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Geotechnical Investigation
Proposed Residential Development
Mahogany Community
Ottawa (Manotick), Ontario

Prepared For

Minto Communities Inc.

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Report: PG4008-1

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Appendices:

1.0 Introduction

Paterson Group Inc. (Paterson) was commissioned by Minto Communities Inc. (Minto) to compile existing geotechnical information from previous geotechnical investigations and to conduct a supplementary geotechnical investigation work for the proposed Mahogany Community residential development located in the City of Ottawa (Manotick) (refer to Figure 1 - Key Plan presented in Appendix 3).

The objectives of the investigation have been:

- ❏ to compile the results of several previous phases of geotechnical investigation at the subject development;
- ❏ to further characterize the subsoil and groundwater conditions at this site by means of a supplementary geotechnical investigation, consisting of boreholes, to supplement the information obtained from the previous investigations;
- ❏ to determine permissible grade raise limits for applicable identified portions of the development having sensitive clay soils;
- ❏ to evaluate the conditions for the design of the side slopes for the ponds for the stormwater management facilities (SWMF) and determine the suitability of material, to be excavated from the SWMF, for re-use as grade raise fill;
- ❏ to provide geotechnical recommendations for the design of the currently proposed development phases, consisting of Mahogany Stages 2 to 4 including foundation design for proposed buildings, grade raise restrictions, bedding and backfill for underground services, pavement design, and construction considerations which may affect the design.

This geotechnical investigation has been completed in general accordance with the requirements of the City of Ottawa's *Geotechnical Investigation and Reporting Guidelines for Development Applications*.

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 subject development as they are understood at the time of writing this report.

2.0 Proposed Development

It is understood that mixed-density residential development is proposed at this site. The investigated parcel also includes a school block and park blocks. Stormwater Management Facilities (SWMF's) are proposed adjacent to the Wilson Cowan Drain, to the west, and adjacent to Mahogany Creek, to the east, and this investigation report provides geotechnical recommendations for their design.

Single homes, town homes and bungalow town homes are all possible development options. It is further understood that municipal services and neighbourhood roads are also anticipated, and car parking and access lanes could be required in the higher density areas.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was carried out between March 30 and April 3, 2017. At that time, a total of ten (10) boreholes were advanced to depths ranging from 5.2 to 10.1 m below existing ground surface (bgs).

Paterson conducted five (5) previous geotechnical field programs at this site, as summarized below:

☐ The first program (File: G7840-1) was conducted in July, 2000, and consisted of completing 18 test pits to a maximum depth of 3.8 m bgs (suffix -00).

☐ The second program (File: PG0219-1) was conducted in May, 2004, and consisted of completing 12 boreholes to a maximum depth of 8.9 m bgs (suffix -04).

☐ The third program (File: PG0328-1) was conducted in July, 2004, and consisted of completing 6 boreholes to a maximum depth of 12.7 m bgs (suffix -04B).

☐ The fourth program (File: PG0834-1) was conducted in June, 2006, and consisted of completing 6 boreholes to a maximum depth of 17.4 m bgs (suffix -06).

☐ The fifth program (File: PG0675-1) was conducted in July, 2007 (-07) and January, 2008 (-08), and consisted of 49 boreholes drilled to a maximum depth of 9.8 m bgs.

The locations of all the test holes are shown on Drawing PG4008-1 - Test Hole Location Plan, included in Appendix 3.

The current boreholes (as well as those for each previous investigation phase), were advanced using a track-mounted auger drill rig operated by a two-person crew. The drilling procedure consisted of augering to the required depths at the selected locations, while sampling and testing the overburden. The fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. Sampling and testing the overburden was completed in general accordance with ASTM D5434-12 - Guide for Field Logging of Subsurface Explorations of Soil and Rock.

Test pits were dug using hydraulic excavating equipment, such as a backhoe, under the full-time supervision of Paterson personnel under the direction of a senior engineer

Sampling and In Situ Testing

Soil samples were recovered from the boreholes using a 50 mm diameter split-spoon sampler or thin walled Shelby tubes. The split spoon soil samples were classified on site and placed in sealed plastic bags. The Shelby tubes were recovered from the borehole using a piston sampler, were sealed with caps at both ends and protected from disturbance during the entire process. The tops of the boreholes were scraped to determine the surficial material. Auger samples were recovered from the upper part of the previous boreholes.

The profiles in the test pits were logged by direct examination of the sides of the pits. Grab samples were recovered of representative materials. The position of the groundwater was inferred from the uppermost depth of seepage into the test pit.

All samples were transported to our laboratory. The depths at which the auger, split spoon and Shelby tube samples were recovered from the boreholes, and grab samples were recovered from the test pits, are shown as AU, SS, TW and G samples, respectively, on the Soil Profile and Test Data sheets, in Appendix 1. Transportation of the samples was completed in general accordance with ASTM D4220-95 (2007) - Standard Practice for Preserving and Transporting Soil Samples.

The 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. This testing was done in general accordance with ASTM D1586-11 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Undrained shear strength testing was conducted in the cohesive soils encountered in the boreholes using a field shear vane apparatus. This testing was done in general accordance with ASTM D2573-08 - Standard Test Method for Field Vane Shear Test in Cohesive Soil. An inspection vane was used to determine the undrained shear strength in the test pits.

The overburden soil thickness was evaluated during the course of the investigation by augering to practical refusal or dynamic cone penetration testing (DCPT) at seven (7) boreholes. In previous investigations, augering to practical refusal was completed at sixteen (16) borehole locations. 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 depth increment.

All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for further review and testing. Transportation of the samples was completed in general accordance with ASTM D4220-95 (2007) - Standard Practice for Preserving and Transporting Soil Samples.

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 selected boreholes to permit the monitoring of groundwater levels subsequent to the completion of the field program.

Monitoring wells, using 50 mm diameter flush-mount PVC screen and risers were installed in each of BH 50-17, BH 51-17, BH 54-17, BH 56-17, BH 57-17, and BH 59-17 to facilitate the accurate measurement of groundwater levels and the collection of groundwater samples, if desired.

It is anticipated that the monitoring wells and boreholes can be decommissioned at the time of construction.

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 current test hole locations were marked by Paterson on a plan and staked out in the field by Annis, O'Sullivan and Vollebekk Surveying Ltd. (AOV), including determining the ground surface elevation referenced to a geodetic datum. The locations and ground elevations of the current and previous test holes from the investigation stages, with the current development fabric and phasing, are presented on Drawing No. PG4008-1 - Test Hole Location Plan, in Appendix 3.

Note that ground elevations provided for the previous test holes were accurate at the time of their respective investigation, but may not be accurate currently, depending on site activities. The ground elevations provided for the current investigation are accurate as of April 2017.

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. The subsurface soils were classified in general accordance with ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

The split spoon samples of the cohesive soils were examined in our laboratory as part of the laboratory review. The consistency of these soil samples was estimated based on tactile examination, as the SPT results tend to underestimate the consistency. The state of compactness of the coarse grained soils was interpreted based on standard correlations with the SPT N values.

Three (3) representative split spoon samples of coarse-grained soils were submitted for grain size analyses. The testing was performed in general accordance with ASTM C117 Test Method for Materials Finer Than 75-m (No. 200) Sieve in Mineral Aggregates by Washing and ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates. The results of the grain size analysis testing are presented on the Grain Size Distribution sheets, in Appendix 2.

A total of 11 Shelby Tube samples were recovered from the new boreholes during the course of the present investigation. The Shelby tube samples were saved and stored for testing purposes. Shear strength testing, using a Geonor-style vane was conducted on all Shelby tubes samples.

The Shelby tube samples that were used for consolidation testing were processed further to determine the water content, as well as to record a description of the soil. Atterberg Limits testing was conducted on two (2) of the consolidation test samples and four (4) split spoon samples to determine representative plasticity characteristics. The Atterberg Limits results are provided on a plasticity chart in Appendix 2.

