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Geotechnical Investigation

Proposed Commercial Development - Phase 2
Trim Road at Watters Road - Ottawa

Prepared For

Taggart Realty Management

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Report: PG4655-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Taggart Realty Management (Taggart) to conduct a geotechnical investigation for Phase 2 of the proposed Crowne Point commercial development to be located at Trim Road and Watters Road, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

☐ determine the subsurface soil and groundwater conditions based on test hole information completed within the subject site.

☐ Provide geotechnical recommendations pertaining to 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. The report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

Investigating the presence or potential presence of contamination on the proposed development was not part of the scope of work. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

It is understood that Phase 2 of the development will consist of a series of commercial slab-on-grade buildings with associated parking areas, access lanes and landscaped areas. It is further anticipated that the development will be serviced by municipal services.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation was carried out between September 17 and 19, 2018. At that time, 16 boreholes were advanced to a maximum depth of 7.2 m below existing ground surface. The borehole locations were placed in a manner to provide general coverage of the subject site taking into consideration existing site features and underground utilities. A previous geotechnical investigation was completed by this firm in 2003 and consisted of seven (7) boreholes extending to a maximum depth of 6.1 m below existing ground surface. The locations of the boreholes are presented on Drawing PG4655-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were put down using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from our geotechnical department. The drilling procedures consisted of augering to the required depths at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler, using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler, or from the auger flights. The depths at which the auger, split spoon and Shelby tube samples were recovered from the test holes are shown as AU, SS and TW, 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.

Overburden thickness was evaluated during the course of the investigation by a dynamic cone penetration testing (DCPT) completed at BH 3-18. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the 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.

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

A 51 mm diameter PVC groundwater monitoring well was installed in BH 6-18, BH 13-18 and BH 15-18 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. The remaining boreholes were equipped with flexible standpipes. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data sheets presented in Appendix 1.

Monitoring Well Installation

Typical monitoring well construction details are described below:

- ☐ 1.5 to 3.0 m of slotted 51 mm diameter PVC screen at the base of the boreholes
- ☐ 51 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- ☐ No.3 silica sand backfill within annular space around screen.
- ☐ 300 mm thick bentonite hole plug directly above PVC slotted screen.
- ☐ Clean backfill from top of bentonite plug to the ground surface.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific well construction details.

Sample Storage

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

3.2 Field Survey

The test hole locations were selected and laid out in the field by Paterson personnel to provide general coverage of the proposed development. The location and ground surface elevation at each test hole location were provided by Stantec Geomatics. It is understood that the ground surface elevations were referenced to a geodetic datum. The borehole location and ground surface elevation at the borehole locations are presented in Drawing PG4655-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the field investigation were examined in our laboratory to review the results of the field logging.

Several laboratory tests were completed for the soil samples recovered across the subject site. The lab testing consisted of submitting three (3) Shelby tube samples for unidimensional consolidation testing, three (3) samples for Atterberg limit testing and three (3) samples for grain size distribution and hydrometer testing. The results of the Atterberg and hydrometer testing are presented on the Atterberg Limits' Results sheet and Grain Size Distribution sheets, respectively, in Appendix 1 and are further discussed in Subsection 4.2. The results of the consolidation testing are presented on the Unidimensional Consolidation Test Results sheets presented in Appendix 1 and are further discussed in Subsections 5.3. It should be noted that moisture content testing was also conducted on the soil samples in all borehole locations and are presented in the Soil Profile and Test Data Sheets in Appendix 1.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was 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 grass covered, relatively flat and at grade with the adjacent commercial development and surrounding roadways, however, the central portion of the site was noted to be low lying and slightly lower than the remainder of the site.

Based on historical aerial photos of the site, the north portion of the site was located within the former Trim Road alignment. The original pavement structure was noted to be removed once the Trim Road realignment was completed. Due to the relocation of Trim Road, underground services such as sanitary, watermain lines and other underground service alignments are expected to be running along the north portion of the site. Also, hydro lines were observed to be running across the subject site.

4.2 Subsurface Profile

Overburden

Generally, the soil conditions encountered at the test hole locations consist of topsoil and/or fill material comprised of brown to grey silty clay mixed with brown silty sand with varying amounts of gravel and cobbles. The above noted layers are underlain by a very stiff to stiff brown silty clay crust. A stiff to firm grey silty clay deposit was encountered below the above noted layers. It should be noted that a compact brown to grey silty sand was encountered at BH 7-18 between 2.7 and 4.6 m below existing ground surface. Practical refusal to DCPT was observed at a depth of 32.9 m at BH 3-18. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in this area mostly consists of limestone of the Bobcaygeon Formation with an overburden drift thickness of 15 to 50 m depth.

Unidimensional Consolidation Testing

A total of three (3) samples of silty clay were subjected to unidimensional consolidation (oedometer) testing. The test results are discussed in Subsection 5.3 and on the Consolidation Test sheets in Appendix 1. The consolidation test results indicate that the silty clay is overconsolidated with overconsolidation ratios (OCR) for the tested samples varying between 1.8 and 2.7. The OCR is the ratio of the preconsolidation pressure to the effective pressure at the sample depth.

Atterberg Testing Results

Three (3) silty clay samples were submitted for Atterberg Limit testing. The tested materials was classified as Inorganic Clays of High Plasticity (CH). The results are summarized in Table 1 and presented on the Atterberg Limits' Results sheet in Appendix 1.

Table 1 - Summary of Atterberg Limits Tests

Sample	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH 7-18 - SS 3	32	60	22	38	CH
BH 14-18 - SS 3	26	66	25	42	CH
BH 15-18 - SS 2	28	71	23	49	CH

Grain Size Distribution and Hydrometer Testing

Three (3) silty clay samples were submitted for grain size distribution and hydrometer testing. The tested material was classified as Silty Clay to Clayey Silt. The results are summarized in Table 2 and presented on the Grain Size Distribution sheets in Appendix 1.

Table 2 - Summary of Grain Size Distribution and Hydrometer Tests

Sample	Gravel (%)	Sand (%)	Fines Content	
			Silt (%)	Clay (%)
BH 5-18 - SS 2	0	7	45	48
BH 10-18 - SS 3	0	5.6	44.9	49.5
BH 12-18 - SS 3	0	7	58	35

4.3 Groundwater

Groundwater levels were measured in the monitoring wells and standpipes installed in the boreholes on October 11, 2018. It is important to note that groundwater readings at the piezometers can be influenced by water perched within the borehole backfill material, which can lead to higher than normal groundwater level readings. Long-term groundwater levels can also be estimated based on the moisture content testing results, observed colour and consistency of the recovered soil samples. Based on these observations, the **long-term groundwater table** can be expected at approximately **3 to 4 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 adequate for a proposed commercial development. It is expected that the proposed commercial buildings will be founded by conventional shallow footings placed on an undisturbed, very stiff to stiff clay bearing surface or engineered fill placed over an approved bearing surface..

It is recommended that footings for the proposed buildings be placed over an undisturbed, stiff silty clay bearing surface. Where existing fill is encountered below the proposed footings, it is recommended to sub-excavate the existing fill down to an undisturbed, very stiff to stiff silty clay layer and in-fill the excavated trench with engineered fill up to the footing level. A sand and gravel (pit run) fill can be used as backfill above footing level to underside of floor slab. The engineered fill should extend a minimum 200 mm horizontally beyond the proposed footing face and should consist of OPSS Granular A crushed stone or Granular B Type II. The engineered fill should be placed in 225 mm loose lifts and compacted to 98% of the material's SPMDD.

Consideration could be given to leaving the existing fill, free of significant amounts of deleterious materials, below the proposed building floor slab outside of the lateral support zone of the proposed footings. However, it is recommended that the existing fill be approved by the geotechnical consultant once the subgrade level is exposed. The approved existing fill material should be proof-rolled using suitable compaction equipment under dry conditions and reviewed by Paterson personnel. Areas deemed poor performing should be removed and replaced with engineered fill.

Due to the presence of the sensitive silty clay layer, the subject site will be subjected to a permissible grade raise restriction. If the grade raise restrictions are exceeded, several options are available, such as a preload/surcharge program or the placement of light weight fill below the proposed buildings.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing significant amounts of organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Consideration could be given to leaving the existing fill, free of significant amounts of deleterious materials, below the proposed buildings' floor slab outside of the lateral support zone of the proposed footings and within the proposed parking areas and access lanes. However, it is recommended that the existing fill be approved by the geotechnical consultant once the subgrade level is exposed. The approved existing fill material should be proof-rolled using suitable compaction equipment under dry conditions and reviewed by Paterson personnel. Poor performing areas should be removed and replaced with engineered 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. 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 building areas should be compacted to at least 98% of the 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. Site excavated, stiff brown silty clay under dry conditions and approved by the geotechnical consultant at the time of placement can be used to build up the subgrade level for areas to be paved. The stiff, brown silty clay should be placed in maximum 300 mm loose lifts and compacted to a minimum density of 95% of its 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.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, very stiff to stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above-noted bearing resistance value at ULS.

Sub-Excavation and Placement of Engineering Fill

Where existing fill is encountered below the proposed footings, it is recommended to sub-excavate the existing fill including a 1.5H:1V lateral support zone beyond the footing face down to an undisturbed, very stiff to stiff silty clay layer and in-fill the excavated trench with engineered fill. The engineered fill should extend horizontally a minimum 200 mm beyond the proposed footing face, covering the lateral support zone of the footing, and should consist of OPSS Granular A crushed stone or Granular B Type II. The engineered fill should be placed in 225 mm loose lifts and compacted to 98% of the material's SPMDD. It is also recommended that a woven geotextile liner such as Terrafix 360R or equivalent be placed over the native soil to minimize disturbance of the subgrade material during placement and compaction of the engineered fill.

Footings founded over engineered fill can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**.

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.

Settlement

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

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 the in-situ bearing medium soils 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.

Permissible Grade Raise Restrictions

Undrained shear strength testing was completed using a vane apparatus at each borehole location. In addition to the shear strength testing, undisturbed silty clay samples were collected using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler. The Shelby tube sample was sealed at both ends and transported to our laboratory for unidimensional consolidation testing.

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For buildings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Three (3) site specific consolidation tests were conducted. The results of the consolidation tests from our investigation is 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

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c	Q (*)
BH 3-18	TW 5	5.05	132	57	0.027	3.182	A
BH 6-18	TW 5	4.29	106	58	0.022	1.136	A
BH 14-18	TW 6	5.71	146	58	0.039	2.612	A

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed
** - p'_o calculated from native soil, not existing grade.

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 native surface and not existing grades and the long term groundwater level being at 0.5 m above 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.

Based on the consolidation testing results and undrained shear strength values, a permissible grade raise of **2 m** above existing ground surface is recommended for the grading within 6 m of the proposed building footprints. Finished grading beyond 5 m of the proposed building footprints are subject to a **2.5 m** grade raise restriction.

5.4 Design for Earthquakes

It is expected that the footings of the proposed commercial buildings will be founded over an undisturbed, silty clay bearing surface. Due to the thickness of the silty clay layer observed across the subject site, a seismic site response **Class D** is applicable for design purposes according to the OBC 2012. The soils underlying the site are not susceptible to liquefaction.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, undisturbed native soil surface or approved existing fill as per Subsection 5.2, will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II is recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of OPSS Granular A crushed stone for slab on grade construction. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

As a general guideline, the pavement structure shown in Table 4 and 5 can be used for car only parking areas, access lanes and heavy truck loading areas at this site, respectively.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas

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 fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 5 - Recommended Pavement Structure
Access Lanes and Heavy Truck Loading Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or fill	

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

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 Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable compaction 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 sub-drain inverts should be approximately 300 mm below subgrade level. 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

A perimeter foundation drainage system is recommended for proposed structures for areas where exterior sidewalks are present. The system should consist of a 150 mm diameter, geotextile-wrapped, 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 structures or at an elevation to allow positive drainage to nearby storm sewers. 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 Against Frost Action

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

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

Excavations will be mostly through fill and brown silty clay. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. 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.

The slope cross-sections recommended above are for temporary slopes. 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.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

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 (in the trench direction) and should extend from trench wall to trench wall. 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 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

Due to the relatively impervious nature of the silty clay materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

Permit to Take Water

A temporary Ministry of the Environment, Conservation and Parks (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, 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.

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.

6.6 Winter Construction

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

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, 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.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a low corrosive environment.

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. The following tree setbacks are recommended for varying types of trees to be planted across the subject site:

- ❏ Shrubs and trees (max. mature height of 3 m) of low water demand with shallow root systems can be planted within 4.5 m of the foundation.
- ❏ Low water demand trees with a maximum mature height of 8 m can be placed between 4.51 to 6 m from the foundation
- ❏ Low water demand trees with a maximum mature height of 12 m can be placed between 6.01 to 7.5 m from the foundation
- ❏ Typical street trees with low to moderate water demand should be placed greater than 7.5 m from the foundation

It is well documented in the literature, and is our experience, that fast-growing trees located near buildings founded on cohesive soils that shrink on drying can result in long-term differential settlements of the structures. Tree varieties that have the most pronounced effect on foundations are seen to consist of poplars, willows and some maples (i.e. Manitoba Maples) and, as such, they should not be considered in the landscaping design.

7.0 Recommendations

It is recommended that the following be completed:

☐ Review detailed grading plan(s) from a geotechnical perspective, once available.

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

☐ 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 placing backfilling materials.

