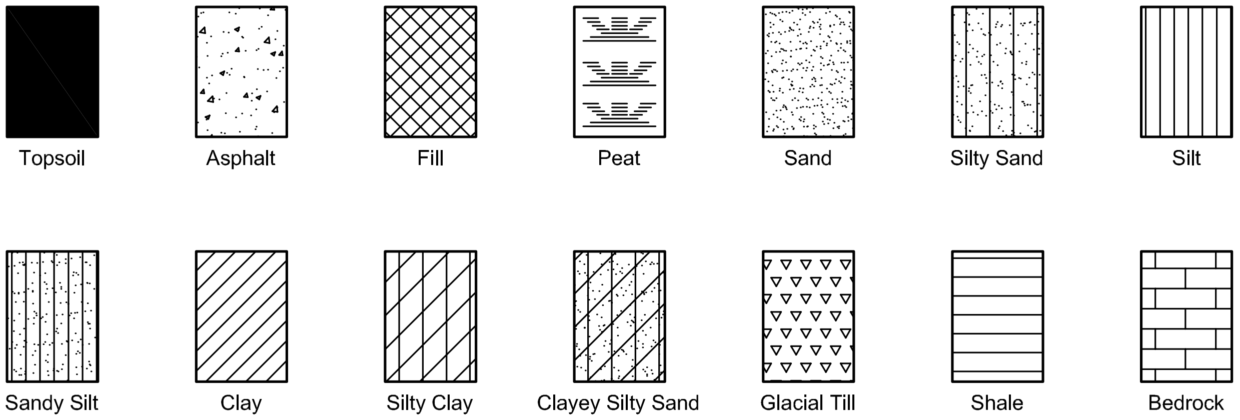
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

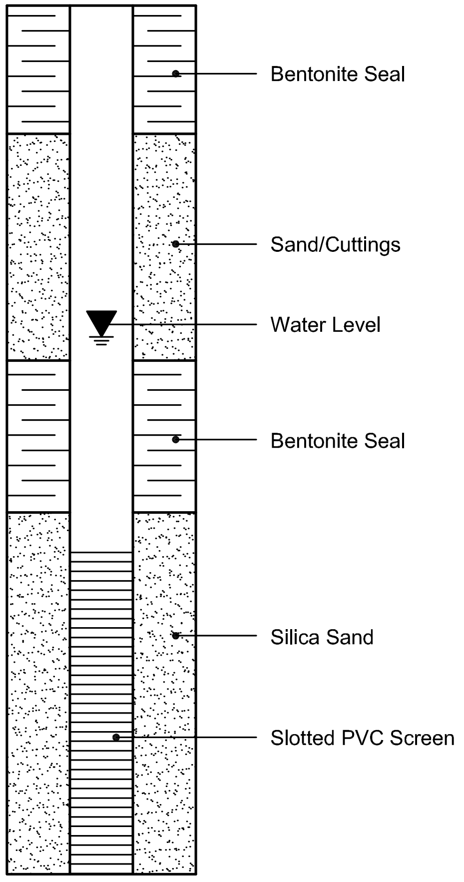
SYMBOLS AND TERMS (continued)