To provide the necessary geotechnical data pertaining to the permissible grade raises for the site and to provide information for settlement analyses, selected undisturbed samples of the silty clay stratum, recovered using a piston sampler in Shelby tubes, were subjected to consolidation testing in our laboratory. Six (6) Shelby tube samples from the new boreholes within Mahogany Community - Stages 2 to 4, were submitted to our geotechnical laboratory for unidimensional consolidation testing.

Eight (8) consolidation tests were previously conducted on samples recovered during previous investigation phases within the subject areas.

The results of the current consolidation tests were assessed for relative sample disturbance, based on estimating the disturbance ratio (Lacasse et. al.) from the test readings, and comparing it to the applicable acceptable range, as part of the consolidation test interpretation. The relative sample disturbance for the previous consolidation tests was also evaluated and classed as “G” for good, “A” for acceptable or “P” for poor and likely disturbed.

The current and previous consolidation test results are summarized in Table 2, in Appendix 2, and are discussed under subsection 5.3 of this report. Consolidation Test sheets showing test results on samples from the current and applicable previous boreholes are also provided in Appendix 2 after Table 2.

3.4 Analytical Testing

Three (3) 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 2 and are discussed further in Subsection 6.7.

Paracel Laboratories (Paracel), of Ottawa, performed the laboratory analysis of the soil sample submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Environmental Analytical Laboratories (SCC/CAEAL). Paracel is accredited and certified by SCC/CAEAL for specific tests registered with the association.

The following testing guidelines were utilized for the submitted soil samples. The anions were analyzed using EPA 300.1, the pH was analyzed using EPA 150.1, the resistivity was analyzed using EPA 120.1, and the percent solids was determined using gravimetrics.

4.0 Observations

4.1 Surface Conditions

The current development site (Stages 2, 3 and 4) is currently undeveloped primarily former agricultural land and covers an area of over 75 hectares, including the SWMF's, with several treed areas and a glacial drumlin feature. Mahogany Creek runs adjacent to the east boundary of Stage 2, and separates it from Stage 1, and the Wilson Cowan Drain runs through Stage 4 towards the western boundary of the currently proposed stages. Future Stage 5 is located to the west of Stage 4 and to the east of Mud Creek.

A sanitary pumping station was previously constructed in the northeast corner of Stage 2. Construction roadways are present along the east boundary of Stage 2 with access for fill dumping from Stage 1. The fill piles generally consist of native glacial till (till) material removed during the construction of Stage 1.

The subject parcel has minimal natural topographical relief, but is generally sloping downwards from west to east towards the Rideau River. The drumlin (till) land form feature provides localized topographic elevation change. The ground surface elevation generally varies from 90 to 91 m with a topographical high point in the west central area with elevations ranging from 90 to 94 m.

4.2 Subsurface Profile

The ground surface at the site is covered with 0.1 to 0.3 m of topsoil. Below the topsoil, the soil profile encountered at the test hole locations consists predominantly of a silty clay deposit with areas of a thin silty sand layer overlying the silty clay deposit. A glacial till (till) deposit consisting of a matrix that ranges from silty sand to silty clay with gravel and cobbles was generally encountered below the silty clay layer in the north portion of the site. Some areas, generally in the north of the development, consist solely of glacial till from ground surface, prior to refusal.

Bedrock was inferred based upon refusal to augering or Dynamic Cone Penetration Testing (DCPT). Note that many of the test hole logs were recorded based on investigations conducted between the years 2000 to 2008 and surficial alterations may have occurred between the recording date and the time of writing this report.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole at the time of investigation.

Silty Sand

A thin layer of silty sand was found typically overlying the silty clay layer in the south and portions of the eastern and western extents of Stages 2, 4 and 5. The silty sand layer ranges from 0.1 to 1.3 m depth from ground surface with thicker layers to the south.

Silty Clay

A layer of sensitive silty clay, ranging from 0.1 to 10.1 m below ground surface was typically encountered across Stages 2 to 4, and extending into Stage 5. The results of the DCPT indicate that silty clay may be inferred to occasionally extend to greater than 13 m in depth from ground surface.

The upper part of the silty clay stratum is generally brown in colour and can generally be considered to have been desiccated to a “crust”. The results of the SPTs and shear strength tests indicate that the consistency of the silty clay crust is within the very stiff to stiff ranges. The shear strength of the silty clay can be expected to decrease with increasing depth as the deposit transitions to a grey silty clay. Shear strength versus elevation plots are provided for various parts of the site on Figures 2 to 7 (Appendix 2).

Where the silty clay layer is thin, and then is generally underlain directly by glacial till, it is generally very stiff to stiff throughout its profile, with water contents in the range of 30 to 50%. Most of these locations are within the northern part of the site.

Where the thicker deposits of silty clay are encountered, the silty clay is sensitive and the shear strength below the stiff crust ranges to as low as a firm consistency. This silty clay has measured water contents generally within the range of 30 to 75%.

The interpretation of the consistency of the upper part of the silty clay stratum from the SPT results has been based on local knowledge of the correlation between the SPT "N" values and the shear strength, supplemented by tactile observation of the recovered clay samples in our laboratory. This interpretation has been supplemented with shear strength testing of the crust using the field vane.

Where the cohesive soil layers are thicker, extensive shear vane testing was conducted, and the sensitivity of the deeper, grey silty clay is interpreted to be within the sensitive to extra-sensitive ranges. Where the silty clay layers are thinner, and within the upper crust of the thicker layers, and the consistency is interpreted to be very stiff, the sensitivity, based on the shear strength results and the tactile examination of the recovered samples, is within the "sensitive" range. Sensitivity ranges are provided in the Symbols and Terms document, in Appendix 1.

The Atterberg Limits test results indicate that three (3) cohesive soil samples tested are classified as clays of low plasticity (CL) and five (5) as clays of high plasticity (CH). The results of the Atterberg Limits testing are provided in Appendix 2.

Six (6) samples of the silty clay were subjected to unidimensional consolidation testing under the current investigative work. Eight (8) samples of the silty clay from the previous investigations had also been subjected to unidimensional consolidation testing with four (4) sample results from boreholes within the current development area. The plotted results of the 6 current test samples, and the 8 previous test samples are presented in Appendix 2 and are discussed under subsection 6.3. All the applicable test results from the current and previous investigations are summarized in Table 2, in Appendix 2.

The consolidation test results indicate that the silty clay is overconsolidated with overconsolidation ratios for the tested samples (with acceptable disturbance ratios) varying between 1.3 and 2.8, with a mean of 2.0. For purposes of comparison, in the presentation of the current test results, it has been assumed that the clay crust thickness is 4.0 m and the low pre-development groundwater level is 3.5. For purposes of analyses, however, the crust thickness varies between 3 and 4 m and the low GWL varies between 2.5 and 3.5 m. The long-term (post-development) low groundwater level is taken to be located 0.5 deeper in the profile (i.e. 3.0 to 4.0 m depth).

A disturbance ratio has been estimated from the initial loading portion of each of the current consolidation test samples to assess whether the sample is acceptable (undisturbed) or disturbed/possibly disturbed. The disturbance ratio is compared to the acceptable range (for acceptable samples) or the upper acceptable limit (for disturbed samples) in Table 2. The specific disturbance ratio was not tabulated for the previous tests from 2007 and 2008, although the results of the relative sample disturbance assessment are provided in Table 2.

Glacial Till

The glacial till soils encountered within the subject development consist of a silty sand to silty clay matrix containing varying quantities of gravel, cobbles and boulders.

Three (3) split spoon samples were submitted for grain size analyses from the proposed stormwater pond facility areas. The results are presented on the Grain Size Distribution sheets in Appendix 2. The textural descriptions of the samples are indicated under the Classification heading, along with the Unified Classification group. Tested samples varied from GM to SM.