☐ Field density tests to ensure that the specified level of compaction has been 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 Paterson’s recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the 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 Taggart Realty Management Inc. or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Faisal Abou-Seido, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Oct 17, 2018
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

Report Distribution:

☐ Taggart Realty (3 copies)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEET

SYMBOLS AND TERMS

UNIDIMENSIONAL CONSOLIDATION TEST SHEETS

ATTERBERG LIMITS' RESULTS

GRAIN SIZE DISTRIBUTION AND HYDROMETER TEST RESULTS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

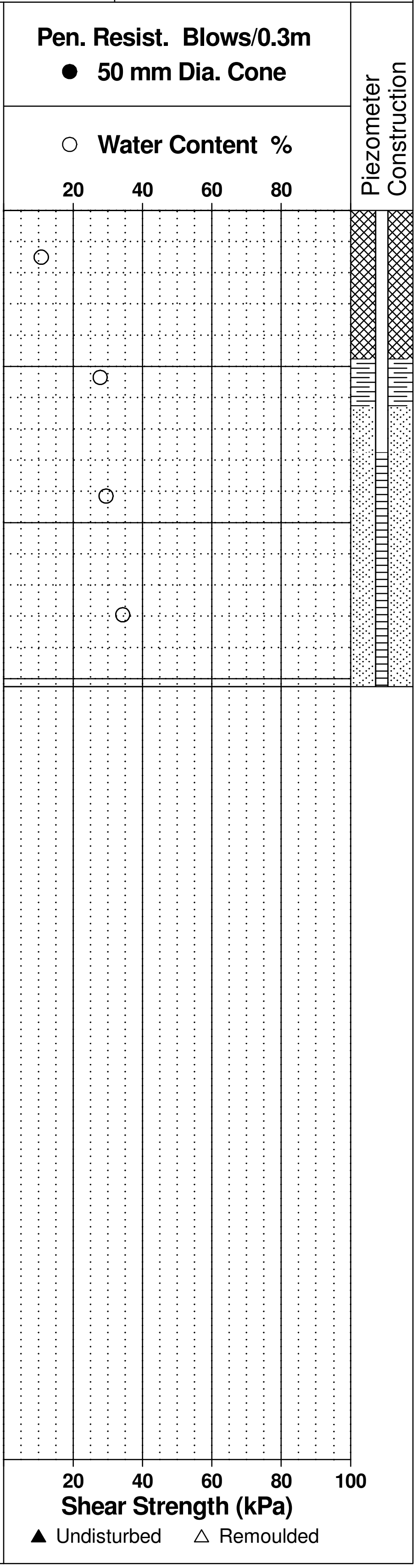
BORINGS BY CME 55 Power Auger

DATE September 17, 2018

FILE NO. PG4655

HOLE NO. BH 1-18

SOIL DESCRIPTION		TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.77
TOPSOIL	0.08						
FILL: Brown silty sand, some gravel, cobbles, organics		SS	1	33	32		
	0.76						
Very stiff, brown **SILTY CLAY**		SS	2	50	13	1	86.77
		SS	3	71	14	2	85.77
		SS	4	79	11		
	3.05					3	84.77
End of Borehole (BH dry - Oct. 11, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

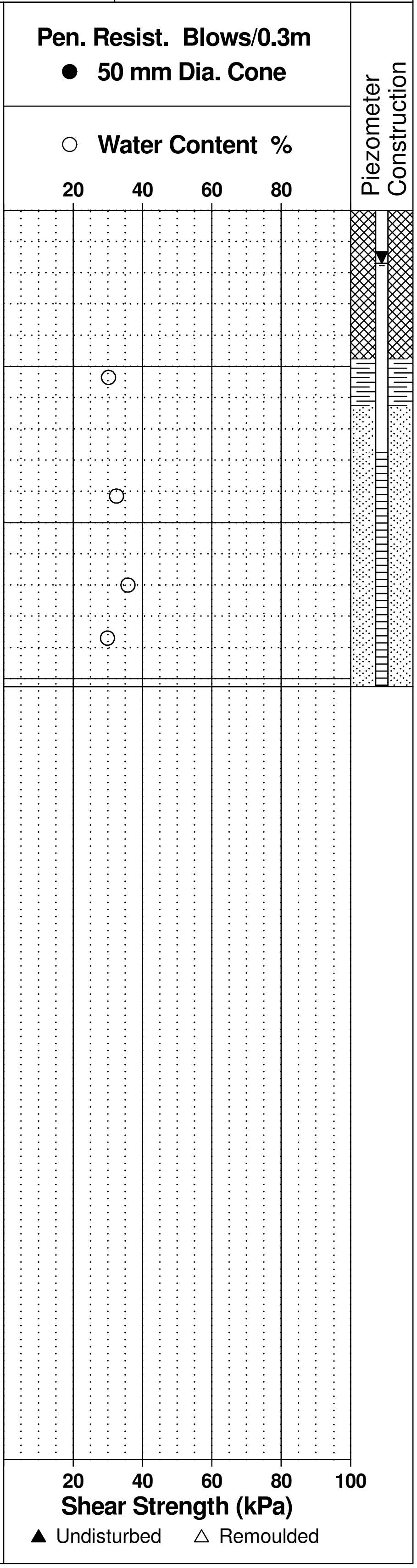
BORINGS BY CME 55 Power Auger

DATE September 17, 2018

FILE NO. PG4655

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							
TOPSOIL 0.10						0	87.52
FILL: Brown silty sand, some gravel, cobbles 0.60		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	42	12	1	86.52
		SS	3	75	12	2	85.52
- firm and grey by 2.7m depth 3.05		SS	4	58	6	3	84.52
End of Borehole							
(GWL @ 0.34m - Oct. 11, 2018)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 17, 2018

FILE NO. PG4655

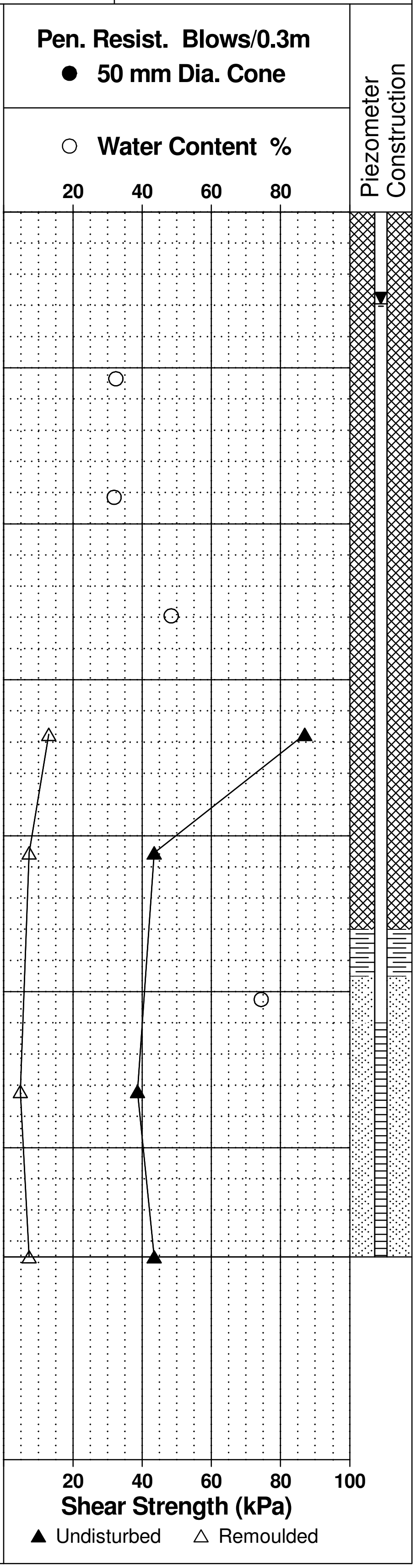
HOLE NO. BH 3-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Silty sand with organics 0.08				
FILL: Brown silty clay with gravel 0.76	AU	1		
Very stiff to stiff, brown **SILTY CLAY**	SS	2	62	12
	SS	3	88	12
	SS	4	92	5
- firm and grey by 3.8m depth	TW	5	75	
6.70				

DEPTH (m)	ELEV. (m)
0	87.16
1	86.16
2	85.16
3	84.16
4	83.16
5	82.16
6	81.16

Dynamic Cone Penetration Test (DCPT) commenced at 6.70m depth, cone pushed to 31.4m depth. Practical DCPT refusal at 32.89m depth.

(GWL @ 0.59m - Oct. 11, 2018)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4655**

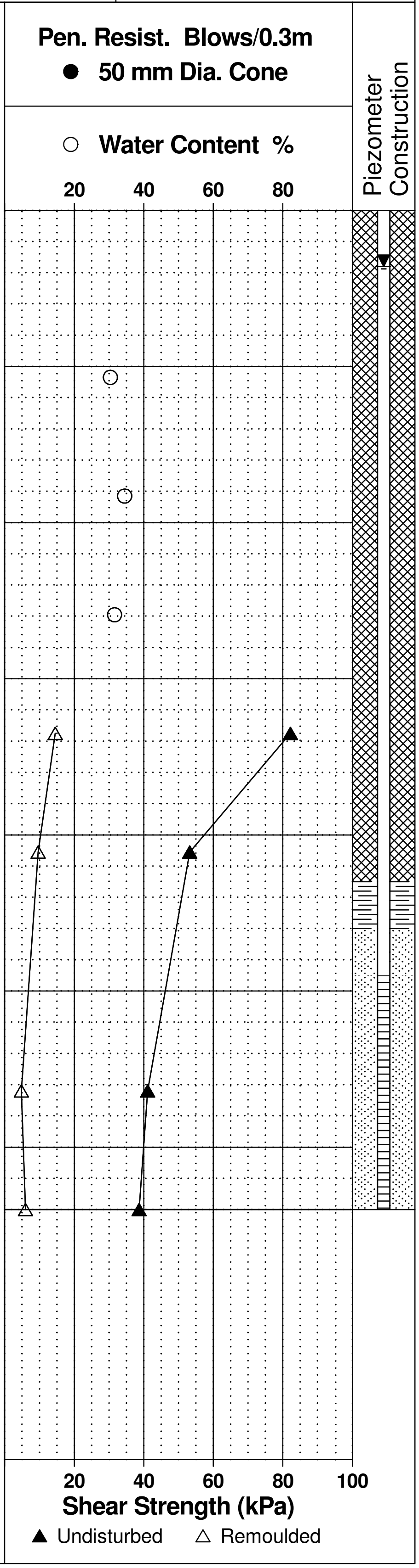
REMARKS

HOLE NO. **BH 4-18**

BORINGS BY CME 55 Power Auger

DATE September 17, 2018

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.05
TOPSOIL 0.08						
Brown **SILTY CLAY,** some organics, roots 0.60	AU	1				
	SS	2	67	12	1	86.05
	SS	3	88	11	2	85.05
Very stiff to stiff, brown **SILTY CLAY**	SS	4	96	5		
					3	84.05
- stiff to firm and grey by 3.8m depth					4	83.05
	TW	5	67		5	82.05
					6	81.05
6.40						
End of Borehole (GWL @ 0.36m - Oct. 11, 2018)						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

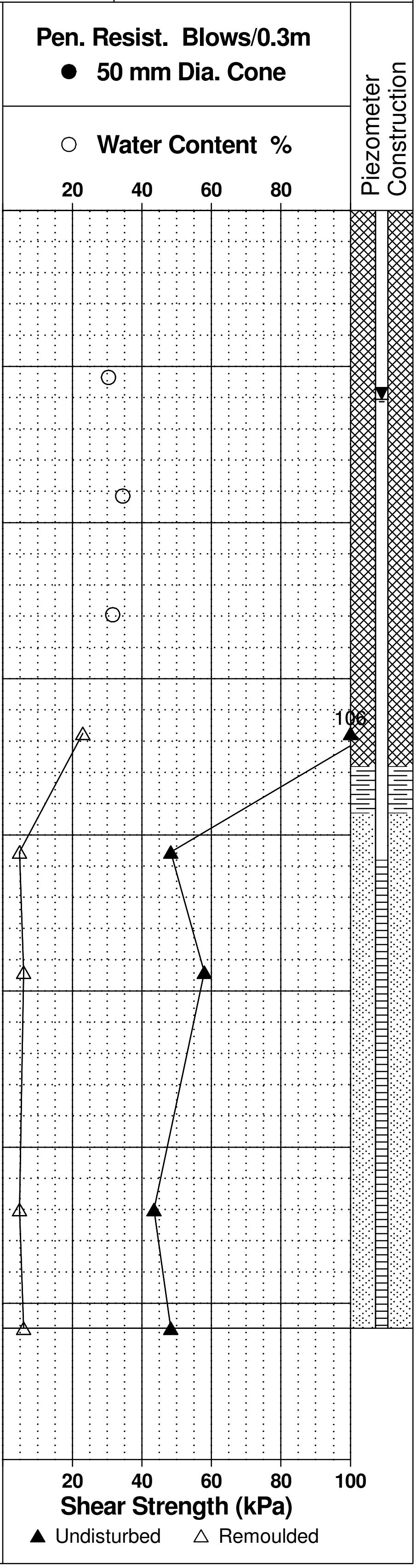
BORINGS BY CME 55 Power Auger

DATE September 17, 2018

FILE NO. PG4655

HOLE NO. BH 5-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.39
TOPSOIL 0.30	AU	1				
					1	86.39
	SS	2	50	13		
	SS	3	83	16		
					2	85.39
Very stiff to stiff, brown **SILTY CLAY**	SS	4	88	8		
					3	84.39
- firm and grey by 3.8m depth						
					4	83.39
					5	82.39
	TW	5	71			
					6	81.39
					7	80.39
7.16 End of Borehole						
(GWL @ 1.21m - Oct. 11, 2018)						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

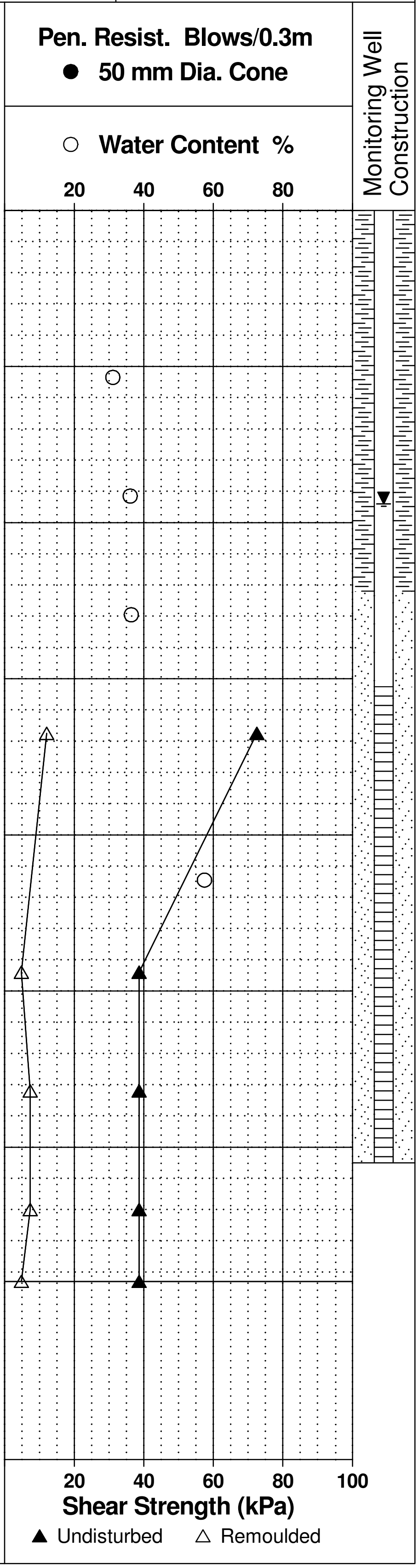
BORINGS BY CME 55 Power Auger

DATE September 18, 2018

FILE NO. PG4655

HOLE NO. BH 6-18

SOIL DESCRIPTION	SAMPLE				DEPTH (m)	ELEV. (m)
	TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE					0	87.23
FILL: Brown silty clay, some gravel, organics 0.30	AU	1				
					1	86.23
	SS	2	54	13		
	SS	3	88	11		
					2	85.23
Very stiff to stiff, brown **SILTY CLAY**	SS	4	100	6		
					3	84.23
- firm and grey by 3.8m depth						
					4	83.23
	TW	5	79			
					5	82.23
					6	81.23
6.86						
End of Borehole						
(GWL @ 1.88m - Oct. 11, 2018)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 18, 2018