STRATA PLOT

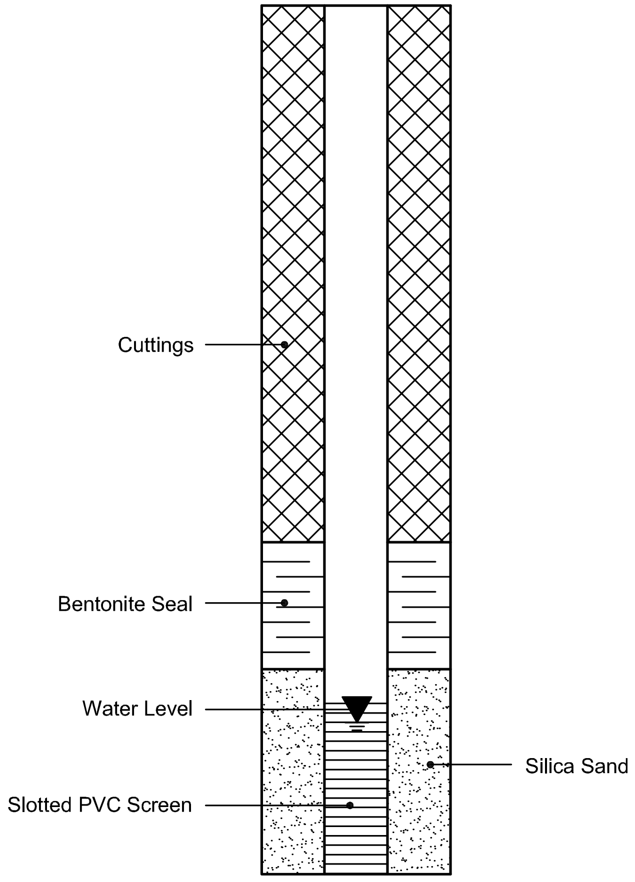


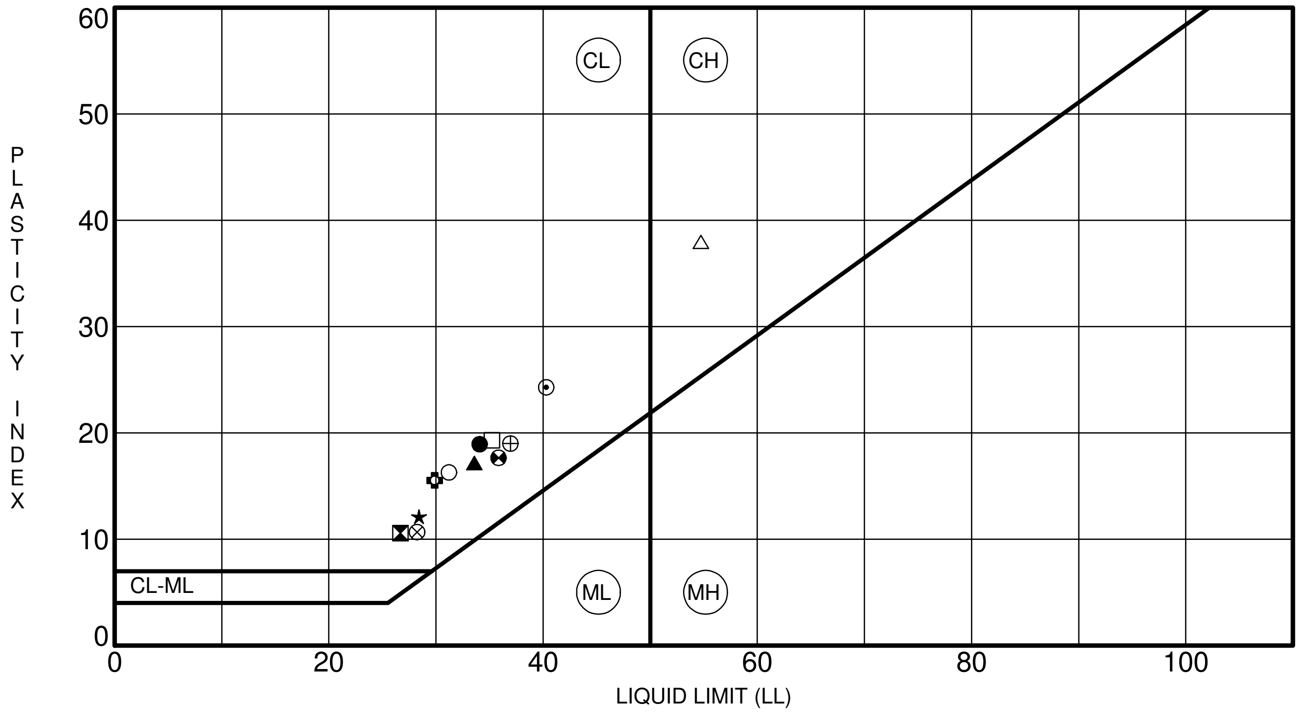
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 1-18**	**SS 4**	**34**	**15**	**19**		**CL - Inorganic clays of low plasticity**
⧗	**BH 2-18**	**SS 4**	**27**	**16**	**11**		**CL - Inorganic clays of low plasticity**
▲	**BH 3-18**	**SS 3**	**34**	**16**	**17**		**CL - Inorganic clays of low plasticity**
★	**TP 1-18**	**G 4**	**28**	**16**	**12**		**CL - Inorganic clays of low plasticity**
⊙	**TP 2-18**	**G 3**	**40**	**16**	**24**		**CL - Inorganic clays of low plasticity**
✿	**TP 3-18**	**G 4**	**30**	**14**	**16**		**CL - Inorganic clays of low plasticity**
○	**TP 4-18**	**G 3**	**31**	**15**	**16**		**CL - Inorganic clays of low plasticity**
△	**TP 5-18**	**G 4**	**55**	**17**	**38**		**CH - Inorganics clays of high plasticity**
⊗	**TP 7-18**	**G 3**	**28**	**18**	**11**		**CL - Inorganic clays of low plasticity**
⊕	**TP 8-18**	**G 2**	**37**	**18**	**19**		**CL - Inorganic clays of low plasticity**
□	**TP 9-18**	**G 3**	**35**	**16**	**19**		**CL - Inorganic clays of low plasticity**
☢	**TP10-18**	**G 2**	**36**	**18**	**18**		**CL - Inorganic clays of low plasticity**