The results of the SPTs indicate that the state of compaction of these coarse-grained soils is predominantly within the compact to very dense ranges.

The investigation was conducted using hollow stem augers, which require a “plug” to be removed prior to retrieving a sample. There were a few localized zones within the deposits that appeared, based on their SPT “N” values to be within the loose range. These “loose” zones were confined within or above compact to dense deposits, but are located below the groundwater level and the underside of the clay, and it is inferred that the state of compaction of these samples has been underestimated because of the conditions during sampling. Shallow deposits of loose glacial till were encountered at BHs 50-17 and 51-17, and were underlain by compact to dense deposits.

Bedrock

Augering was conducted, under the current investigation, to the depth of practical refusal, at BH 52-17 and BH 55-17 at depths of 8.8 and 9.7 m, respectively.

Previous investigations encountered practical refusal to augering at BH 6-07, BH 7-07, BH 8-07, BH 19-07, BH 21-07, BH 26-07, BH 29-07, BH 35-07 and BH 39-07 for File PG0675 and at BH 3-04B and BH 6-04B for File PG0328. Practical refusal was encountered at depths of 4.7, 2.4, 6.0, 4.5, 3.7, 4.6, 3.7, 2.1, and 7.1 m, respectively, for PG0675, and at 12.7 and 7.1 m, respectively, for PG0328, respectively. The elevations corresponding to these depths are shown in parentheses on the Test Hole Location Plan, Drawing No. PG4008-1, in Appendix 3.

The depths of practical refusal to augering do not necessarily indicate the position of the bedrock and in many cases may be within dense soil and/or on cobbles and/or boulders within the glacial till.

Based on digital geological mapping produced by Natural Resources Canada, sourced from the Geological Survey of Canada, the bedrock in this area consists of dolomite of the Oxford formation with an overburden drift thickness of 5 to 15 m depth.

4.3 Groundwater

The measured groundwater levels from the current investigation are presented in Table 1, below. Reference should be made to the Soil Profile and Test Data sheets for the groundwater levels recorded from the previous investigation stages.

The groundwater levels in BH 52-17, BH 53-17, BH 55-17, and BH 58-17 were measured in the standpipe tubing. The groundwater levels in the remaining boreholes were measured in monitoring wells, consisting of 50 mm diameter PVC screen and risers with protective steel casing extending above ground surface.

Table 1: Summary of Groundwater Level Readings

Borehole Number	Ground Elevation, m	Groundwater Levels, m		Recording Date
		Depth	Elevation	
BH 50-17	90.06	0.49	89.57	April 13, 2017
BH 51-17	89.78	0.51	89.27	April 13, 2017
BH 52-17	89.29	-0.10	89.39	April 13, 2017
BH 53-17	89.54	0.12	89.42	April 13, 2017
BH 54-17	89.19	0.19	89.00	April 13, 2017
BH 55-17	89.20	-0.22	89.42	April 13, 2017
BH 56-17	88.84	0.28	88.56	April 13, 2017
BH 57-17	88.55	-0.19	88.74	April 13, 2017
BH 58-17	89.04	2.62	86.42	April 13, 2017
BH 59-17	88.78	0.07	88.71	April 13, 2017

Notes: 1. The ground surface elevations at the test hole locations were provided by AOV Ltd. and are referenced to geodetic datum.

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

Where the groundwater was encountered, the recorded groundwater depths varied from 0.2 above ground surface to 2.6 m bgs. The elevations varied from to 89.4 to 86.4 m.

5.0 Discussion

5.1 Geotechnical Assessment

Based on the results of the current and previous geotechnical investigations, the subject site is suitable, from a geotechnical perspective, for the proposed residential development. The geotechnical conditions at the site are not restrictive with respect to the density of the development with respect to lot size and frontage. Considering that parts of the site are underlain by sensitive silty clay deposits, those portions of the site may be subject to grade raise restrictions.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, and any fill containing deleterious or organic materials, should be stripped from under any buildings and other settlement sensitive structures, such as retaining walls, hard landscaping and pavements.

Fill Placement

Fill used for grading beneath building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A, Granular B Type II, Granular B Type I or select subgrade material. This material should be tested and approved prior to delivery to the site. Testing may consist of the suppliers own Quality Control testing, or samples can be submitted to the geotechnical consultant for testing. Initial acceptance testing can consist of gradation analyses and comparison to OPSS MUNI 1010 (Nov, 2013) gradation limits.

The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Engineered fill placed beneath the buildings should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD) value. Engineered fill placed below the subgrade level for pavements should be compacted to at least 95% of its SPMDD value. The materials comprising the pavement structures should be compacted to at least 100% of their SPMDD values.

The laboratory testing reference for the specified density is ASTM D698-07 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).

Site-excavated soil, along with non-specified existing fill, 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. It is anticipated that site-excavated material within the glacial till areas will include cobbles and large boulders. Boulders should be culled from the material before reuse to allow the resulting material to be placed in appropriate lift thicknesses.

If site-excavated soil materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. These materials should meet the requirements for Select Subgrade Material (SSM) under OPSS MUNI 1010 (Nov, 2013). Non-specified existing fill and site-excavated soils, are not suitable as backfill against foundation walls unless a composite drainage blanket, connected to a perimeter drainage system, is provided.

5.3 Foundation Design

Limit States Design

The Ontario Building Code (OBC 2012) Part 9 residential structures that are proposed for the development will be founded on either glacial till, stiff to very stiff silty clay over glacial till or stiff silty clay over sensitive silty clay. For those foundations located on glacial till directly or stiff to very stiff silty clay over glacial till, the foundation design provisions of OBC Part 9, namely prescriptive or working stress allowable soil pressure methods will be applicable. For those foundations located on stiff silty clay over sensitive silty clay, where grade raise restrictions will be in effect, it is a requirement that the foundations for the proposed Part 9 structures be designed according to the requirements of Part 4 of the OBC 2012.

Limit States Design is the only design method permitted under Part 4 of OBC 2012. As such, the OBC Part 4 footing foundations for structures are required to be designed for the Bearing Resistance at Serviceability Limit States (SLS) and the Factored Bearing Resistance at Ultimate Limit States (ULS). For simplicity in interpretation for this project, the limit states design method will be used for all the foundation design.

The bearing resistance at SLS pertains to the permissible (geotechnical) serviceability or deformation-related bearing resistance. Unfactored foundation loads are used in conjunction with the bearing resistance at SLS values. For the subject development, the bearing resistance at SLS value can be established on a lot-by-lot basis, based on traditional shear strength testing and bearing capacity formulae used to establish the old working stress “allowable bearing pressure” values, provided the effects of grade raise and groundwater position stresses have been considered.

The bearing resistance at SLS values are generally equivalent to the allowable bearing pressure values for working stress design.

The factored bearing resistance at ULS pertains to the ultimate (geotechnical) capacity of the bearing medium, reduced by a geotechnical resistance factor. The geotechnical resistance factor is 0.5 for footing foundations. Factored loads are used in conjunction with the factored bearing resistance at ULS values.

Bearing Resistance for Shallow Foundations

Founding conditions at the site are favourable for the construction of the light residential structures that are proposed, provided that the grade raise is within an acceptable range. Based on the subsurface profiles encountered, it is expected that the bearing medium will consist of either glacial till, stiff to very stiff silty clay over glacial till or stiff silty clay over sensitive silty clay. The glacial till or stiff to very stiff silty clay over glacial till bearing media can be provided with reliable bearing resistance values at this stage. The stiff silty clay over sensitive silty clay bearing media can be assigned preliminary bearing resistance values, to be refined during detailed grading review and then confirmed at the time of foundation construction.

The founding levels of conventional full-basement singles and/or town home structures will be of the order of 2.1 m below finished exterior grade at the front of the houses, and these structures are expected have up to 60 kN/m full (unfactored) foundation wall loads.