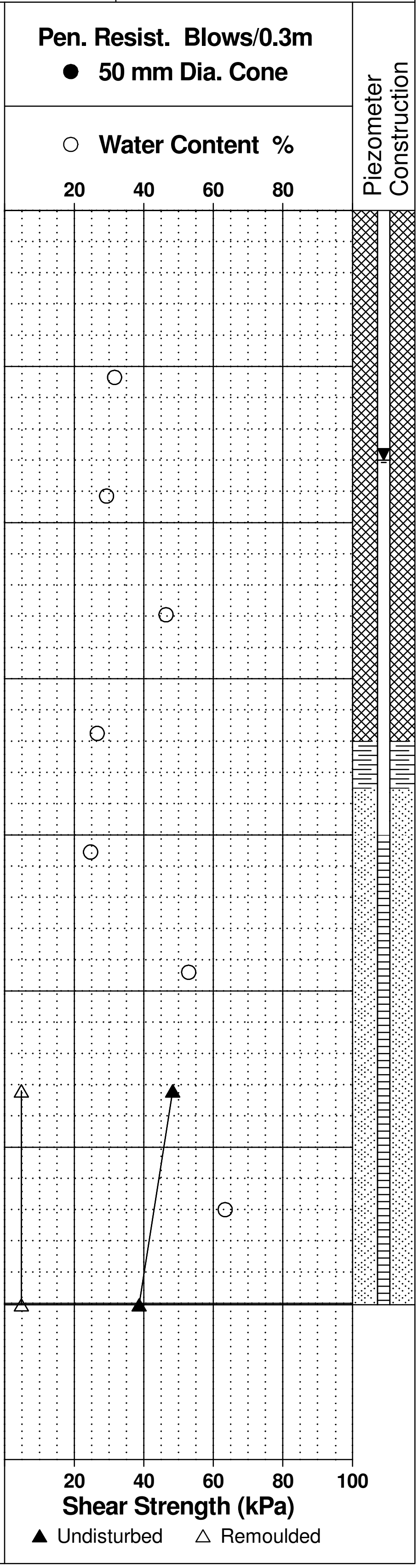
FILE NO. PG4655

HOLE NO. BH 7-18

SOIL DESCRIPTION	
GROUND SURFACE	
FILL: Brown silty sand, with clay, some gravel, trace organics	0.30
Very stiff, brown **SILTY CLAY,** some sand	2.74
Compact, brown **SILTY SAND,** trace shells - grey by 3.8m depth	4.57
Firm, grey **SILTY CLAY**	7.01
End of Borehole (GWL @ 1.60m - Oct. 11, 2018)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	42	13
SS	3	92	12
SS	4	79	11
SS	5	62	10
SS	6		
SS	7	100	W
SS	8		W

DEPTH (m)	ELEV. (m)
0	87.54
1	86.54
2	85.54
3	84.54
4	83.54
5	82.54
6	81.54
7	80.54



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE September 18, 2018

FILE NO. PG4655

HOLE NO. BH 8-18

SOIL DESCRIPTION

GROUND SURFACE

FILL: Brown silty sand, some gravel, crushed stone, trace clay 0.30

FILL: Grey silty clay, some topsoil, trace gravel, organics 1.83

Very stiff to stiff, brown **SILTY CLAY**

- stiff to firm and grey by 3.8m depth

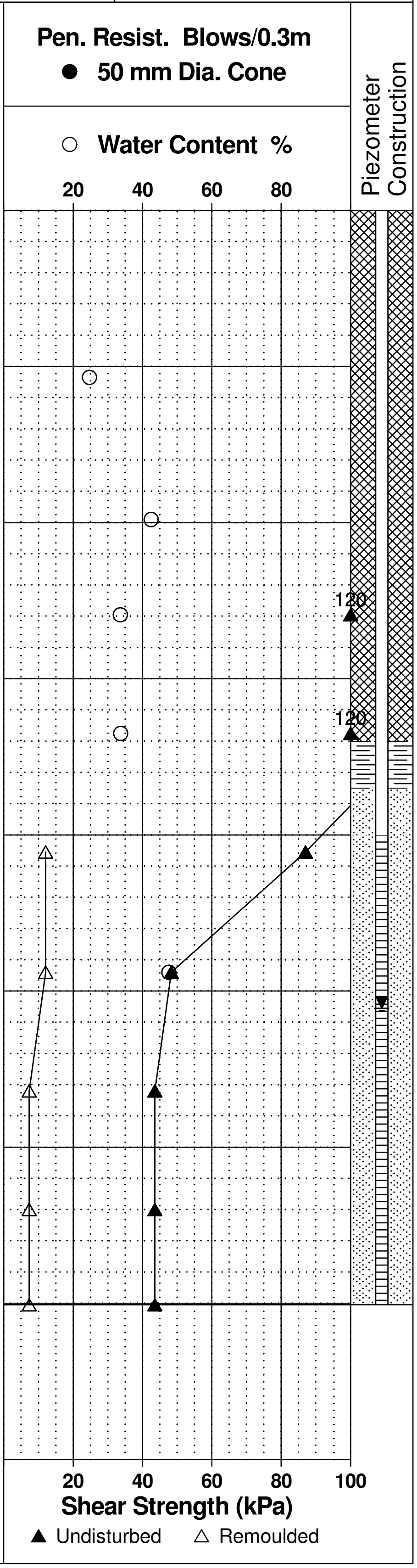
7.01

End of Borehole

(GWL @ 5.11m - Oct. 11, 2018)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	71	5
SS	3	83	5

DEPTH (m)	ELEV. (m)
0	87.52
1	86.52
2	85.52
3	84.52
4	83.52
5	82.52
6	81.52
7	80.52



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4655**

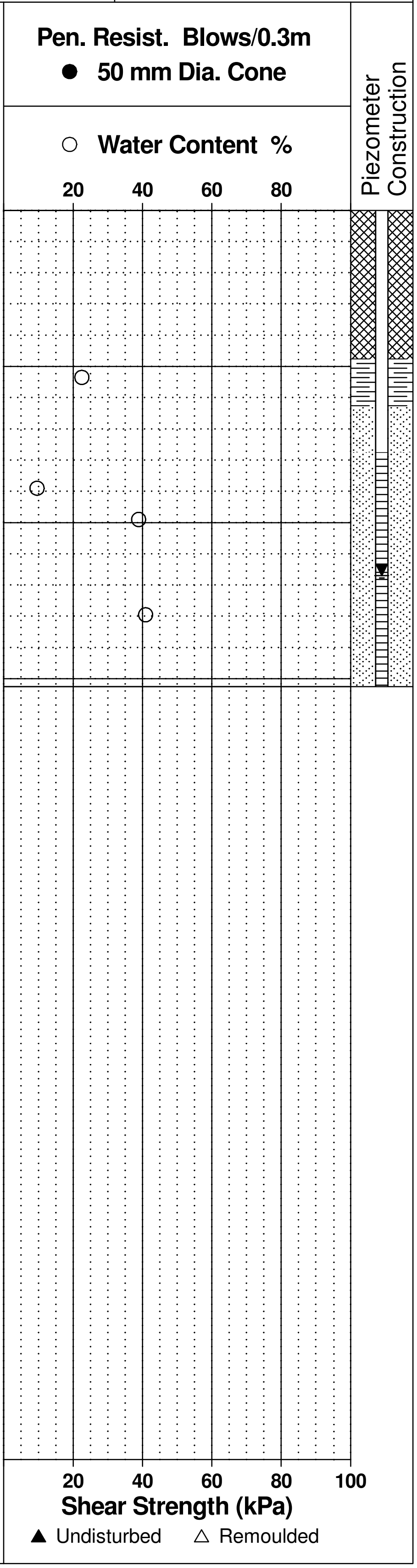
REMARKS

HOLE NO. **BH 9-18**

BORINGS BY CME 55 Power Auger

DATE September 18, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.23
FILL: Brown silty sand, some gravel, trace organics 0.30		AU	1				
FILL: Dark grey silty clay		SS	2	62	6	1	86.23
1.73 Compact, brown **SILTY FINE SAND** 1.83		SS	3	88	12	2	85.23
Very stiff, brown **SILTY CLAY**		SS	4	88	5		
3.05						3	84.23
End of Borehole							
(GWL @ 2.34m - Oct. 11, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4655**

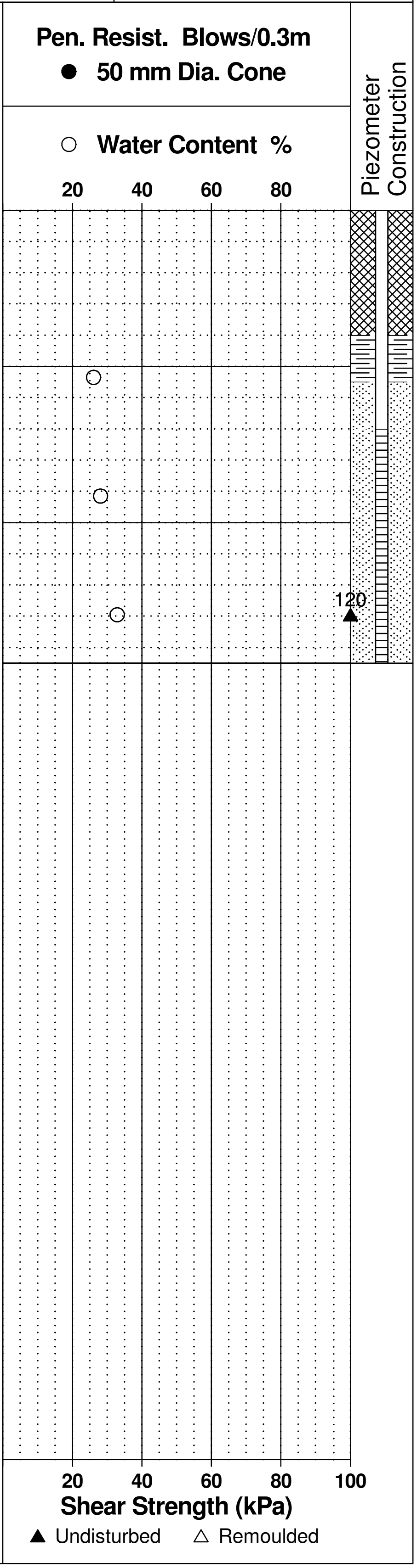
REMARKS

HOLE NO. **BH10-18**

BORINGS BY CME 55 Power Auger

DATE September 18, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.35
FILL: Brown silty sand, some gravel, clay, trace organics 0.60		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	38	13	1	86.35
		SS	3	79	13	2	85.35
- firm and grey by 2.4m depth 2.90		SS	4	92	W		
End of Borehole (Piezometer blocked - Oct. 11, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

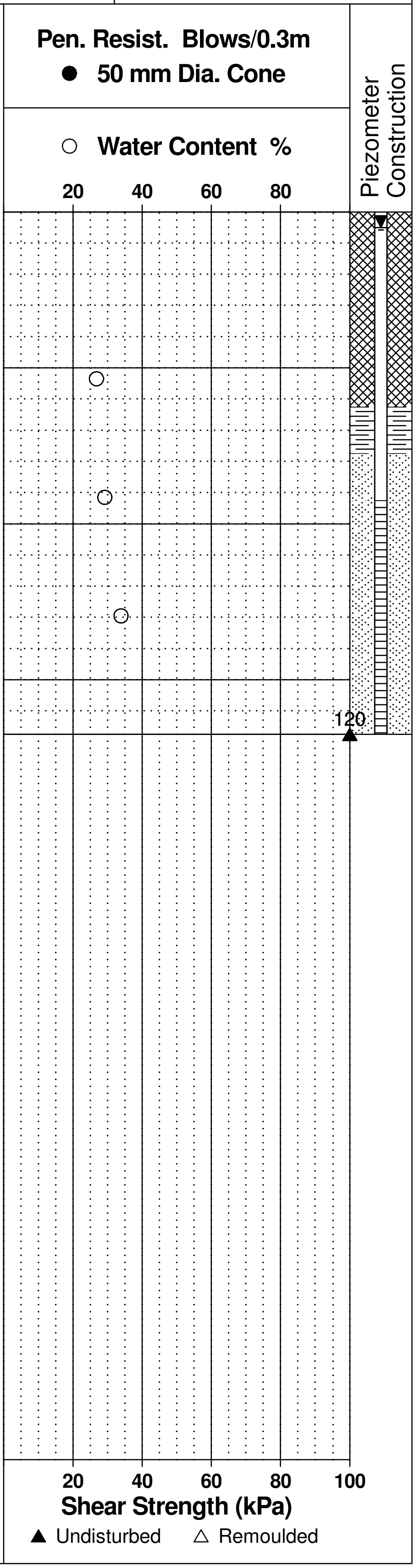
BORINGS BY CME 55 Power Auger

DATE September 18, 2018

FILE NO. **PG4655**

HOLE NO. **BH11-18**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.86
TOPSOIL 0.13		AU	1				
		SS	2	83	10	1	85.86
Very stiff, brown **SILTY CLAY**		SS	3	83	14	2	84.86
		SS	4	92	7	3	83.86
3.35							
End of Borehole (GWL @ 0.10m - Oct. 11, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