CLIENT **First Capital Asset Management**

FILE NO. **PG3411**

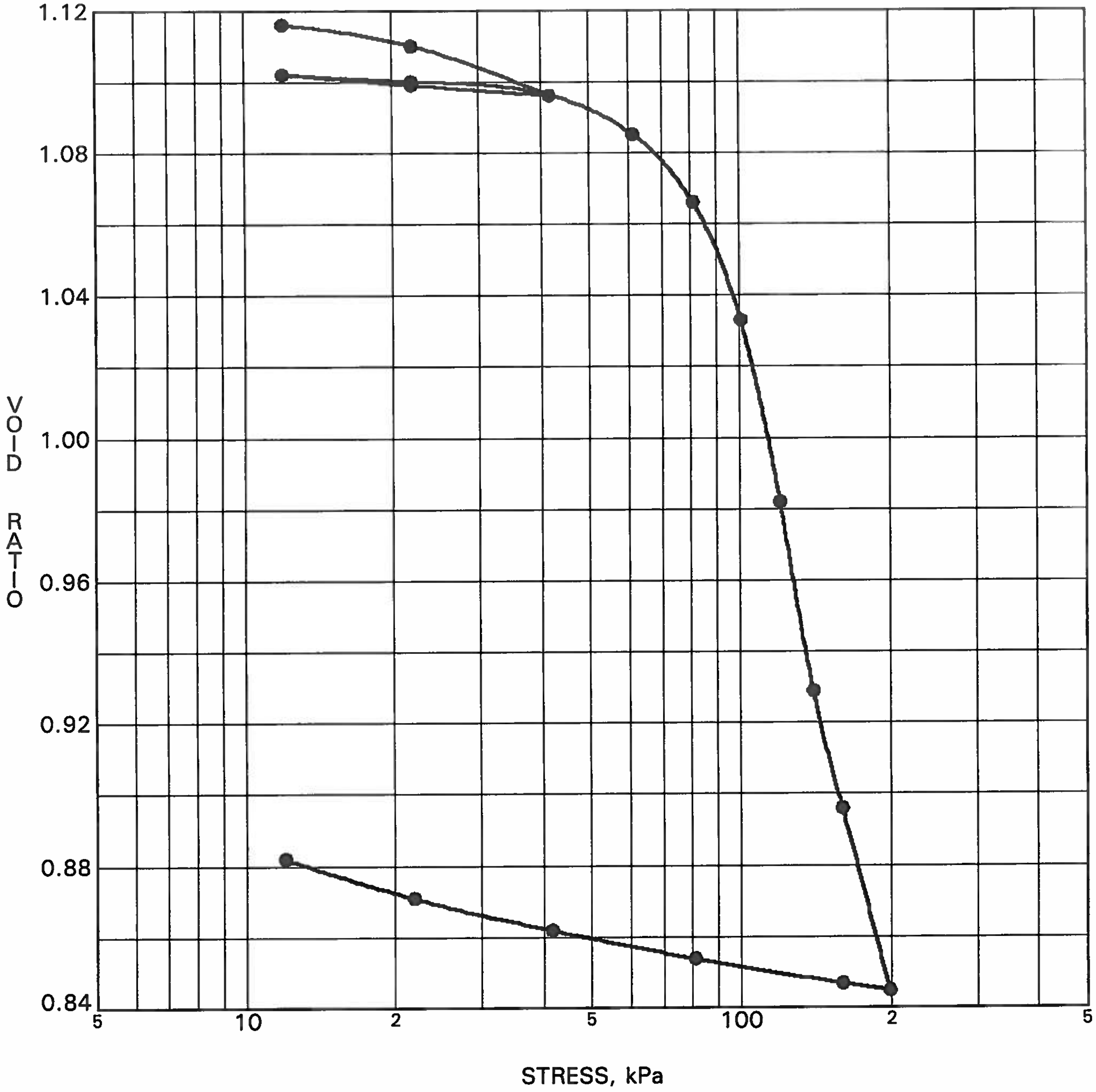
PROJECT **Geotechnical Investigation - Prop. Development - Eagleson Road at Terry Fox Drive**

DATE **9 Oct 18**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 5	p'o	61 kPa	Ccr	0.012
Sample No.	TW 4	p'c	87 kPa	Cc	0.706
Sample Depth	4.28 m	OC Ratio	1.4	Wo	40.9 %
Sample Elev.	92.01 m	Void Ratio	1.125	Unit Wt.	17.9 kN/m^3

CLIENT **Stantec Consulting Limited**

PROJECT **Preliminary Geotechnical Investigation -**
Eagleson Road @ Terry Fox Drive Extension