Glacial Till or Stiff Silty Clay over Glacial Till Bearing Media

For either glacial till or stiff to very stiff silty clay over glacial till bearing media, the following bearing resistance values are applicable. Strip or square footings, up to 3 m wide, placed on undisturbed soil bearing surfaces can be designed using a bearing resistance at SLS (serviceability limit states) value of **100 kPa** and a factored bearing resistance at ULS (ultimate limit states) value of **175 kPa**. A geotechnical resistance factor of 0.5 has been applied to the above noted bearing resistance at ULS value. These values should be confirmed by field review by geotechnical personnel at the time of construction.

Note that the allowable soil pressure for working stress design can be taken to be equal to the bearing resistance at SLS values, as noted above, for the appropriate bearing medium.

Sensitive Silty Clay Bearing Media

For sensitive silty clay bearing media at this development, for the types of structures presently proposed, the bearing resistance at SLS (equivalent to the allowable bearing pressure) will generally govern the foundation design for structures to be supported on footings.

Footings founded over sensitive silty clay, for structures with up to 60 kN/m full (unfactored) foundation wall loads and 100 kN full (unfactored and not including footing weight) column loads, can generally be designed using a **bearing resistance at SLS (allowable bearing pressure) value of 70 kPa**. A **factored bearing resistance at ULS value of 105 kPa** (incorporating a geotechnical resistance factor of 0.5) can be used for the above foundation loading cases. These ranges of foundation loads are typical of one to two-storey wood-frame singles and/or town home structures. Higher bearing resistance values may be applicable, depending on factors such as grading, crust thickness and underlying shear strength.

Depending on the structure configuration, such as garages, porches, slabs-on-grade, and the grade raise as compared to permissible grades, lightweight fill (LWF) materials may be recommended for the above-noted bearing resistance values to be applicable, especially where the grade raise levels approach the maximum permissible, and as the depth of foundations approaches the underside of stiff crust levels.

Bearing Medium Review Observations

On-site bearing medium assessment observations are recommended as part of the geotechnical field review. Observations and, where applicable, the results of shear strength testing conducted from the excavation level are used to assess the allowable bearing pressure, or bearing resistance at SLS, for the sizing of footings, based on footing matrices prepared by the structural engineer and reviewed, in consideration of the (approved) proposed grading by the Paterson geotechnical project manager.

As such, for one to two-storey wood-frame full basement or slab-on-grade town homes and/or singles within the subject development, the bearing resistance at SLS value can be confirmed on a lot-by-lot or town home block-by-block basis, based on traditional shear strength testing within the house excavations at the time of construction.

The above-noted bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one 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.

Where fill is required to raise the grade below the footing level, or to replace unsuitable material, the fill located within the zones of influence of the footings should consist of engineered fill, as described under Subsection 5.2. The bearing resistance at SLS values for footings placed on engineered fill should generally be equivalent to the above-noted values for footings on native soil.

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 compact to dense glacial till and/or stiff to firm silty clay 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 or engineered fill of the same or higher capacity as the bearing medium soil.

Foundation Settlement

Footings designed using the above-noted bearing resistance at SLS values will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively. These are the generally accepted tolerable settlement values for wood-frame residential construction. Refer to section 5.4 for recommendations concerning permissible grade raises that need to be respected for these foundation settlement limits to be applicable.

5.4 Permissible Grade Raises

The Mahogany Community has areas that are insensitive to grade raises, as part of the proposed development, and areas that are sensitive to grade raises. Generally those areas that have only glacial till and/or stiff to very stiff clay deposits within the soil profile are not sensitive to grade raises and high permissible grade raise values are applicable. Those areas that are underlain by stiff to firm sensitive silty clay are sensitive to the potential effects of development grade raises and have specific permissible grade raise values. This issue is discussed in more detail below.

Grading in Glacial Till or Stiff Silty Clay over Glacial Till Areas

A permissible grade raise of up to 3.0 m is applicable for the portions of the development within the area underlain by either glacial till or stiff to very stiff silty clay over glacial till deposits. If the permissible grade raise is to be exceeded in these areas, the Geotechnical Consultant should be asked to review the grading plan. Greater grade raises could be acceptable in many areas on the basis of further review and/or further investigation and testing.

Grading in Sensitive Silty Clay Areas

In areas underlain by sensitive silty clay, consideration must be given to potential post construction settlements that can occur due to the compression of the deep silty clay deposit under the combination of the loads from the footings, the grade raise fill pressures and groundwater lowering effects.

Consolidation Testing

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. A total of 14 site specific consolidation tests were carried out on undisturbed sensitive clay samples recovered from current or previously reported boreholes within the Mahogany Community development parcel, of which 10 tests were located within Stages 2 to 4 of the development.

The results of the all the consolidation testing are plotted and tabulated in Appendix 2.

The shear strength tests conducted in the current boreholes and applicable previous boreholes have been plotted against elevation and this information is provided graphically in several figures, in Appendix 2, representing portions of the proposed Mahogany Community. These plots consist of Figure 2 (Stage 2 North), Figure 3 (Stage 2 South), Figure 4 (Stage 3 North), Figure 5 (Stage 3 South), Figure 4 (Stage 4) and Figure 5 (Stage 5).

Value p'_c is the preconsolidation pressure of the sample and p'_o is the effective overburden pressure (for the applicable groundwater level, as noted in the table). 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 cannot exceed the available preconsolidation if the potential total and differential settlements are to be maintained within tolerable limits for the proposed development.

The values C_{cr} and C_c are the recompression and compression indices, respectively, and are a measure of the compressibility of the soil 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.

It should be noted that the values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering practices and are estimates only.

Groundwater Level Considerations

The effective overburden stress, p'_o, is directly influenced by the groundwater level. While the groundwater levels were measured at the time of the fieldwork, the levels tend to vary, especially seasonally, and this has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Higher than tolerable settlements could be induced by a significant lowering of the groundwater level. The groundwater levels were measured, in the current boreholes, at depths between just above ground surface and 2.6 m below existing ground surface. For purposes of analysis, however, the realistic low groundwater level is inferred to be located at between 2.5 and 3.5 m depth below the original ground surface level in the sensitive clay areas, based on the thickness of the stiff clay crust, ranging from 3 to 4 m in thickness.

The effective overburden stresses for the consolidation test samples, provided in Table 2, in Appendix 2, were estimated using a low groundwater depth of 3.5 metres. Long-term low groundwater levels of 2.5 to 3.5 m depth below original ground level, were used for the determination of the p'_o values for the settlement analyses carried out for the present investigation.

It has been considered that the groundwater level will vary seasonally and may be affected by other factors that could reduce groundwater infiltration as part of development (pavements, storm sewers, etc.) or promote groundwater depletion (trees, dry seasons, etc). As such, our analyses have considered the post-development long term groundwater level at a position 0.5 m lower than the assumed long-term low seasonal groundwater level of 2.5 to 3.5 m below OGS.

Settlement Analyses Results and Discussion

Our analyses considered a long-term groundwater level drawdown of 0.5 m, used approximately 80% of the estimated soil overconsolidation, continuously applied foundation wall loads of 50 kPa on a 0.9 m wide footing (i.e. continuously applied wall loads of 45 kN/m), and conventional slab-on-fill garage construction. The foundation load represents full dead load and 50% of live load, as discussed previously.

Analyses were also conducted for conditions where lightweight fill (LWF) material is used under the garage (and porch) slab-on-grade. The LWF, as described later in this report, is used to reduce the weight of the garage fill and, thereby, reduce the estimated settlement of the garage footings, which are the limiting serviceability design case for a conventional house.