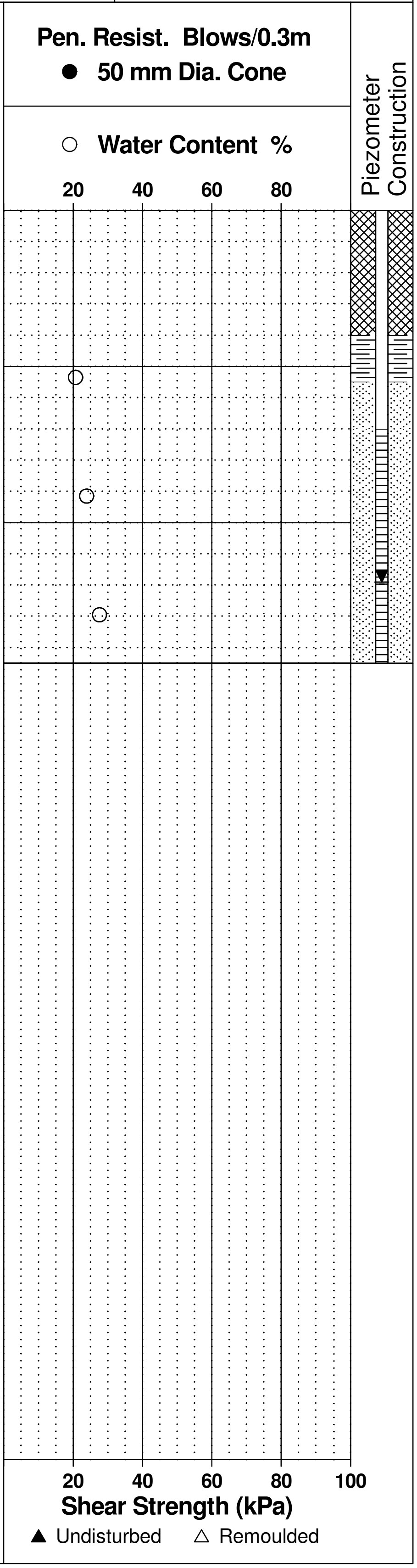
BORINGS BY CME 55 Power Auger

DATE September 18, 2018

FILE NO. PG4655

HOLE NO. BH12-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.38
FILL: Brown silty sand, some gravel, trace organics — 0.15	AU	1				
FILL: Grey silty clay, some topsoil, sand and gravel	SS	2	50	11	1	86.38
1.68	SS	3	75	12	2	85.38
Very stiff, brown **SILTY CLAY** — 2.90	SS	4	92	11		
End of Borehole (GWL @ 2.38m - Oct. 11, 2018)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

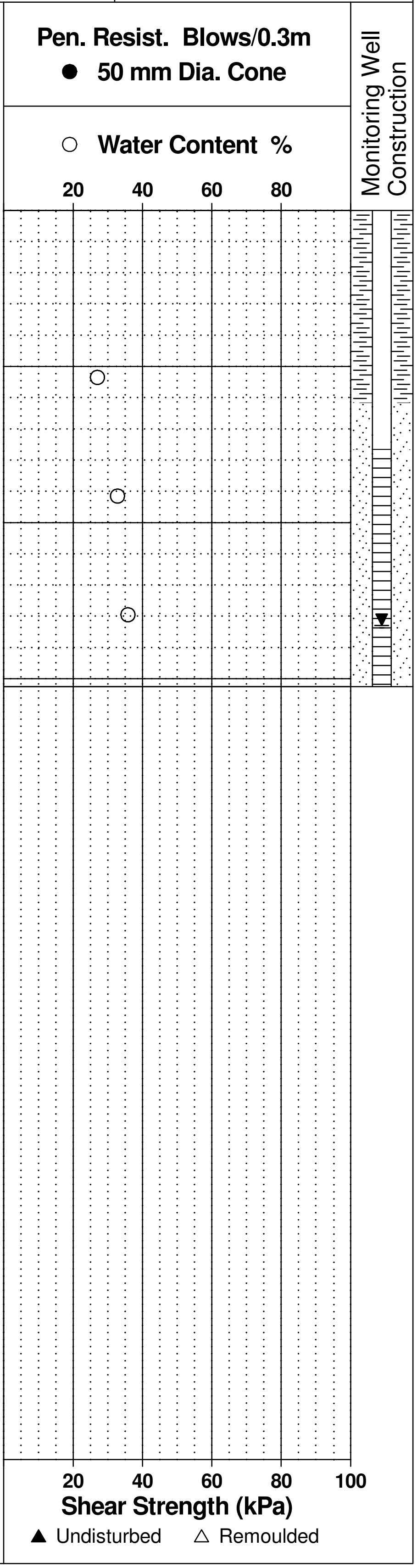
BORINGS BY CME 55 Power Auger

DATE September 18, 2018

FILE NO. PG4655

HOLE NO. BH13-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.35
FILL: Brown silty sand, some gravel, clay, organics — 0.30	AU	1				
FILL: Brown silty clay, some topsoil, trace sand and gravel — 1.37	SS	2	25	7	1	86.35
Very stiff, brown **SILTY CLAY**	SS	3	58	9	2	85.35
— 2.90	SS	4	79	W		
End of Borehole (GWL @ 2.66m - Oct. 11, 2018)					3	84.35



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

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REMARKS

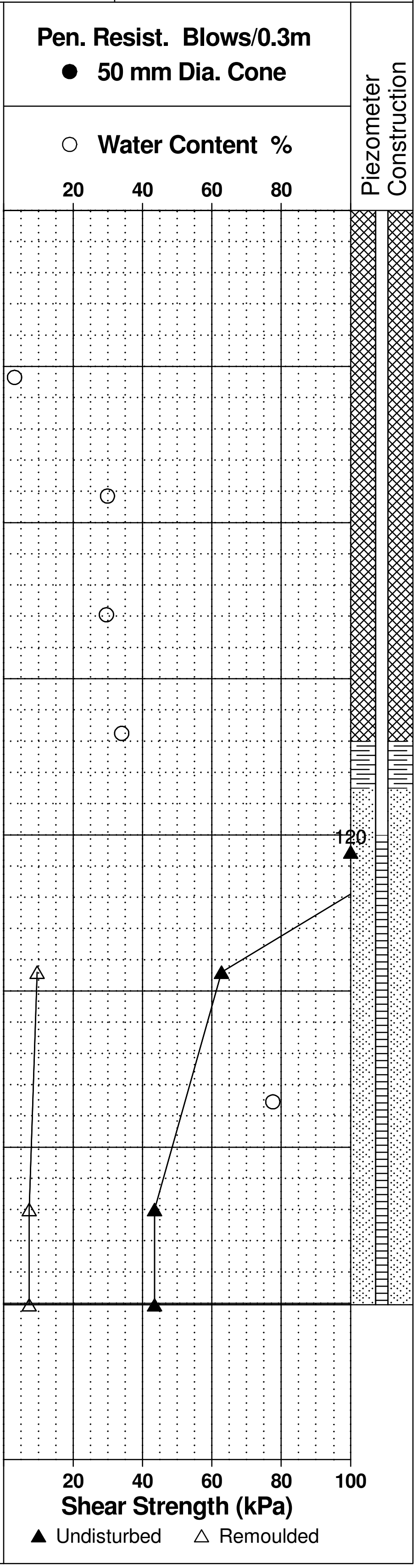
BORINGS BY CME 55 Power Auger

DATE September 19, 2018

FILE NO. PG4655

HOLE NO. BH14-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.06
FILL: Brown silty sand, some gravel, organics, trace clay 0.30		AU	1				
FILL: Brown silty sand with gravel, crushed stone 1.37		SS	2	46	34	1	87.06
Very stiff, brown **SILTY CLAY**		SS	3	50	12	2	86.06
		SS	4	88	12		
		SS	5	92	10	3	85.06
						4	84.06
- stiff to firm and grey by 4.6m depth						5	83.06
		TW	6	79		6	82.06
7.01						7	81.06
End of Borehole (BH dry - Oct. 11, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

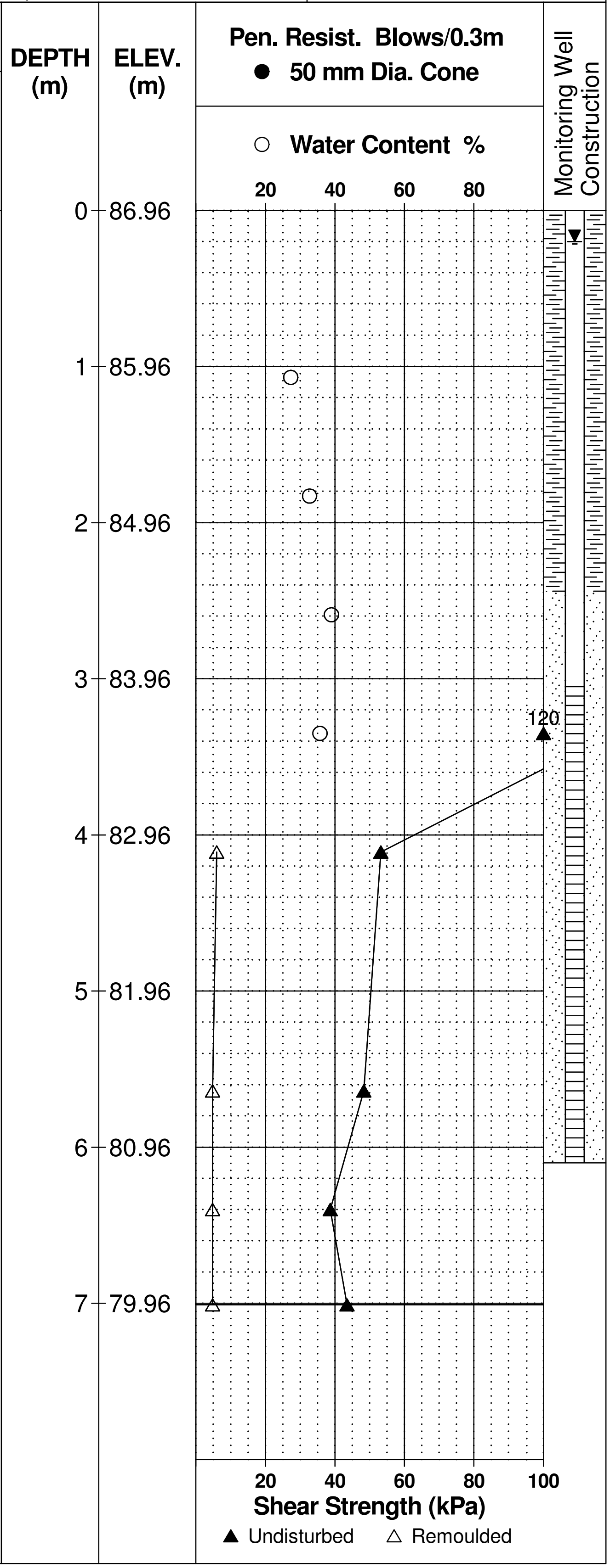
BORINGS BY CME 55 Power Auger

DATE September 19, 2018

FILE NO. PG4655

HOLE NO. BH15-18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.30		AU	1		
		SS	2	71	12
		SS	3	83	11
		SS	4	100	7
Very stiff, brown **SILTY CLAY** - stiff to firm and grey 3.8m depth					
		TW	6	75	
7.01					
End of Borehole (GWL @ 0.20m - Oct. 11, 2018)					



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

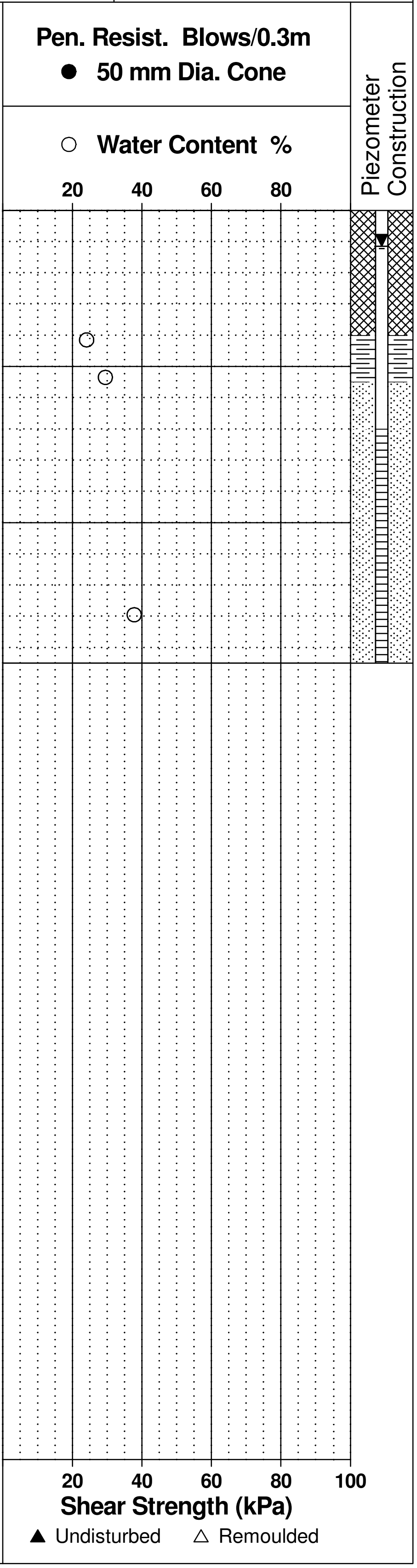
BORINGS BY CME 55 Power Auger

DATE September 19, 2018

FILE NO. PG4655

HOLE NO. BH16-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.00
FILL: Dark brown silty sand with organics and gravel 0.25	AU	1				
	SS	2	62	9	1	86.00
Very stiff to stiff, brown **SILTY CLAY**	SS	3	75	13		
					2	85.00
2.90	SS	4	100	8		
End of Borehole (GWL @ 0.23m - Oct. 11, 2018)						



JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 1**

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.30

Very stiff to stiff, brown
SILTY CLAY

- grey by 4.0m depth

- firm by about 5.0m depth

- soft by 5.6m depth

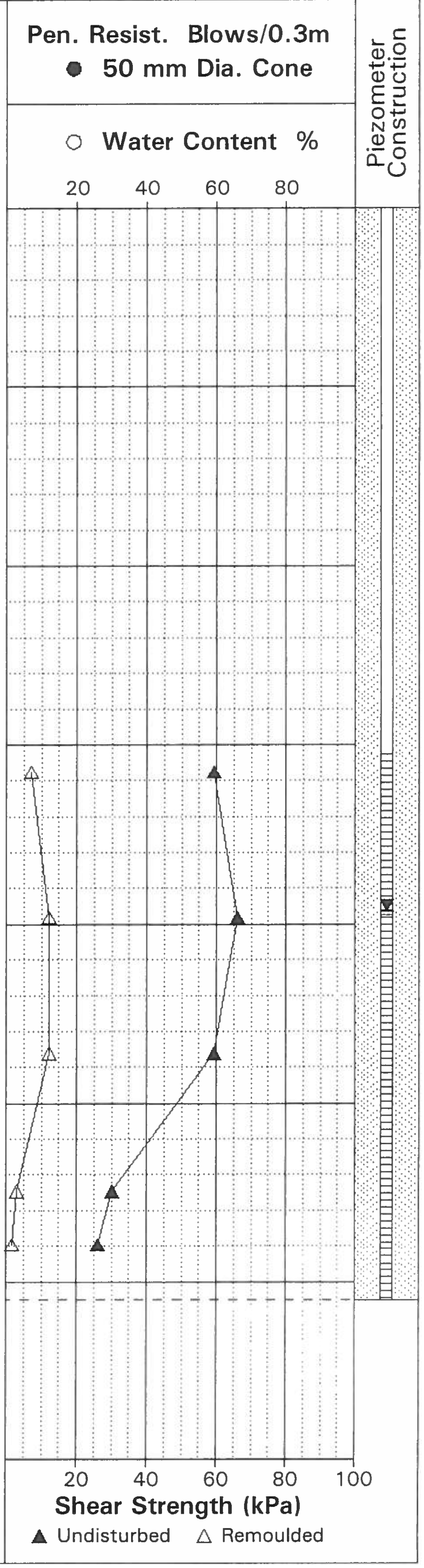
6.10

End of Borehole

(GWL @ 3.93m-Feb. 26/03)