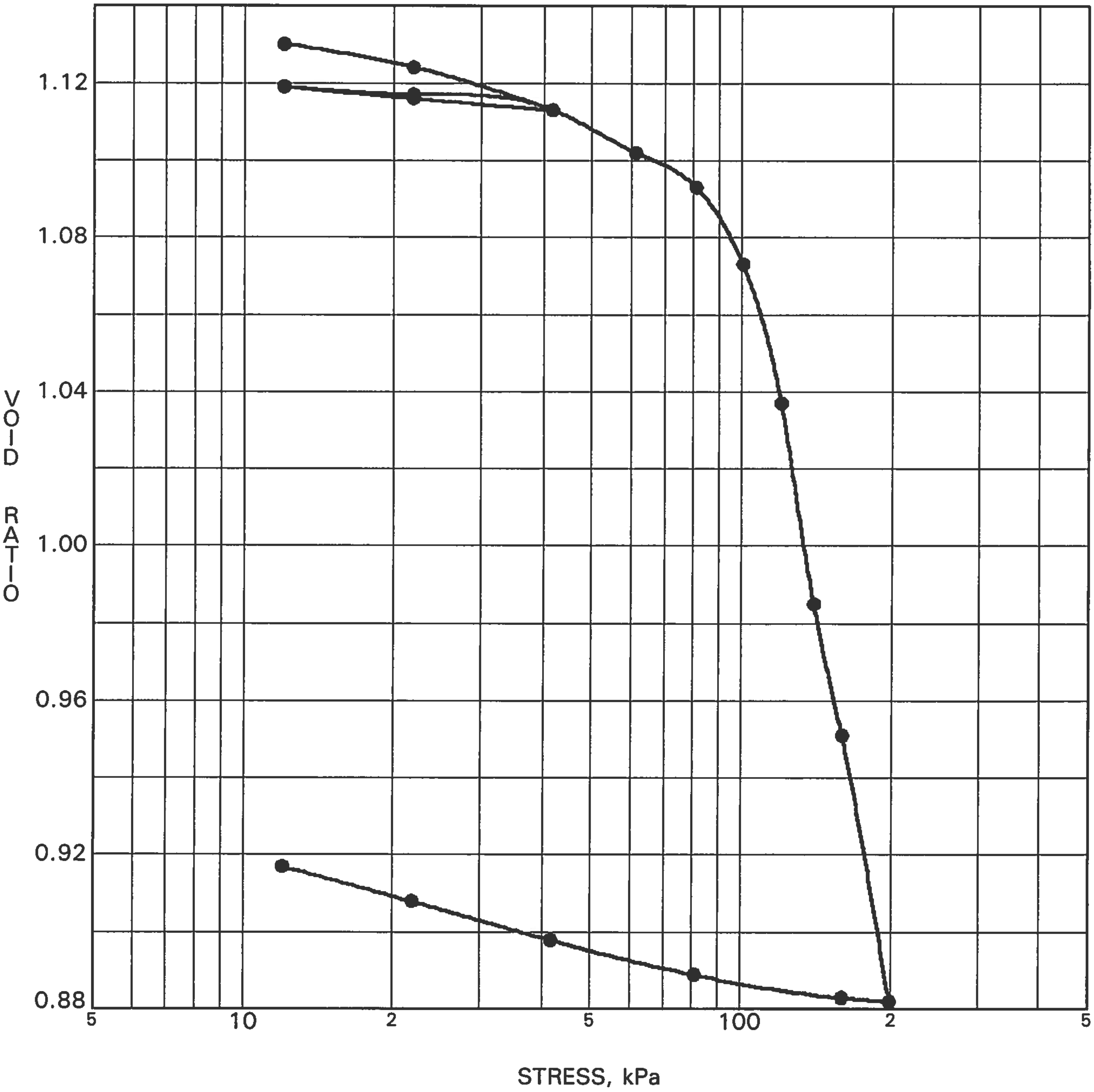
FILE NO. **PG0881**

DATE **18/09/06**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 6**	p′o	**57** kPa	Ccr	**0.012**
Sample No.	**TW 3**	p′c	**104** kPa	Cc	**0.696**
Sample Depth	**4.11** m	OC Ratio	**1.8**	Wo	**41.4** %
Sample Elev.	**91.61** m	Void Ratio	**1.138**	Unit Wt.	**17.7** kN/m^3

CLIENT **Stantec Consulting Limited**

PROJECT **Preliminary Geotechnical Investigation -**
Eagleson Road @ Terry Fox Drive Extension

FILE NO. **PG0881**

DATE **18/09/06**

patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

CONSOLIDATION TEST

Certificate of Analysis

Report Date: 18-Sep-2006
Order Date: 12-Sep-2006

Client: **Paterson Group Inc.**
Client PO: **4691**

Project: **PG0881**

Matrix: Soil

	Sample ID:	BH1 SS1	BH4 SS2
	Sample Date:	08/09/2006	11/09/2006
Parameter	MDL/Units	L7686.1	L7686.2
Chloride	5 ug/g	20	20
Sulphate	5 ug/g	25	70
pH	0.05 pH units	7.99	7.77
Resistivity	0.1 ohm.m	52	64