Based on geotechnical considerations, and the above-noted criteria, permissible grade raises for conventional (i.e. no LWF) construction have been determined at each applicable borehole location and are summarized in Table 3, on the following page. The permissible grade raises thickness values have also been expressed as finished grades in Table 3, using the OGS values, and these permissible finished grades should be compared to the finished grades, measured at the garage, from grading plans. This permissible grading information, as well as the limits of the portions of Stages 2, 3 and 4 where specific grade restrictions are applicable, is also provided on Drawing No. PG4008-2, Permissible Grade Raise Plan, in Appendix 3.

Table 3: Permissible Grade Raise at Borehole Locations - Stages 2, 3 and 4

Borehole Number	Ground Elev. (m)	Permissible Grade Raise - No LWF		Permissible Grade Raise - LWF	
		Raise (m)	Fin. Grade (m)	Raise (m)	Fin. Grade (m)
Mahogany Stage 2					
BH 55-17	89.20	1.50	90.70	1.90	91.10
BH 56-17	88.80	2.00	90.80	2.40	91.20
BH 12-07	88.60	2.50	91.10	2.90	91.50
BH 17-07	89.10	2.00	91.10	2.40	91.50
BH 18-07	89.00	2.00	91.00	2.40	91.40
BH 22-07	89.30	2.00	91.30	2.40	91.70
BH 23-07	89.40	2.50	91.90	2.90	92.30
BH 3-04B	88.90	2.50	91.40	2.90	91.80
BH 4-04B	89.30	2.50	91.80	2.90	92.20
Mahogany Stage 3					
BH 54-17	89.20	1.50	90.70	1.90	91.10
BH 34-07	88.90	1.80	90.70	2.20	91.10
BH 5-04B	89.20	2.50	91.70	2.90	92.10
Mahogany Stage 4					
BH 52-17	89.30	2.20	91.50	2.60	91.90
BH 28-07	89.30	2.20	91.50	2.60	91.90
BH 9-04	89.00	2.20	91.20	2.60	91.60
BH 10-04	88.90	2.20	91.10	2.60	91.50

Notes:

1. “Permissible Grade Raises - No LWF” are based on conventional wood-frame single home or town home housing construction with normal weight fill within garage, porch or floor slabs-on-grade (for back-to-back town home homes).
2. “Permissible Grade Raises - LWF” are based on installing EPS LWF in garages and porches and/or under slab-on-grade floors. Up to 0.4 to 0.6 m of additional grade raise can be achieved using LWF in garages and porches for singles and town homes.

3 Permissible Grade Raises - No LWF values for boreholes not listed in this table can be taken to be 3.0 m, and may be greater, based on specific geotechnical review.

The basic grade raise limits are referenced with respect to the garage of the houses, as this is the most critical grading condition for the structures, in terms of differential settlement, for conventional slab-on-fill garage construction. The basic permissible grade raise is limited by settlement of the garage and, as such, can be exceeded by up to at least 0.5 m if techniques are used to reduce the settlement of the garage (and slab-on-fill porch) portion of the house, as described later in this report section. If reference to the centreline of the road is desired, the permissible grade raise value can be reduced by 0.4 to 0.5 metres.

Techniques to Reduce Settlements

The techniques that can be used to reduce the garage settlement include using lightweight fill (such as EPS foam insulation) in garages and slab-on-fill porches and/or using structural garage and porch floor slabs over a basement or cold storage. For slab-on-grade terrace homes and back-to-back town homes, EPS LWF can be used under the floor slabs, as well as on the exterior around the perimeter to meet the tolerable settlement objectives.

The differential settlements will be somewhat dependent on the design of the buildings. Differential settlements can result in the cracking of foundation walls and other structural/serviceability problems (deformation of door and window frames, etc).

The potential post construction total and differential settlements are influenced by the position of the long-term groundwater level when building over thick deposits of compressible silty clay. While efforts can be made to reduce the impacts of the residential development on the long-term groundwater level, by placing clay dykes or seepage barriers in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge and limiting the planting of trees to areas away from the buildings, it is not economically possible in the context of a residential development to absolutely control the level of the groundwater.

It is, therefore, prudent to allow for some level of post-development groundwater lowering, although the low permeability clay soils in the study area are not conducive to rapid groundwater fluctuations and groundwater lowering. It is recommended that a long-term groundwater lowering of 0.5 m be considered when estimating settlements at this site. The levels of the foundations, and in turn the foundation drainage systems, for the grading presently proposed, will generally be above the estimated seasonal low groundwater level of 2.5 to 3.5 m depth below ground surface.

Means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc) should be implemented for the proposed development. It is not possible to economically prevent all potential cracking of foundation walls and slabs in residential construction using standard construction practices. It should be noted that building on thick silty clay deposit increases the likelihood of house movements and therefore of cracking. It is recommended that reinforcing steel be provided in the foundation walls of all structures to make the structures more resistant to the effects of differential settlement.

5.5 Geotechnical Grading Plan Review

The site grading for the development is being designed by Stantec Consulting Limited (Stantec). Paterson will be providing geotechnical review of the development grading plans, prepared by Stantec as the grading design progresses to ensure that the grading plans are in general conformance with our geotechnical recommendations.

5.6 Design for Earthquakes

The site class for seismic site response can be taken as Class C for the foundations considered at this site that are located within the areas that consist of glacial till soils or very stiff to stiff silty clay over glacial till and do not include sensitive silty clay. This is primarily the north part of the development.

The site class for seismic site response can be taken as Class D for the foundations considered at this site that are located within areas that contain sensitive silty clay. This is primarily the south part of the development.

This assessment was based on (rational) average Vs using representative subsurface profiles, where the test holes were extended to practical refusal, as shown on Table 4, in Appendix 2. Reference should be made to the Ontario Building Code 2012 for a full discussion of the earthquake design requirements.

The soils underlying the subject site are not susceptible to seismic liquefaction. The shallow loose sand at various boreholes is not expected to be used as a bearing medium. The glacial till soils below the groundwater level and the silty clay that had low “N” values have been inferred to actually be compact to dense deposits and, therefore, not susceptible. The state of compaction had been underestimated by the testing within the hollow stem auger. The high silt contents observed in the glacial till soils also significantly reduces the risk of liquefaction.

The Bray criteria have been interpreted to confirm that the plasticity characteristics of the silty clay soils encountered at the site are not susceptible to loss of strength under the cyclic loading that would occur during and earthquake, as described in more detail below. As previously noted, the Atterberg Limits Results are provided in Appendix 1.

The Bray criteria states that soils with plasticity indices less than 20% may have reduced strength following the strong cyclic loading resulting from a severe earthquake. If reference is made to the Atterberg Limits Results, only one (1) of the eight (8) samples tested had a plasticity index less than 20. That sample was further evaluated and has a w/w_L of 0.80, at the upper limit of the acceptable criteria. The residual shear strength after cyclic loading will be the undisturbed undrained shear strength.

5.7 Pavement Structures

With the complete removal of all topsoil and any deleterious fill and/or organic soils, the uppermost in situ soils are suitable subgrade media for roadway construction. Recommended pavement material thicknesses for subdivision roads and subdivision collector roads (City of Ottawa standards) are provided in Tables 5 and 6, below and on the following page.

The pavement structure design for the subdivision collector roads is based on potential future municipal bus traffic loading.

Table 5: Recommended Pavement Material Thicknesses
Medium Duty - Local Subdivision Roads

Depth in Pavement Profile (mm)		Layer Thickness (mm)	Pavement Material Description
From	**To**		
0	40	40	**Wear Course:** SP 12.5 Asphaltic Concrete
40	90	50	**Binder Course:** SP 19.0 Asphaltic Concrete
90	240	150	**BASE:** OPSS Granular A
240	615	375	**SUBBASE:** OPSS Granular B Type II
615	615+	---	**SUBGRADE:** In situ soil and native trench fill materials.