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	83	11
SS	2	12	11
SS	3	100	5
SS	4	100	3
SS	5	100	5
SS	6	100	1

DEPTH (m)	ELEV. (m)
0	98.75
1	97.75
2	96.75
3	95.75
4	94.75
5	93.75
6	92.75



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Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

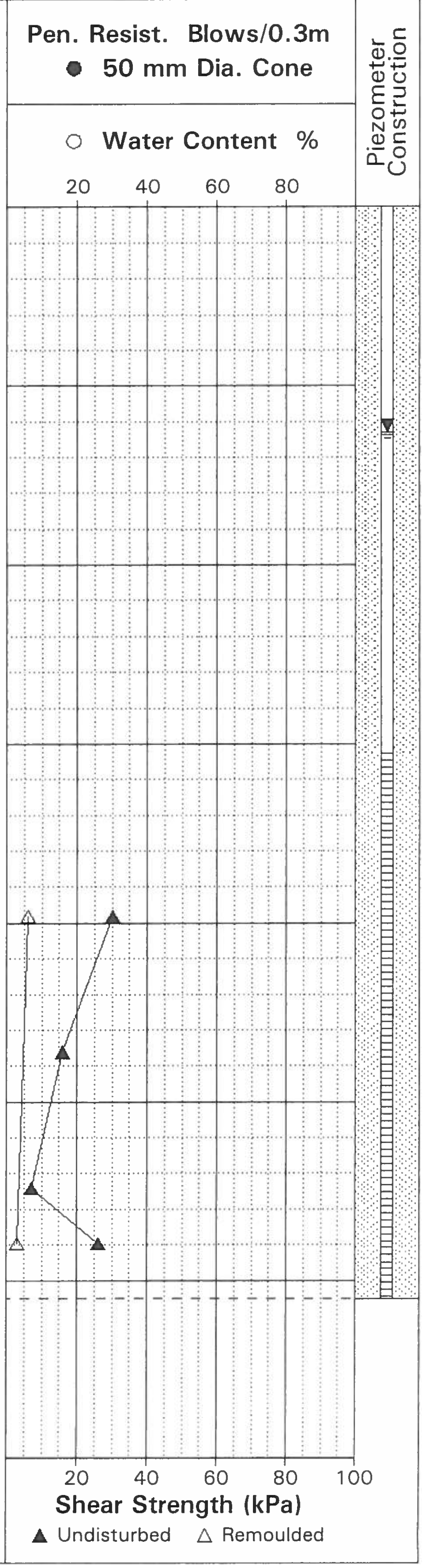
BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 2**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	98.80
TOPSOIL 0.30							
Very stiff to stiff, brown **SILTY CLAY**		SS	1	83	16	1	97.80
		SS	2	83	5	2	96.80
2.44							
Compact, brown SILTY **SAND**		SS	3	50	21		
3.05						3	95.80
Firm to soft, grey SILTY **CLAY**		SS	4	100	2		
		SS	5	100	3	4	94.80
		SS	6	100	1	5	93.80
6.10						6	92.80
End of Borehole (GWL @ 1.26m-Feb. 26/03)							



JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

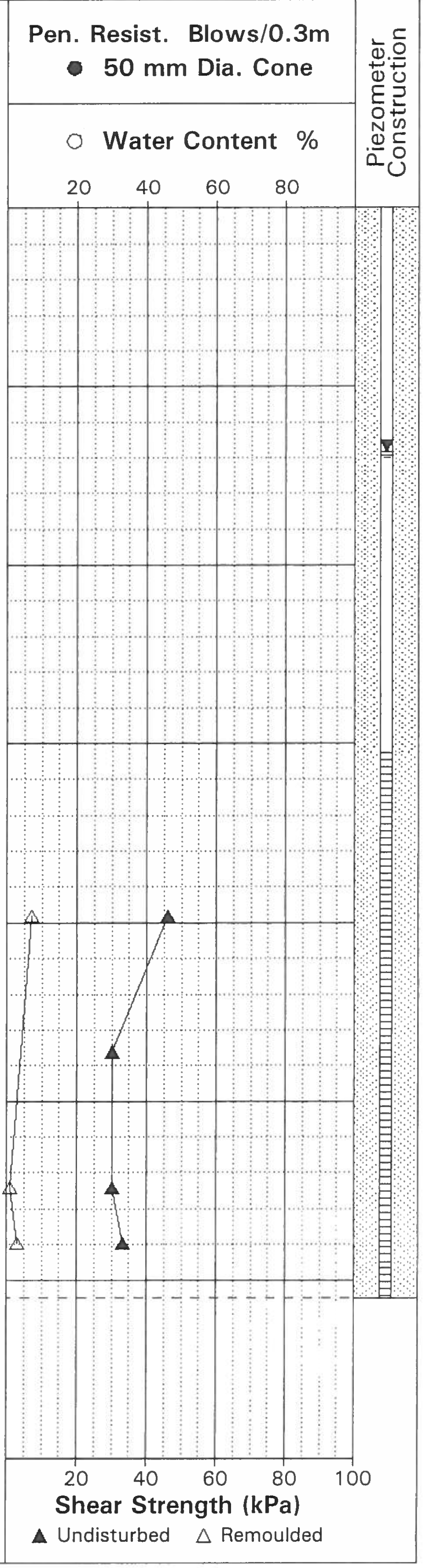
BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 3**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.38
TOPSOIL 0.30						
	SS	1	75	13	1	98.38
	SS	2	100	11		
					2	97.38
Very stiff to stiff, brown **SILTY CLAY**	SS	3	100	7		
					3	96.38
- firm to soft by 3.4m depth	SS	4	100	4		
- grey by 3.8m depth						
	SS	5	100	6	4	95.38
	SS	6	100	1		
					5	94.38
6.10					6	93.38
End of Borehole						
(GWL @ 1.37m-Feb. 26/03)						



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Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd,
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

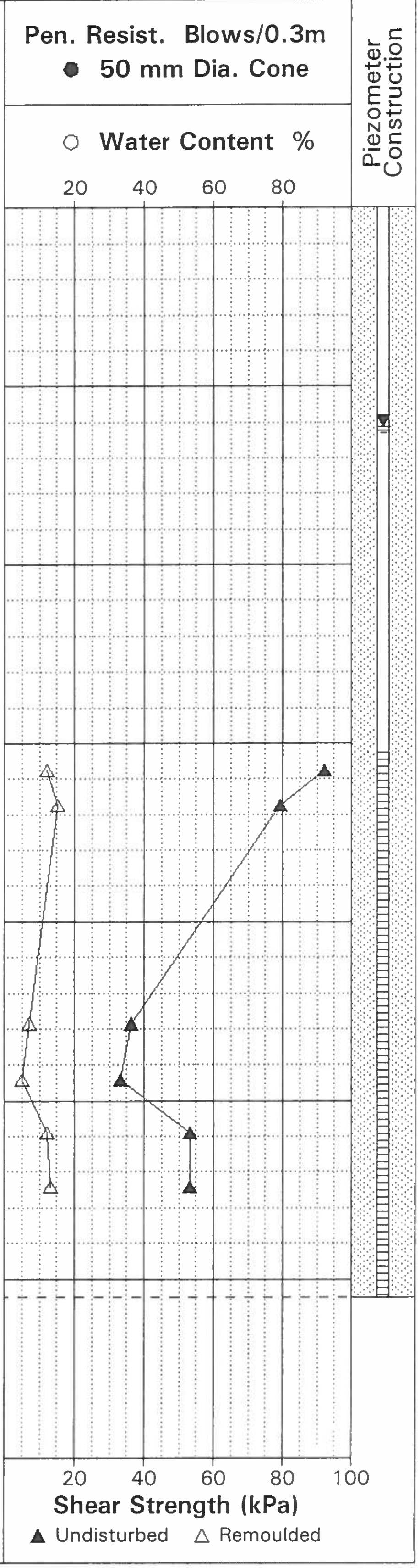
BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 4**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.24
TOPSOIL 0.30						
	SS	1	83	14	1	98.24
	SS	2	92	9	2	97.24
Very stiff to stiff, brown **SILTY CLAY**	SS	3	100	3		
					3	96.24
	SS	4	100	3		
- grey by 3.8m depth						
- firm by 4.0m depth	SS	5	100	3	4	95.24
					5	94.24
- stiff by 5.2m depth						
6.10					6	93.24
End of Borehole						
(GWL @ 1.23m-Feb. 26/03)						



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Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

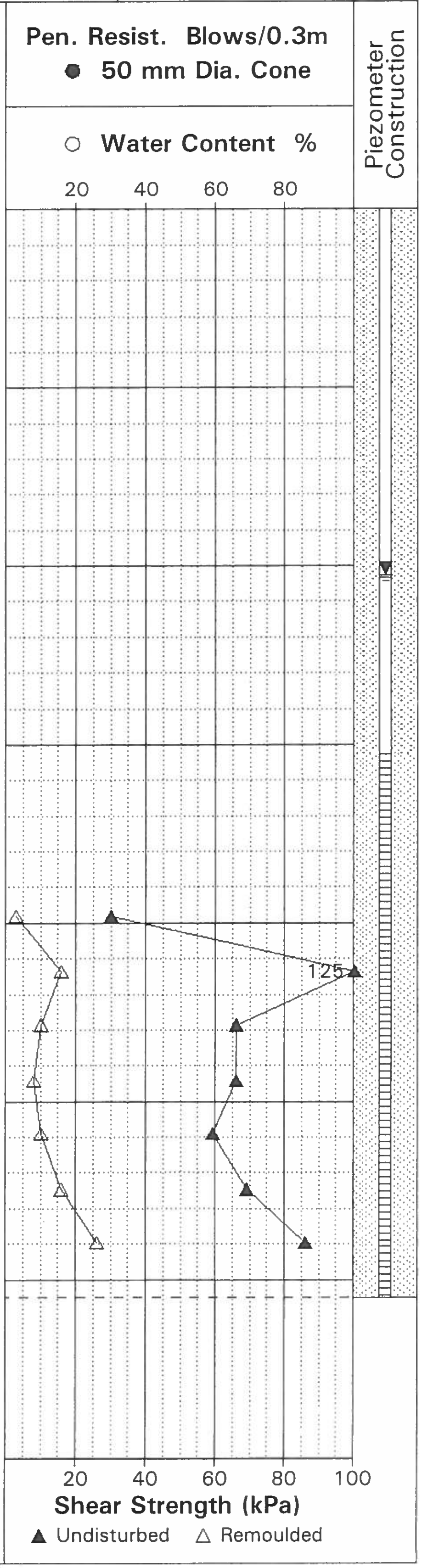
BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 5**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.64
TOPSOIL 0.30							
		SS	1	50	16		
						1	98.64
		SS	2	100	17		
Very stiff to stiff, brown **SILTY CLAY**						2	97.64
		SS	3	100	12		
						3	96.64
		SS	4	100	9		
- firm to stiff by 4.0m depth						4	95.64
						5	94.64
6.10						6	93.64
End of Borehole (GWL @ 2.05m-Feb. 26/03)							



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Consulting Engineers
28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

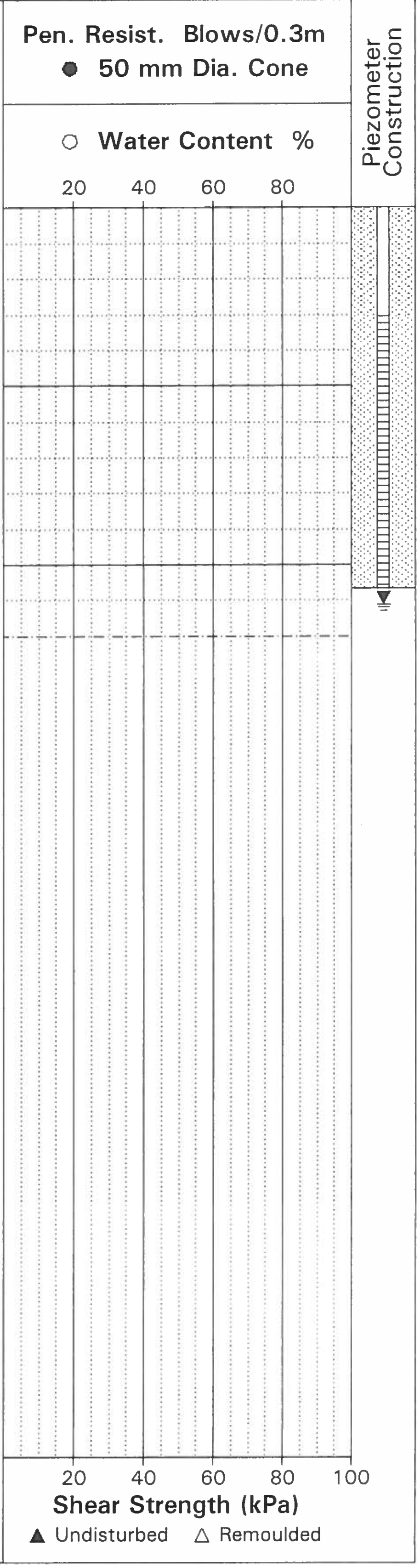
FILE NO. **G8867**

HOLE NO. **BH 6**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.89
TOPSOIL 0.30							
Very stiff to stiff, brown **SILTY CLAY**		SS	1	75	21	1	97.89
		SS	2	83	19	2	96.89
2.40							

End of Borehole

(GWL @ 2.22m-Feb. 26/03)



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Consulting Engineers

28 Concourse Gate, Nepean, Ont. K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
Commercial Development, Trim Rd. at Watters Rd.
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant (see plan). Assumed elevation = 100.00m.