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG3411-2 - TEST HOLE LOCATION PLAN

DRAWING PG3411-3 - PERMISSIBLE GRADE RAISE AREAS - HOUSING

DRAWING PG3411-4 - PERMISSIBLE GRADE RAISE AREAS - ROADWAYS

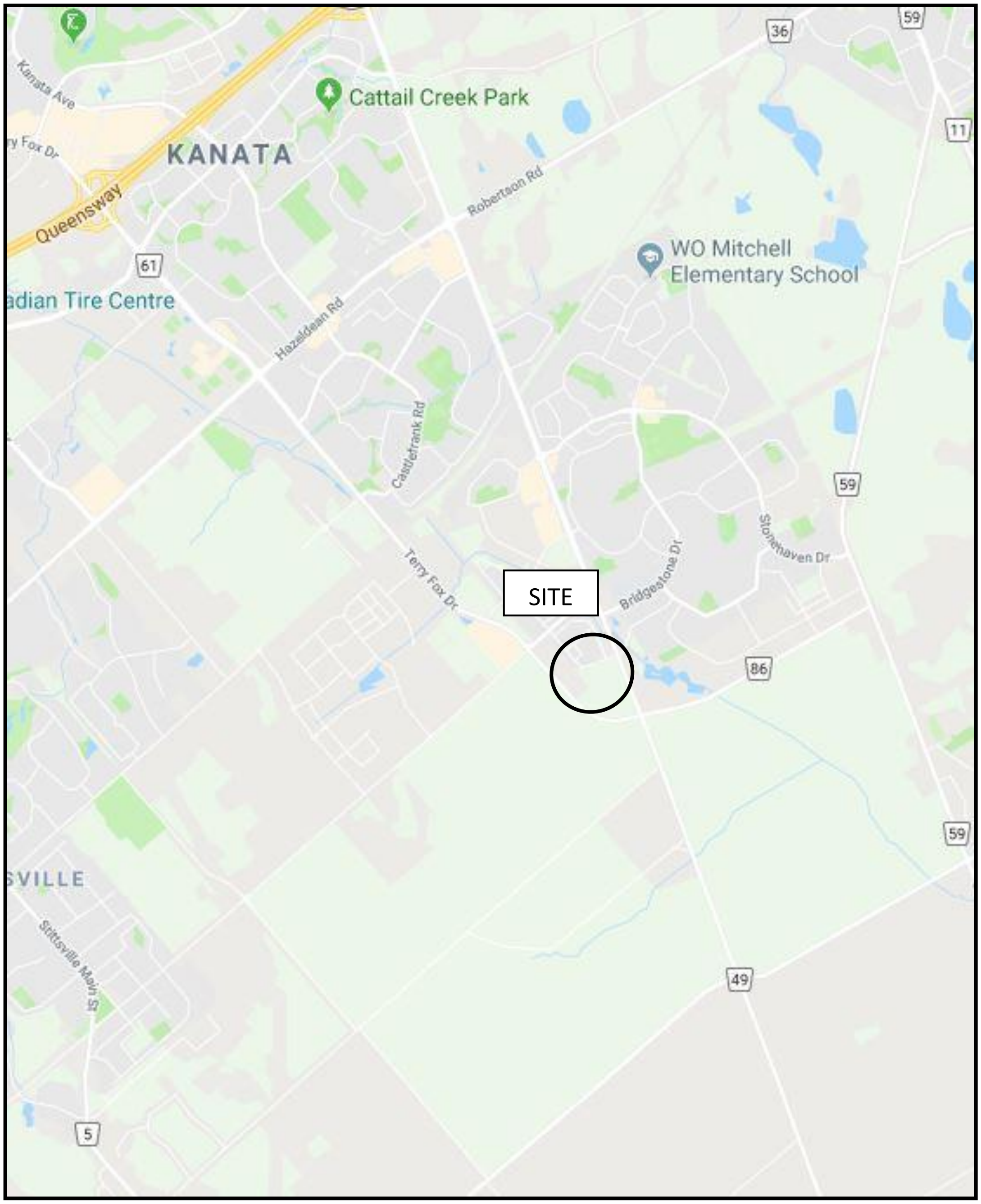
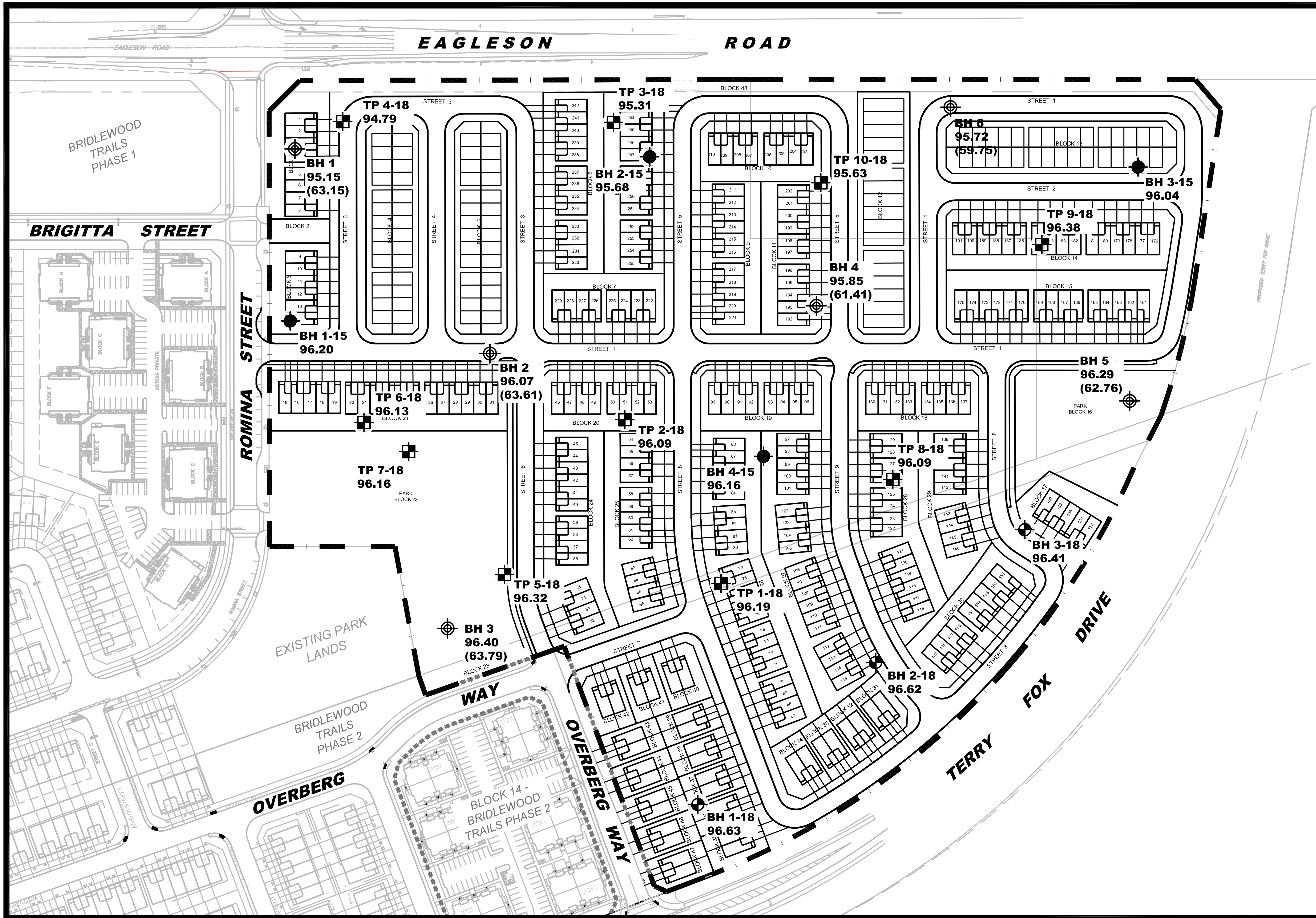