Table 6: Recommended Pavement Material Thicknesses
Heavy Duty - Collector Roads - Bus Traffic

Depth in Pavement Profile (mm)		Layer Thickness (mm)	Pavement Material Description
From	To		
0	50	50	**Wear Course:** SP 12.5 Asphaltic Concrete
50	150	100	**Binder Course:** SP 19.0 Asphaltic Concrete
150	300	150	**BASE:** OPSS Granular A
300	750	450	**SUBBASE:** OPSS Granular B Type II
750	750+	---	**SUBGRADE:** In situ soil and native trench fill materials.

All granular base and subbase materials are required to be compacted to a minimum of 100 percent of Standard Proctor maximum dry density (SPMDD).

It can be foreseen that, depending on the location on site, and the time between the installation of services and the ensuing roadway construction, localized or extensive soft areas could be present over service trenches. In these localized areas, it may be necessary to subexcavate deleterious materials, and replace them with compacted granulars, providing tapers, where applicable.

The use of the “cow-path” technique of placing granulars may assist in these cases, namely placing the granular base in a double thick “path” down the middle of the road over the services and then spreading the material out with the dozer or loader prior to grading and compacting.

The use of woven geotextile, or preferably a biaxial geogrid over a non-woven geotextile, could be of some to significant benefit, with or without thickening the granular subbase, where onerous subgrade conditions prevail, especially over the trenches within the sensitive clay portions of the site. Guidelines in this regard can be provided by the geotechnical consultant at the time of construction (if required). These are considerations for localized conditions at time of construction, and geotextiles or geosynthetics are not a general requirement.

It is recommended that the road structure granular layers be protected from surface water. 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.

The pavement structure should maintain a suitable crown to shed water towards the available storm sewer catch basins. Consideration should be given to the placement of subdrains along the pavement edge for major roads, or “stubby” drains, leading into the catch basins at the subgrade level.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. Asphaltic concrete mixes should be in conformance with OPSS MUNI 1151 (Nov 2006), for Ontario Traffic Category C. The asphaltic concrete should be compacted in conformance with OPSS 310 (Nov 2012), Table 9.

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.

Due to the low permeability nature of much of the expected subgrade media, consideration should be given to installing subdrains during the pavement construction.

If pavement drainage is implemented, the subdrains should be installed at each catch basin as per City of Ottawa standards and specifications. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

5.8 Stormwater Management

Stormwater Management Facilities (SWMF’s) are proposed adjacent to the Wilson Cowan Drain, at the northwest corner of Stage 4 (West Pond), and adjacent to Mahogany Creek, at the northeast corner of Stage 2 (East Pond). These facilities are assumed to consist of wet ponds.

Review of the subsurface information indicates that the West SWMP (stormwater management pond) will encounter mixed soil strata consisting of 3 to 4 m of very stiff to stiff silty clay over compact glacial till. The sides of the West SWMP should be profiled at slopes no steeper than 3H:1V for stability considerations.

Considering that the glacial till may contain zones of open graded and more permeable structure, it is recommended that the glacial till portions of the sides and base of the pond be provided with a 0.6 m thick compacted clay liner. The clay liner material can be sourced from the upper silty clay layer and should be compacted in thin lifts, using pad-foot compaction equipment to a minimum of 98% of its SPMDD (standard Proctor maximum dry density) value.

Review of the information indicates that the East SWMP should encounter very stiff to stiff silty clay over its full depth. The sides of the West SWMP should be profiled at slopes no steeper than 3H:1V for stability considerations.

SWMP inlet and outlet structures can be placed on a granular bedding over undisturbed soil subgrade surfaces and can be designed using a bearing resistance at SLS (serviceability limit states) value of **100 kPa** and a factored bearing resistance at ULS (ultimate limit states) value of **175 kPa**. A geotechnical resistance factor of 0.5 has been applied to the bearing resistance at ULS value. These values should be confirmed by field review by geotechnical personnel at the time of construction.

Low Impact Development (LID) techniques may be implemented as part of the stormwater management for the development. The upper brown silty clay and the glacial till may be taken to have hydraulic conductivities in the 10^{-7} to 10^{-9} m/s and 10^{-6} to 10^{-8} m/s ranges, respectively. It is recommended that field permeameter testing be conducted once the preliminary locations of these features has been determined.

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 dwellings. The system should consist of a 100 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, such as clean sand or OPSS Granular B Type I material. The greater part of the site excavated native soil materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain 6000 or G100N), connected to a drainage system is provided.

Alternatively, backfill against the exterior sides of the foundation walls can consist of free-draining non frost susceptible granular materials, such as OPSS Granular B Type I material. No geotextile separator is required between these materials and the native soils, although the perforated foundation drainage pipe should have a geotextile “sock”.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures, including attached garages, 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 and wing walls may require more soil cover or a combination of soil cover and rigid insulation.

Manufactured rigid insulation can be used to supplement soil cover. As this generally requires a specific engineered design, incorporating specific foundation details, it should be addressed, if required, at Building Permit stage.

6.3 Sensitive Soil Foundation Design and Field Review Protocol

The reader should be aware that the City of Ottawa Building Services Branch has recommended a sensitive soils foundation design and field review protocol that has been fully implemented by Minto and their geotechnical and structural engineering consultants, and is considered to be applicable to the subject development.

The sensitive soils protocol is a comprehensive and holistic methodology that ensures that the structural design incorporates the geotechnical design elements. In addition, the construction-related elements, such as field measured shear strengths, underside of footing levels, grade raises, are checked or reviewed during construction and compared with the design assumptions, so modifications can be made where the results of the field observations warrant, and otherwise, as-built conditions can be confirmed to be according to design assumptions.

Bearing resistance values for footing designs should be confirmed on a lot-by-lot or town home block-by-block basis at the time of construction, as part of the protocol, to refine the recommended design values provided in this report.

6.4 Excavation Side Slopes

Unsupported Excavations

The side slopes of excavations in the soil 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 applicable structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavations for the residential structures to be undertaken by open-cut methods (i.e. unsupported excavations).

Temporary excavation side slopes above the groundwater level, and extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter.

Flatter excavation slopes will be required for excavation below the groundwater level. In the case of the glacial till and the silty sand/sandy silt, excavations below the groundwater will require slopes of 2H:1V or shallower. Where active groundwater seepage occurs, a non-woven geotextile can be placed over the toe of the slope, covered with clear stone to provide a free-draining ballast that lets seepage through but holds back the soil, and thereby reduce sloughing-in of the excavation toe.

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. The frequency of monitoring can be established by the geotechnical consultant at the time when the need arises, based on the specific conditions that warrant the monitoring.

Trench Excavations and Support

The installation of the proposed services in soils can be carried out safely within the confines of a trench box or in an open cut. An open cut in overburden materials will require that all side slopes be cut back at appropriate inclinations, as noted above, to maintain stability. If a shoring system (i.e. trench box) is used to support the walls of the cut, the trench box design should, for safety purposes, allow for additional surcharge pressures associated with construction equipment and stockpiled fill materials above the cut, although stockpiling of materials above excavations is strongly discouraged.

The interpretation of the soil descriptions in the Occupational Health and Safety Act, Regulations for Construction Projects, for purposes such as trench box design, should be undertaken by experienced geotechnical personnel. The information provided in the Soil Profile and Test Data sheets in Appendix 1 can be consulted for this purpose, with due consideration that the information is only accurate at the applicable test hole locations, and in consideration that the contractor's equipment and methods, as well as the depth of the excavation, can have a significant effect on the actual earth pressures in force at the time of construction.

Basal Instability of Trench Excavations

Basal instability of trench excavation can potentially be caused by two situations that could be encountered at this development.

Basal Instability in Weak Clays

There is a potential for basal heave to occur in deep excavations in firm to soft clay at the site. Our calculations indicate that there is a factor of safety against base heave of 2.0 for cuts of up to 5.5 metres in depth, and a factor of safety of 1.5 for cuts of 7.5 metres in depth for clays with a shear strength of 25 kPa. Generally the shear strengths of the sensitive silty clay at this site are in excess of 25 kPa, so we expect a low risk of basal instability due to weak clays.