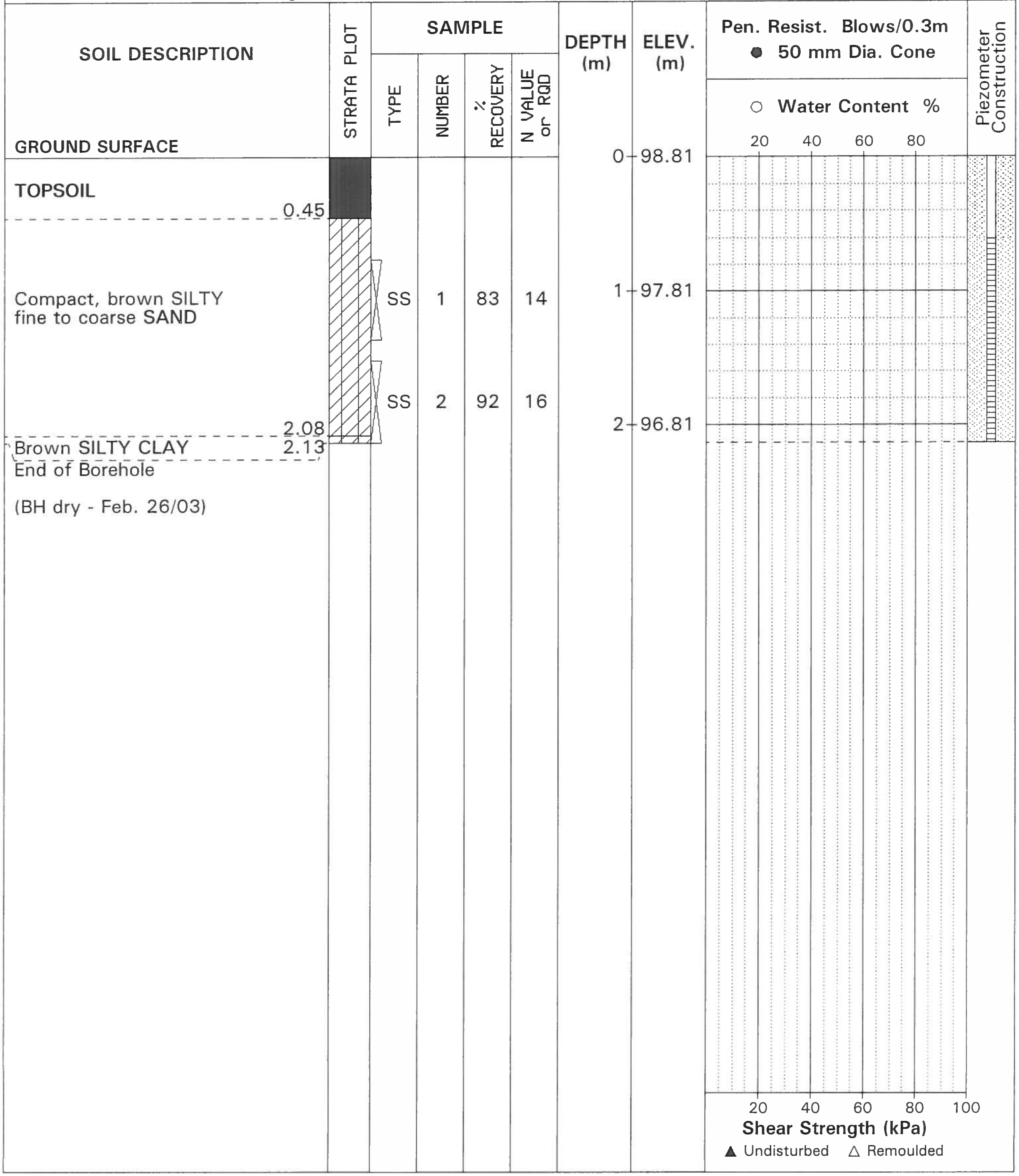
REMARKS

BORINGS BY CME 55 Power Auger

DATE 19 FEB 03

FILE NO. **G8867**

HOLE NO. **BH 7**



SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	98.81
TOPSOIL 0.45						
Compact, brown SILTY fine to coarse SAND	SS	1	83	14	1	97.81
	SS	2	92	16		
2.08					2	96.81
Brown SILTY CLAY 2.13						
End of Borehole (BH dry - Feb. 26/03)						

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))

TW - Thin wall tube or Shelby tube

PS - Piston sample

AU - Auger sample or bulk sample

WS - Wash sample

RC - Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = D60 / D10

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

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

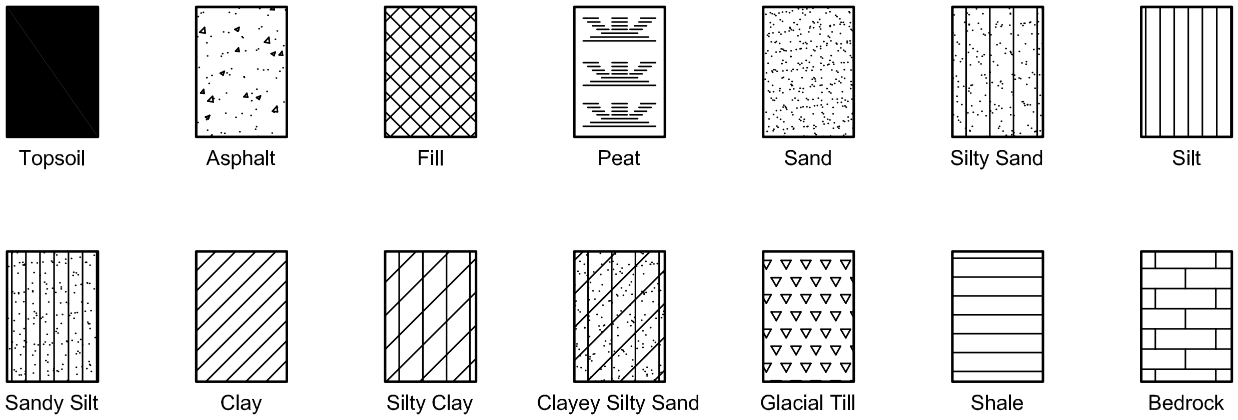
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

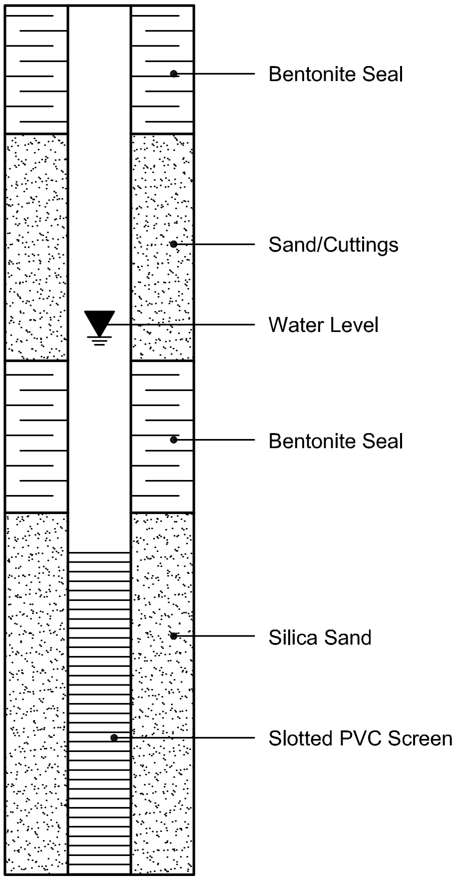
SYMBOLS AND TERMS (continued)

STRATA PLOT

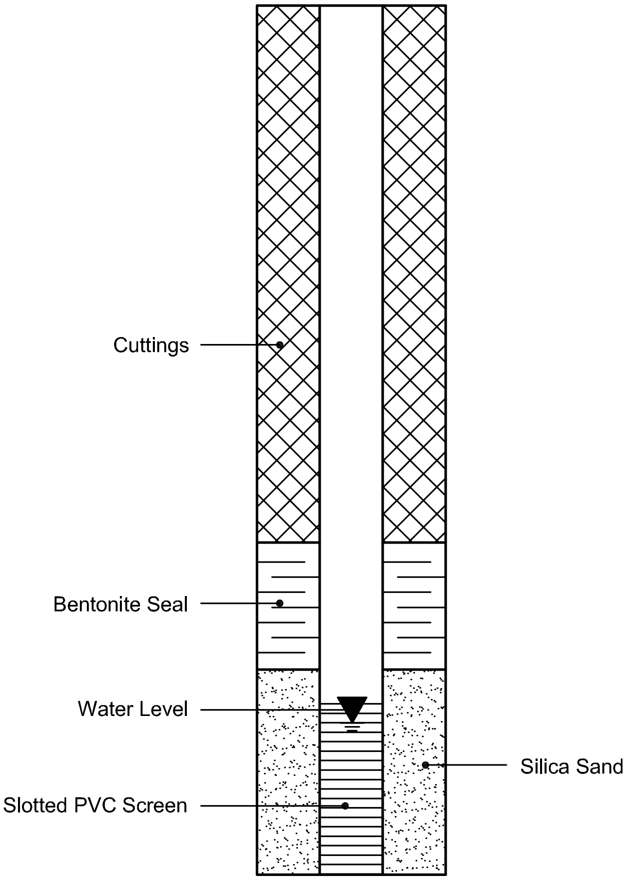


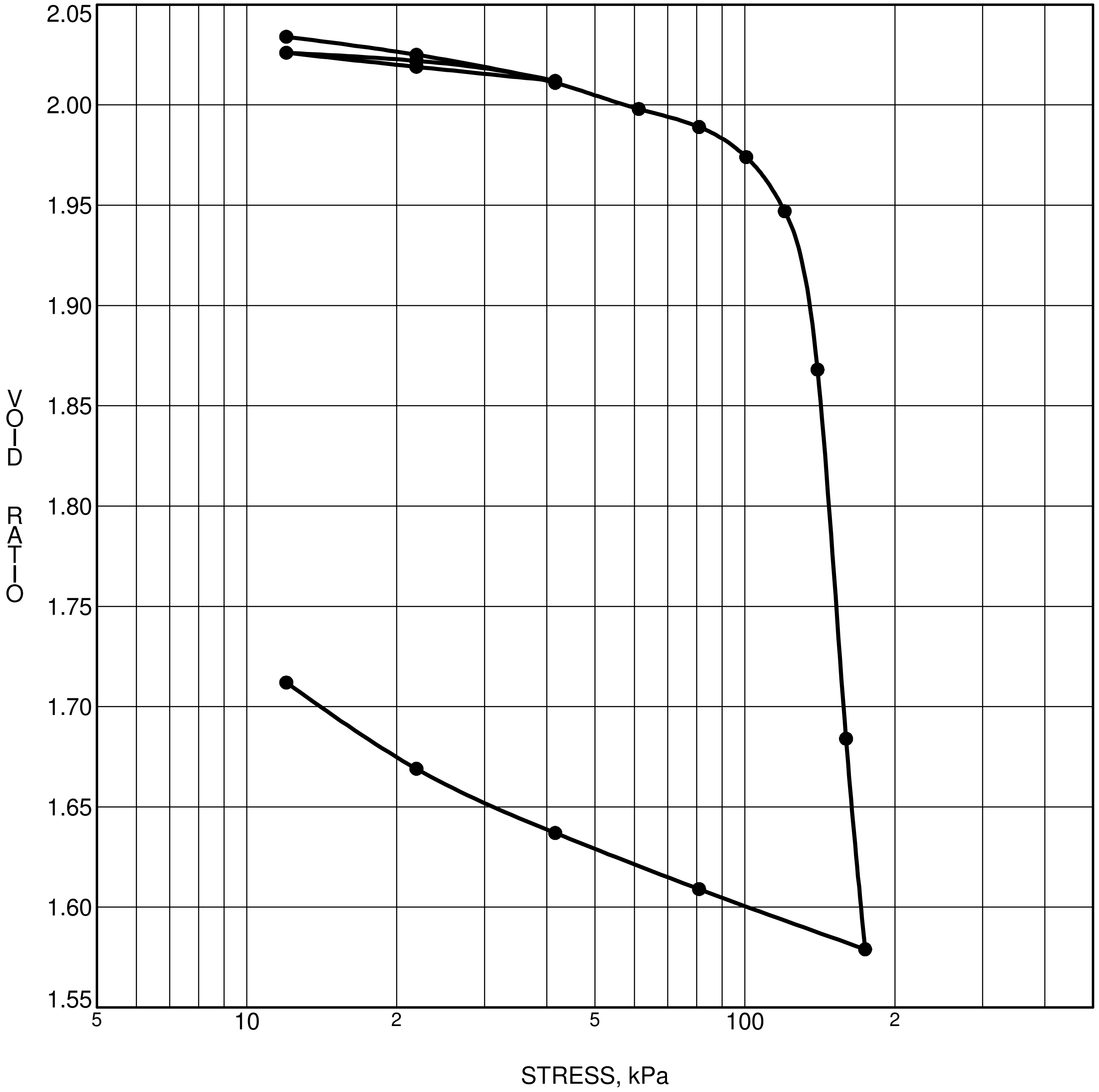
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





CONSOLIDATION TEST DATA SUMMARY								
Borehole No.	**BH 3-18**		p'_o	**56.75**	kPa	Ccr	**0.027**	
Sample No.	**TW 5**		p'_c	**132.23**	kPa	Cc	**3.182**	
Sample Depth	**5.05**	m	OC Ratio	**2.3**		Wo	**74.4**	%
Sample Elev.	**82.11**	m	Void Ratio	**2.046**		Unit Wt.	**15.5**	kN/m^3