FIGURE 1

KEY PLAN



LEGEND:

⊕	BOREHOLE LOCATION, CURRENT INVESTIGATION
▣	TEST PIT LOCATION, CURRENT INVESTIGATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG3411, 2015
◎	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG0881, 2006
96.29	GROUND SURFACE ELEVATION (m)
(62.76)	PRACTICAL DCPT REFUSAL ELEV. (m)

TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

SCALE: 1:2000

0 25 50 75 100 125 150m

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
1	BASE PLAN UPDATED	09/01/2018	DJG

CLARIDGE HOMES
GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - EAGLESON ROAD AT TERRY FOX DRIVE
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:2000
Date: 10/2018
Drawn by: MPG
Report No.: PG3411-2
Checked by: FA
Dwg. No.: PG3411-2
Approved by: FA
Revision No.: 1

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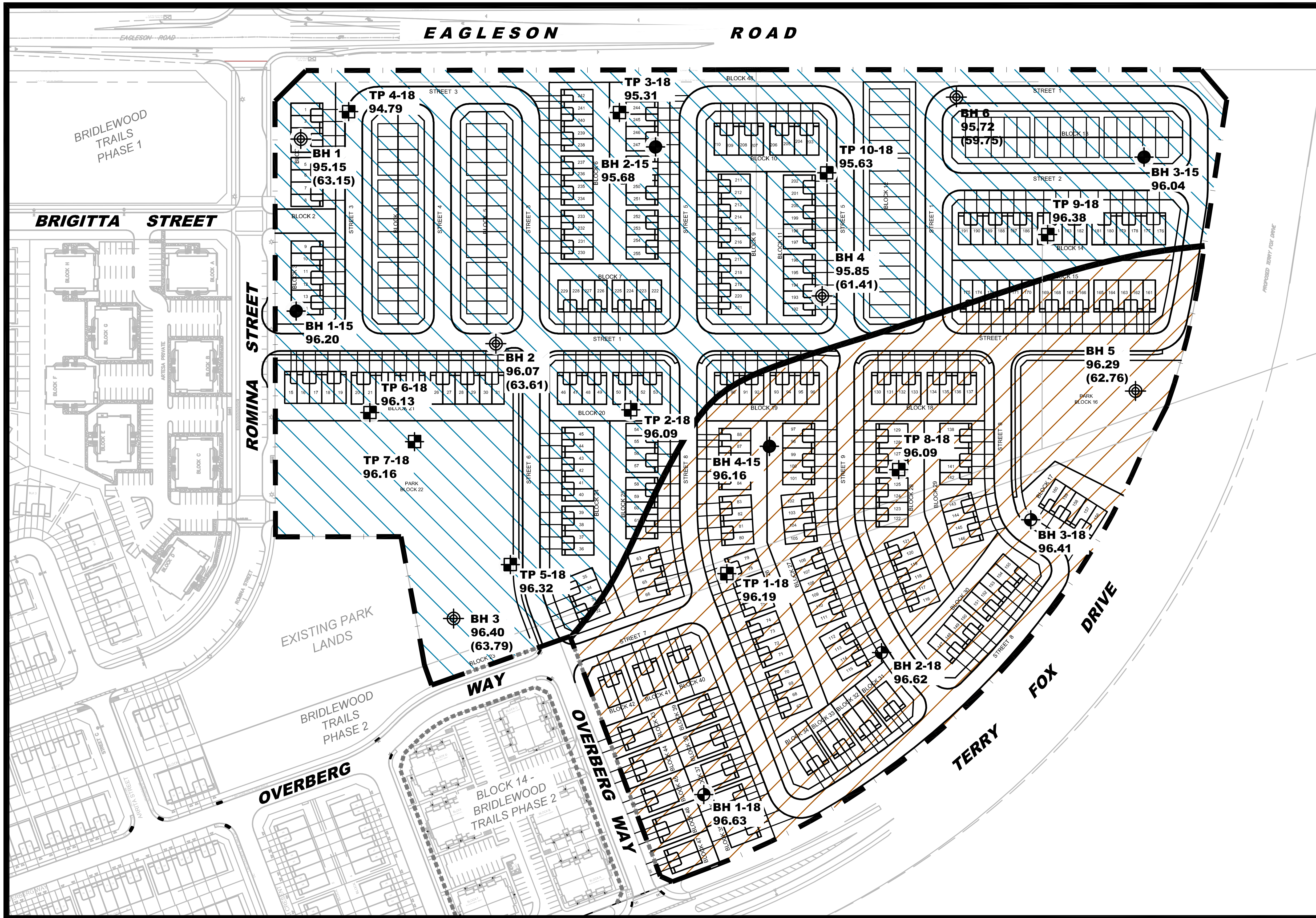

GRADE RAISE:

▨	UP TO 1.0m GRADE RAISE
▨	UP TO 1.2m GRADE RAISE

LEGEND:

⊕	BOREHOLE LOCATION, CURRENT INVESTIGATION
⊞	TEST PIT LOCATION, CURRENT INVESTIGATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG3411, 2015
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG0881, 2006
96.29	GROUND SURFACE ELEVATION (m)
(62.76)	PRACTICAL DCPT REFUSAL ELEV. (m)

TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

SCALE: 1:2000

0 25 50 75 100 125 150m

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consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL
1	BASE PLAN UPDATED	09/01/2018	DJG

CLARIDGE HOMES

GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - EAGLESON ROAD AT TERRY FOX DRIVE
OTTAWA, ONTARIO

Title:
PERMISSIBLE GRADE RAISE AREA - HOUSING

Scale: 1:2000	Date: 10/2018
Drawn by: MPG	Report No.: PG3411-2
Checked by: FA	Dwg. No.: PG3411-3
Approved by: FA	Revision No.: 0