Improved basal stability can be provided by keeping excavation lengths shorter and trench widths narrower. Cutting back the sides of the excavation at shallower slopes and/or "benching" the top of the excavation sides, also provides increased stability in this regard. The beneficial effects of the benching are improved by widening the benches and increasing the depth of the benches. Excavated materials can exert a surcharge and should not be placed beside the top of the trench cut. These materials should be placed a lateral distance equivalent to a minimum of 1.5 times the trench depth away from the side of the trench in order to minimize their surcharge effects. Where the work area for the shovel is weak, the use of steel plates, beams and/or wood timbers, under the front of its tracks should be considered.

Basal Instability in Sands and Silts

Where trench excavations will extend below the groundwater level in areas of sandy silt soils, such as some of the glacial till, basal instability could occur due to groundwater influx. This phenomenon is referred to as a “quick” condition, where the effective strength of the soil is reduced by upward flowing groundwater. This situation is exacerbated where the sand is overlain by a low permeability “confining” layer, such as silty clay, that extend below the groundwater level. When the excavation penetrates the confining layer, the sandy soil is under higher groundwater pressure and the ensuing seepage into the excavation leads to a quick condition.

It is recommended that trench excavations in areas where basal instability due to groundwater influx is observed should be dewatered from within the excavation by pumping in a slow and controlled manner in order to give time for the groundwater to be lowered beyond the excavation limits. In order to reduce the loss of soil fines from the trench base and walls, non-woven geotextile can be placed against the soil and covered with fine clear crushed stone. The geotextile will retain the soil fines, be held in place by the clear stone, and the clear stone will allow the influx water to be collected and pumped.

In extreme conditions, the basal instability can be avoided by lowering the groundwater level in the offending sand, silty sand or sandy silt soil stratum by pumping from deep wells or well-points installed outside the proposed excavation so that the excavation is completed “in the dry”.

Extensive dewatering should not be conducted without consideration of potential off-site effects if the work is being conducted in close proximity to existing structures that could be adversely affected by groundwater lowering.

6.5 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa. Trench details should be as per Detail Drawing Nos. W17, S6 and S7.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD value. The bedding material should extend at least to the spring line of the pipe.

Where site conditions at the bedding subgrade are poor, it may be necessary to subexcavate and increase the thickness of the bedding, as indicated in Note 5 of both Detail Drawing Nos. W17 and S6. For this development, such a case would be the result of unexpected conditions encountered during construction and would, therefore, be an evaluation to be made in the field. This would be an issue that would be evaluated as part of the field review services during construction.

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 value.

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.

6.6 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be moderate to high depending upon depth of excavation. Pumping from open or cased sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The use of non-woven geotextile and clear stone may be necessary to control silt and prevent clogging of submersible pumps. 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.

A temporary Ministry of the Environment and Climate Change (MOECC) 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 MOECC.

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 MOECC review of the PTTW application.

6.7 Additional Construction Precautions

Winter Construction

Precautions must be taken if winter construction is considered for this project.

The subsoil 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.

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.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice 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. Also, 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.

Protection of Clay Subgrades and Bearing Media

The silty clay soils encountered at several areas of the site are susceptible to disturbance due to drying shrinkage, and resulting cracking, under hot and/or windy conditions. These soils are also susceptible to disturbance due to machine and worker traffic, especially in the presence of water. Silty clay subgrades or bearing surface should not be left exposed for extended periods. Disturbed soil should be removed prior to placing granular fill over subgrades or concrete over bearing surfaces.

To reduce the propensity for drying shrinkage to occur during susceptible exposure conditions, subgrades should generally be covered with appropriate fill materials on a daily basis. Concrete for footings should be placed on bearing surfaces within two days of final excavation for bearing media, unless the surface is wet (i.e. from precipitation) or the bearing medium can be covered with a 100 mm to 150 mm thick layer of sand to provide protection for a week, with the sand removed from within the forms prior to concrete placement. It is recommended that all bearing surfaces be field-reviewed by geotechnical personnel prior to the placement of concrete or engineered fill.

6.8 Corrosion Potential and Sulphate

The results of the analytical testing for corrosion of four (4) soil samples from the current investigation are provided in Appendix 2. The results of analytical testing show that the sulphate content is less than 0.1% (1 mg/g). This result indicates that Type GU (general use) cement, as per CSA A23.1 Section 4.2.1.1.2, is appropriate for this site.

The chloride content is less than 400 mg/g and the pH of the sample is greater than 5. These results indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site. The resistivity values range from 7210 to 12100 ohm-cm and are indicative of a non-aggressive to slightly aggressive corrosive environment for exposed ferrous metals at this site, with the lower resistivity values indicating more aggressive conditions.

The appropriate concrete exposure class is “N”, for soil contact based on chloride content, where freezing and thawing (F-1 or F-2 exposure class) is not an issue.

6.9 Landscaping Considerations

Tree Planting Restrictions

Based on our review of the subsurface conditions, the soils underlying the site consist of a combination of fine-grained silty clays and coarse-grained silty sand and gravel glacial till. Where fine-grained silty clay soils are present, they are stiff to very stiff in consistency where the deposits are thin and stiff to very stiff in their upper part over firm silty clay where they are deeper. The fine-grained soils are classified as silty clays of low plasticity (CL) or silty clays of high plasticity (CH). From the perspective of volume change potential (shrinkage) related to trees, these soils are generally within the medium ($20\% \leq PI < 40\%$) range, as shown on the Atterberg Limits Results, in Appendix 2.

The standard City of Ottawa tree to structure setback of 7.5 m is too great to be realistic for this site that has medium volume change potential cohesive soils and negligible volume change potential glacial soils. Low to moderate water demand broadleaf trees or up to high water demand coniferous trees should be used in the landscape plan.

It is recommended that a minimum tree to foundation wall setback of 4.5 m should be provided for areas within the subject site where a silty clay deposit is encountered, and where large trees of up to 8 m in mature height are proposed.

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, and lower water demand trees should be used.

7.0 Recommendations

It is recommended that the following be carried out once the site development plans are finalized and during site development:

☐ Geotechnical review of development grading plans.

☐ 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 the completion of a satisfactory field review and materials testing 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.

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.

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) or entities other than Minto Communities Inc. or their agent(s) is not authorized without review by Paterson Group Inc. for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Tovell

Andrew J. Tovell, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Jul. 07-17
A. J. TOVELL
46812509
Tovell
PROVINCE OF ONTARIO

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS:

BH 50-17 to BH 59-17, Inclusive (File: PG4008)
BH 1-07 to BH 39-07, Inclusive (File: PG0675)
BH 40-08 to BH 49-08, Inclusive (File: PG0675)
BH 1-06 to BH 6-06, Inclusive (File: PG0834)
BH 1-04B to BH 6-04B, Inclusive (File: PG0328)
BH 1-04 to BH 12-04, Inclusive (File: PG0219)
TP 1-00 to TP 18-00, Inclusive (File: G7840)