CLIENT **Taggart Realty Management**

FILE NO. **PG4655**

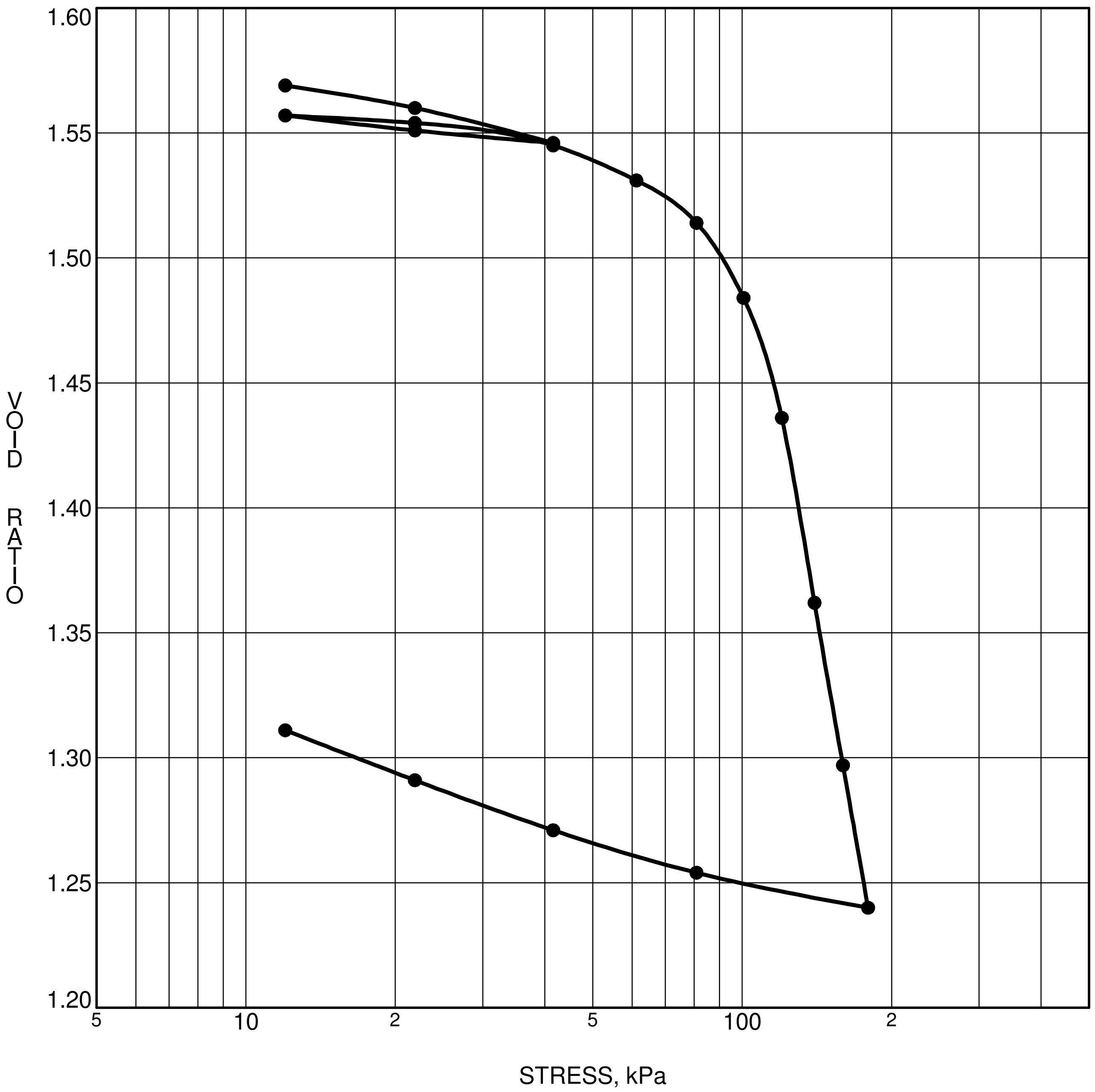
PROJECT **Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**

DATE **02/10/2018**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



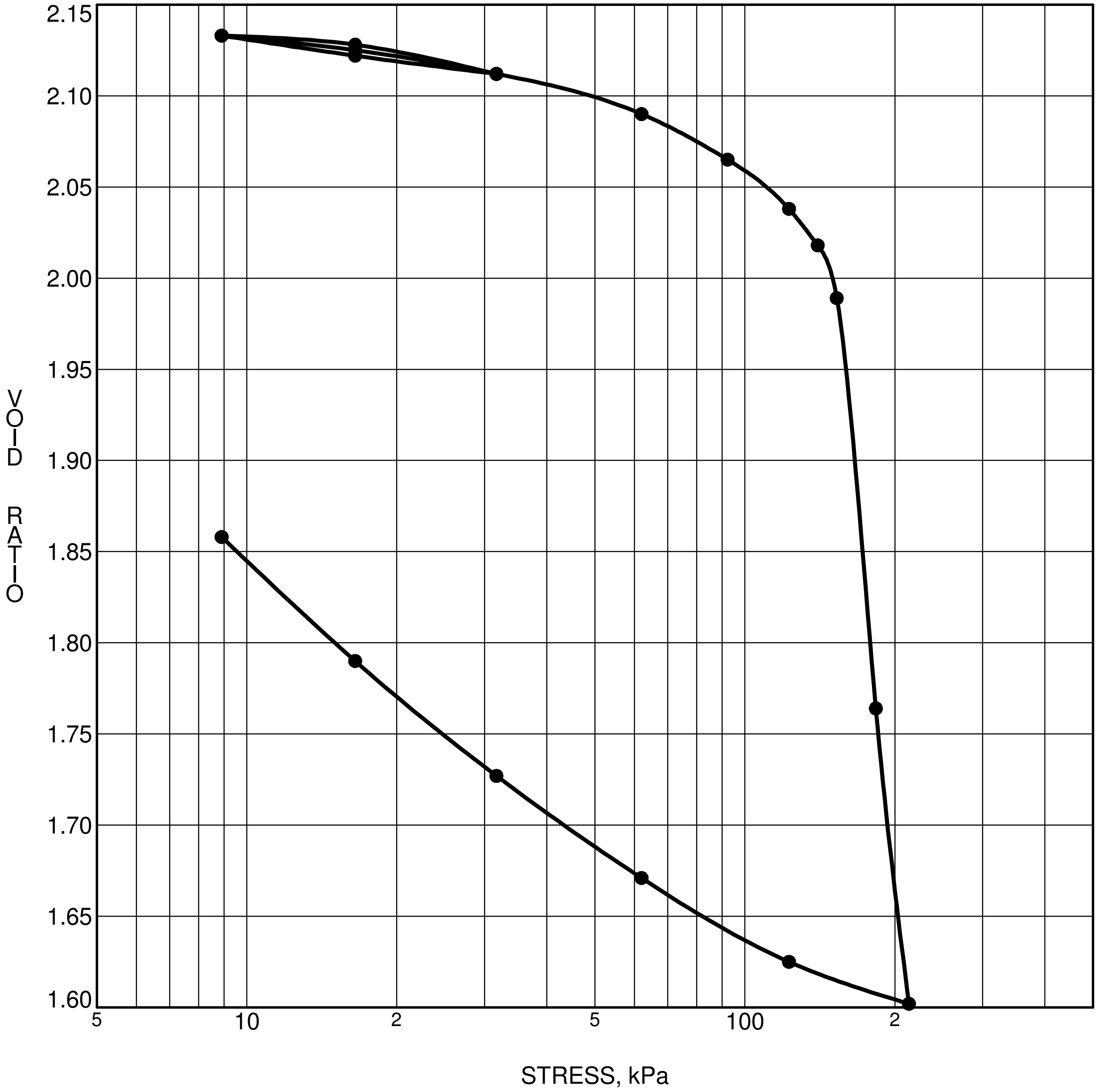
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 6-18**	p'o	**57.62** kPa	Ccr	**0.022**
Sample No.	**TW 5**	p'c	**105.68** kPa	Cc	**1.136**
Sample Depth	**4.29** m	OC Ratio	**1.8**	Wo	**57.5** %
Sample Elev.	**82.94** m	Void Ratio	**1.58**	Unit Wt.	**16.5** kN/m ^{3}

CLIENT	**Taggart Realty Management**	FILE NO.	**PG4655**
PROJECT	**Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**	DATE	**01/10/2018**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



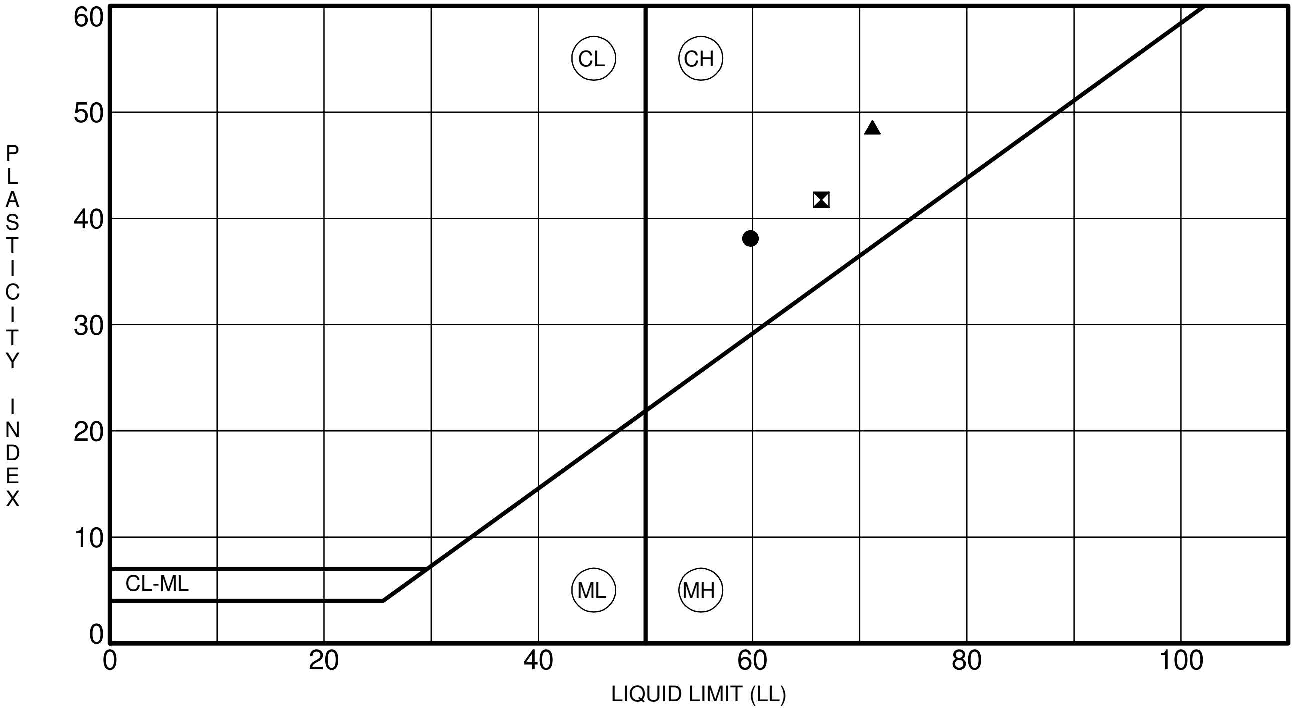
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH14-18**	p'$_o$	**57.62** kPa	Ccr	**0.039**
Sample No.	**TW 6**	p'$_c$	**146.55** kPa	Cc	**2.612**
Sample Depth	**5.71** m	OC Ratio	**2.5**	Wo	**77.6** %
Sample Elev.	**82.35** m	Void Ratio	**2.134**	Unit Wt.	**15.3** kN/m ^{3}

CLIENT	**Taggart Realty Management**	FILE NO.	**PG4655**
PROJECT	**Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**	DATE	**02/10/2018**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 7-18**	**SS 3**	**60**	**22**	**38**		**CH - Inorganic clays of high plasticity**
⧗	**BH14-18**	**SS 3**	**66**	**25**	**42**		**CH - Inorganic clays of high plasticity**
▲	**BH15-18**	**SS 2**	**71**	**23**	**49**		**CH - Inorganic clays of high plasticity**

CLIENT **Taggart Realty Management**

PROJECT **Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**

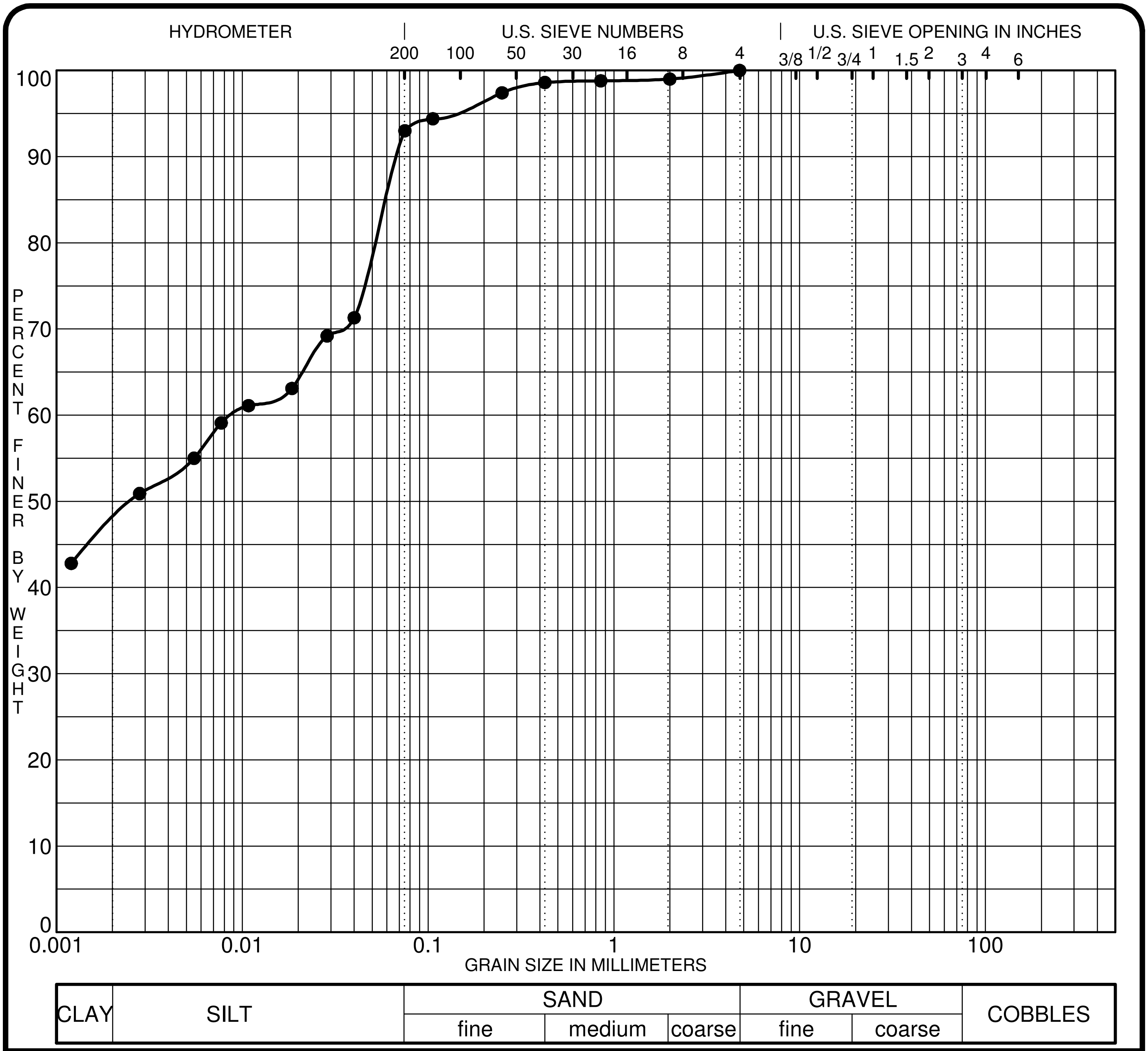
FILE NO. **PG4655**

DATE **19 Sep 18**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 5-18**	**SS 2**	**Clay and silt with trace sand**	**30**					
☒									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 5-18**	**SS 2**	**4.75**	**0.01**			**0.0**	**7.0**		
☒										
▲										
★										