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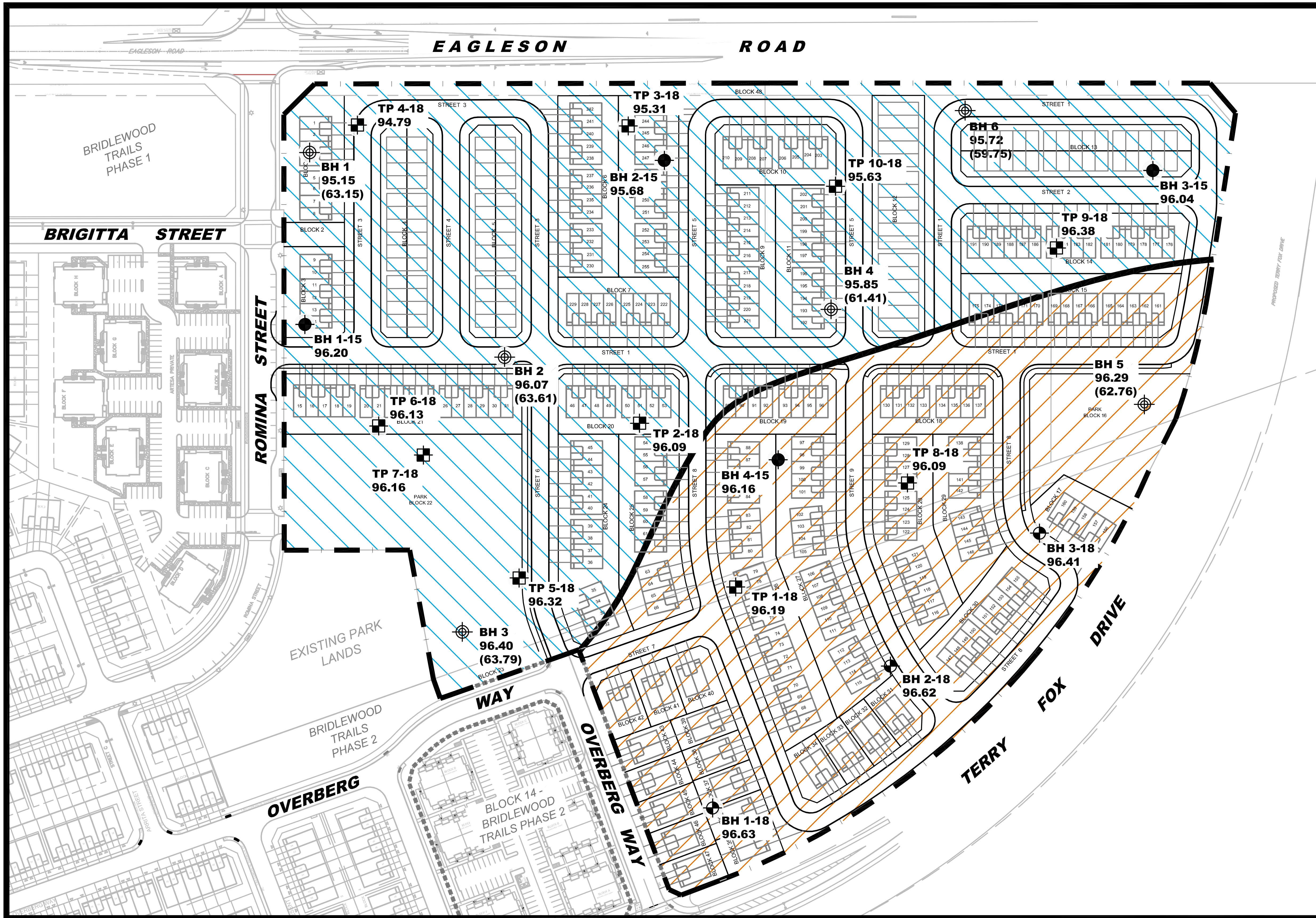

GRADE RAISE:

▨	UP TO 1.7m GRADE RAISE
▨	UP TO 1.9m GRADE RAISE

LEGEND:

⊕	BOREHOLE LOCATION, CURRENT INVESTIGATION
▣	TEST PIT LOCATION, CURRENT INVESTIGATION
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG3411, 2015
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION, PATERSON GROUP REPORT PG0881, 2006
96.29	GROUND SURFACE ELEVATION (m)
(62.76)	PRACTICAL DCPT REFUSAL ELEV. (m)

TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY STANTEC GEOMATICS LTD.

SCALE: 1:2000

0 25 50 75 100 125 150m

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GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - EAGLESON ROAD AT TERRY FOX DRIVE
OTTAWA, ONTARIO

Title:
PERMISSIBLE GRADE RAISE AREA - ROADWAYS

Scale: 1:2000
Date: 10/2018
Drawn by: MPG
Report No.: PG3411-2
Checked by: FA
Dwg. No.: PG3411-4
Approved by: FA
Revision No.: 0

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