CLIENT **Taggart Realty Management**

FILE NO. **PG4655**

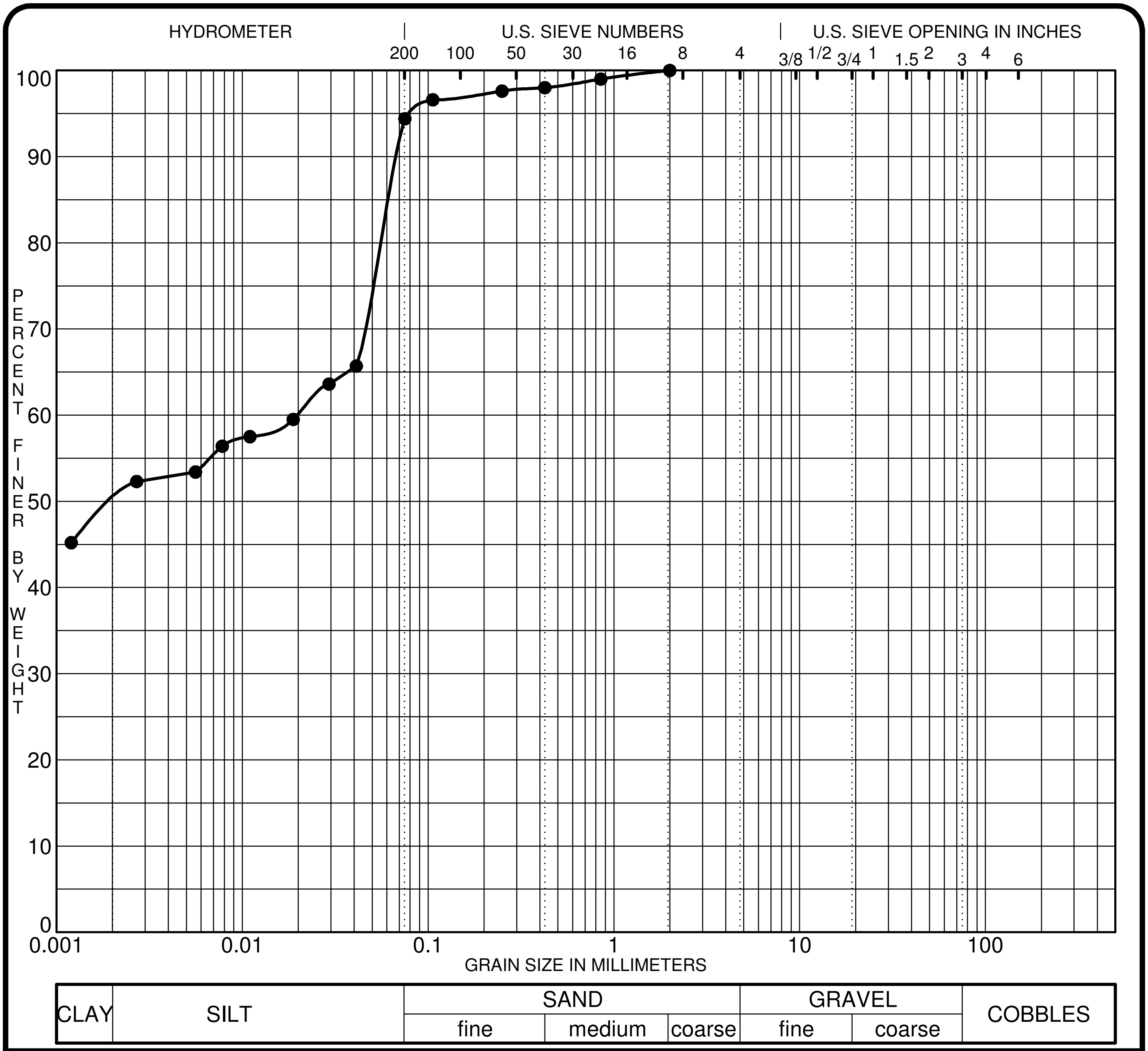
PROJECT **Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**

DATE **17 Sep 18**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH10-18**	**SS 3**	**Clay and silt with trace sand**	**28**					
⌧									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH10-18**	**SS 3**	**2.00**	**0.02**			**0.0**	**5.6**		
⌧										
▲										
★										

CLIENT **Taggart Realty Management**

FILE NO. **PG4655**

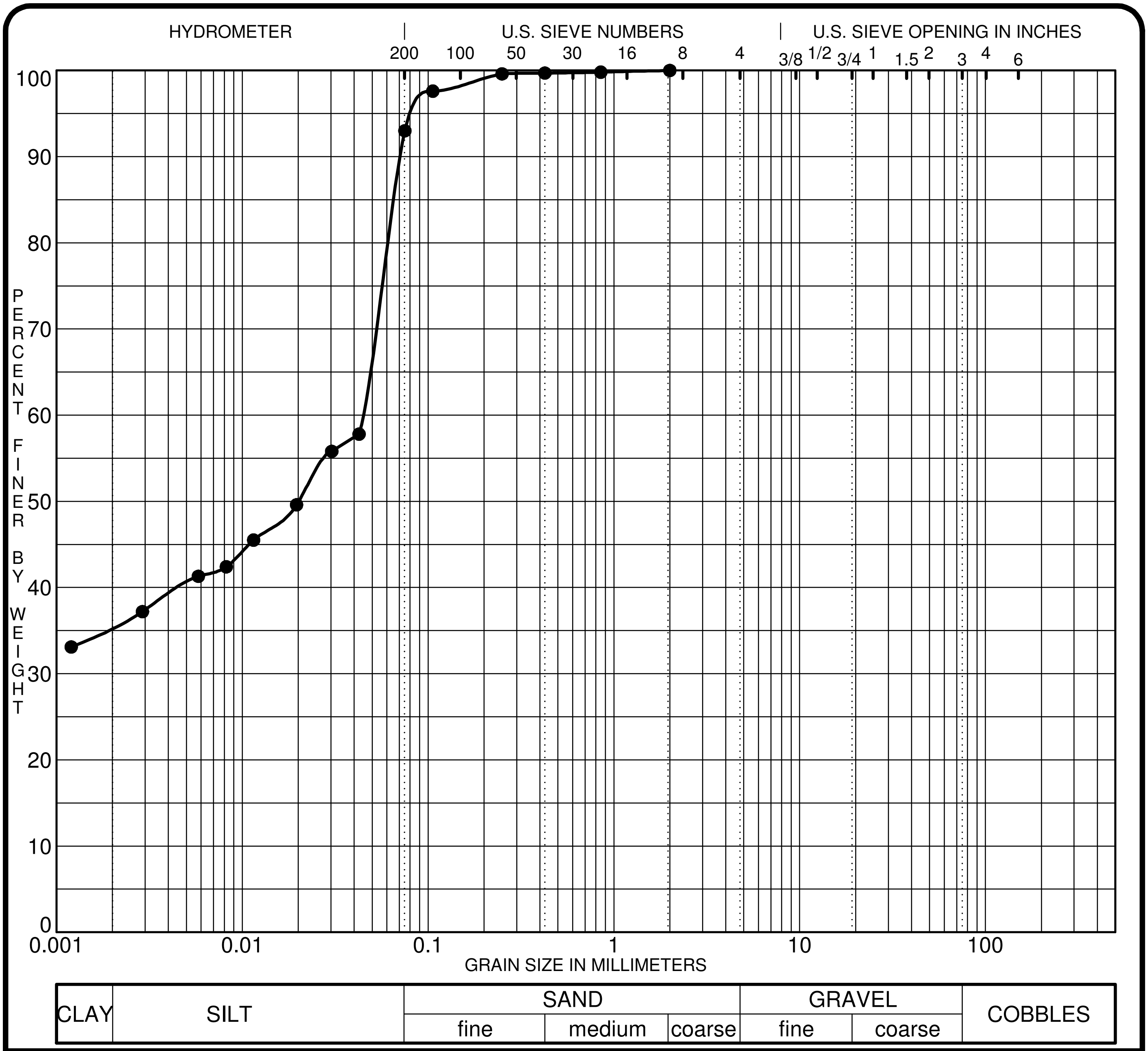
PROJECT **Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**

DATE **18 Sep 18**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH12-18 SS 3**	**Clay and silt with trace sand**	**24**					
☒								
▲								
★								

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH12-18 SS 3**	**2.00**	**0.04**			**0.0**	**7.0**		
☒									
▲									
★									

CLIENT **Taggart Realty Management**

FILE NO. **PG4655**

PROJECT **Geotechnical Investigation - Prop. Commercial Development - Trim Rd. at Watters Rd.**

DATE **18 Sep 18**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION

	Client ID:	BH4-18-SS2	-	-	-
	Sample Date:	09/21/2018 16:30	-	-	-
	Sample ID:	1839110-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	78.9	-	-	-
General Inorganics					
pH	0.05 pH Units	7.73	-	-	-
Resistivity	0.10 Ohm.m	12.2	-	-	-
Anions					
Chloride	5 ug/g dry	458	-	-	-
Sulphate	5 ug/g dry	169	-	-	-

APPENDIX 2

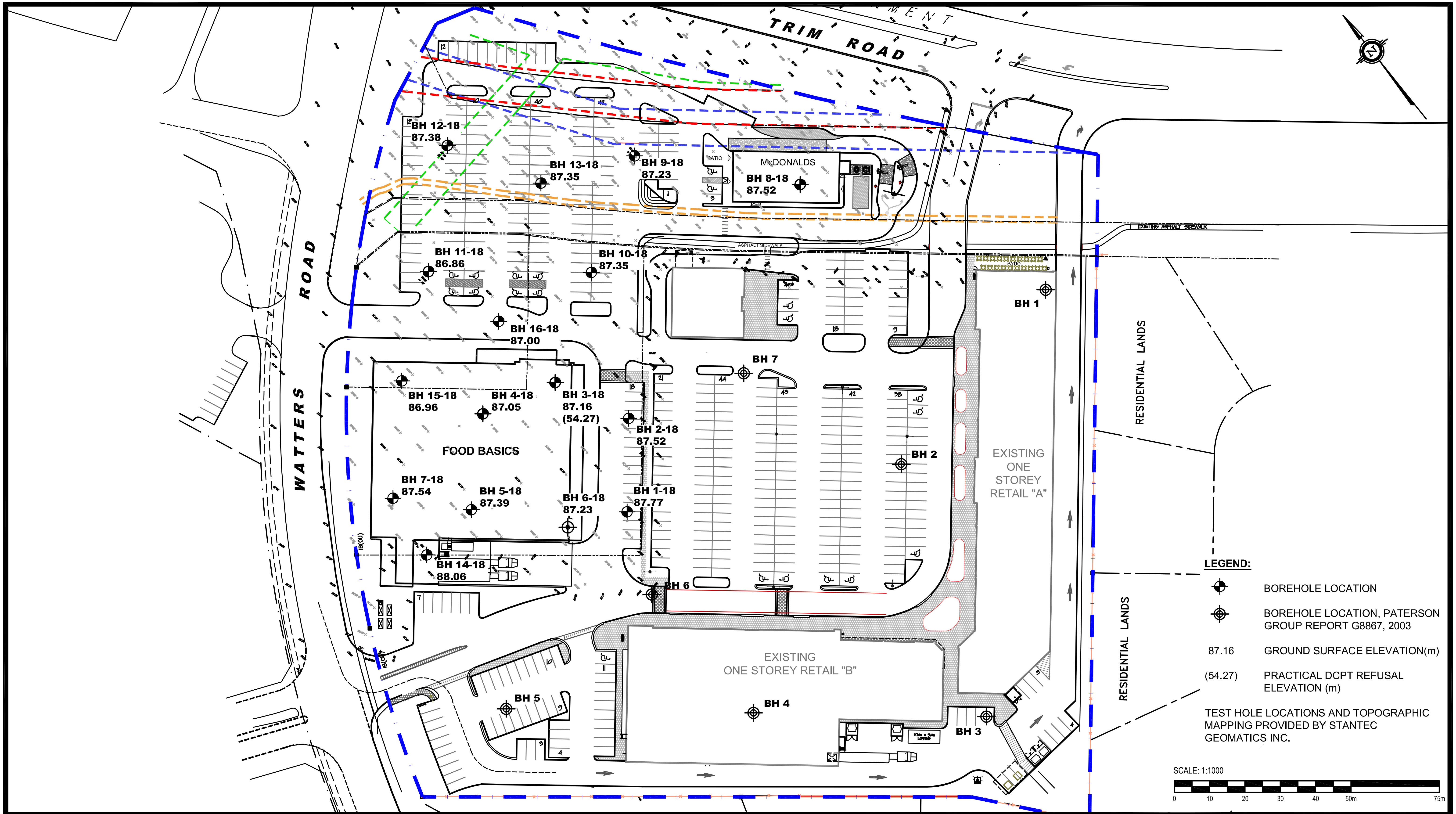
FIGURE 1 - KEY PLAN

DRAWING PG4655-1 - TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN

patersongroup



LEGEND:

●	BOREHOLE LOCATION
⊕	BOREHOLE LOCATION, PATERSON GROUP REPORT G8867, 2003
87.16	GROUND SURFACE ELEVATION(m)
(54.27)	PRACTICAL DCPT REFUSAL ELEVATION (m)

TEST HOLE LOCATIONS AND TOPOGRAPHIC MAPPING PROVIDED BY STANTEC GEOMATICS INC.

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
0			

TAGGART REALTY MANAGEMENT

GEOTECHNICAL INVESTIGATION
PROP. COMMERCIAL DEVELOPMENT - TRIM ROAD AT WATTERS ROAD
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:1000
Date: 10/2018
Drawn by: RCG
Report No.: PG4655-1
Checked by: FA
Dwg. No.: PG4655-1
Approved by: DJG
Revision No.: 0

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