SYMBOLS AND TERMS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. PG4008

REMARKS

HOLE NO. BH50-17

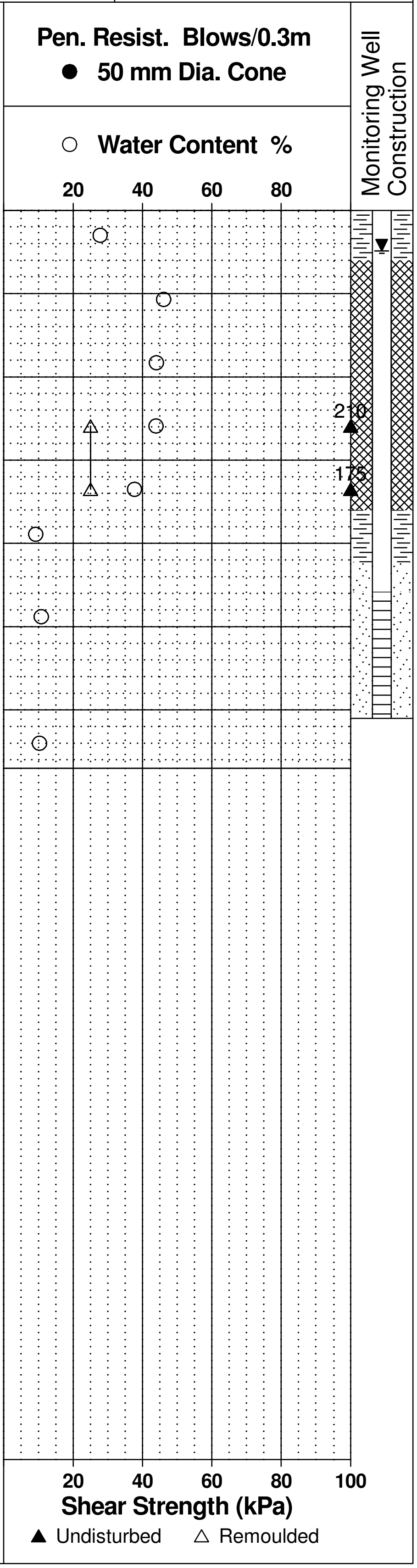
BORINGS BY CME 55 Power Auger

DATE April 3, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	90.06
TOPSOIL, trace organics and sand 0.28		SS	1	58	5		
Hard to very stiff, brown **SILTY CLAY,** trace sand seams		SS	2	100	13	1	89.06
		SS	3	100	6	2	88.06
						3	87.06
3.66							
GLACIAL TILL: Grey silty sand, some clay, cobbles and boulders		SS	4	71	10	4	86.06
		SS	5	42	6	5	85.06
		SS	6	58	11	6	84.06
6.70		SS	7	58	29		

End of Borehole

(GWL @ 0.49m - April 13, 2017)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 3, 2017

FILE NO. PG4008

HOLE NO. BH51-17

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.20

Hard to very stiff, brown **SILTY CLAY,** trace sand 2.95

Very stiff, brown **CLAYEY SILT** with sand 3.50

GLACIAL TILL: Grey silty sand with gravel and cobbles, some boulders 6.70

Dynamic Cone Penetration Test (DCPT) commenced at 6.70m depth 7.64

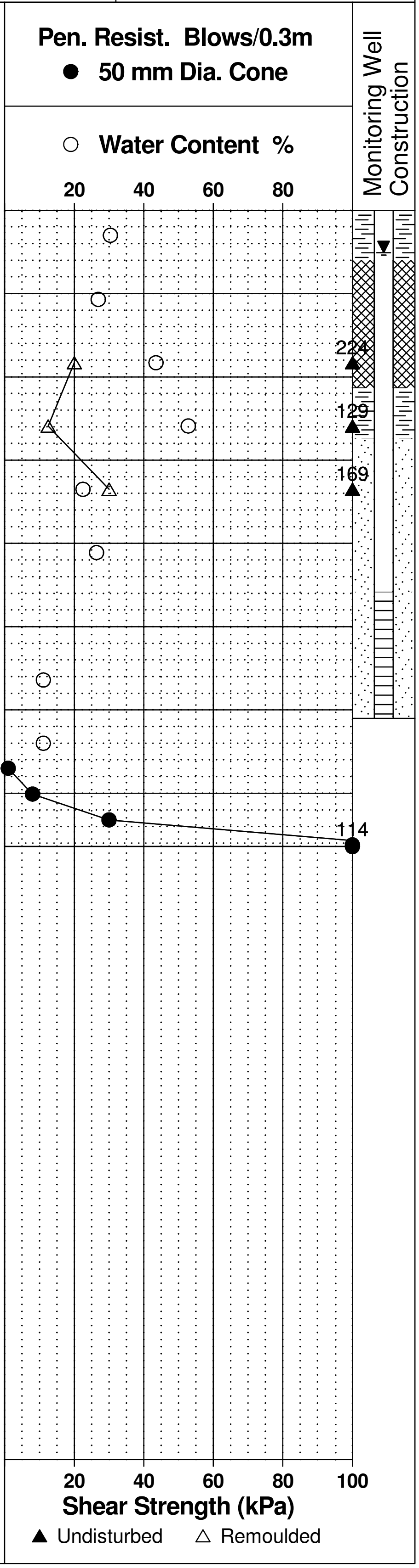
End of Borehole

Practical DCPT refusal at 7.64m depth

(GWL @ 0.51m - April 13, 2017)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	79	7
SS	2	96	10
SS	3	33	7
SS	4	75	3
SS	5	46	3
SS	6	58	6

DEPTH (m)	ELEV. (m)
0	89.78
1	88.78
2	87.78
3	86.78
4	85.78
5	84.78
6	83.78
7	82.78



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. **PG4008**

REMARKS

HOLE NO. **BH52-17**

BORINGS BY CME 55 Power Auger

DATE April 3, 2017

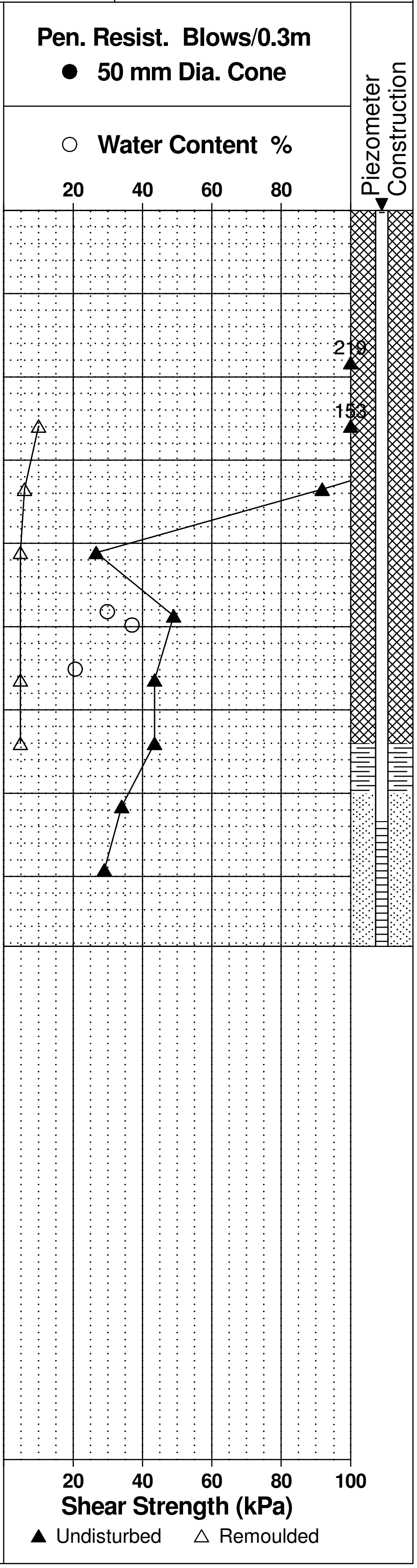
SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.25	SS	1	83	4
Hard to very stiff, brown **SILTY CLAY,** some sand - stiff to firm and grey by 3.2m depth	SS	2	100	5
	TW	3	98	
8.23	TW	4	100	
GLACIAL TILL: Grey silty sand, some gravel, cobbles and boulders 8.84	SS	5	47	50+

End of Borehole

Practical refusal to augering at 8.84m depth

(GWL @ 0.10m above ground surface - April 13, 2017)

DEPTH (m)	ELEV. (m)
0	89.29
1	88.29
2	87.29
3	86.29
4	85.29
5	84.29
6	83.29
7	82.29
8	81.29



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. PG4008

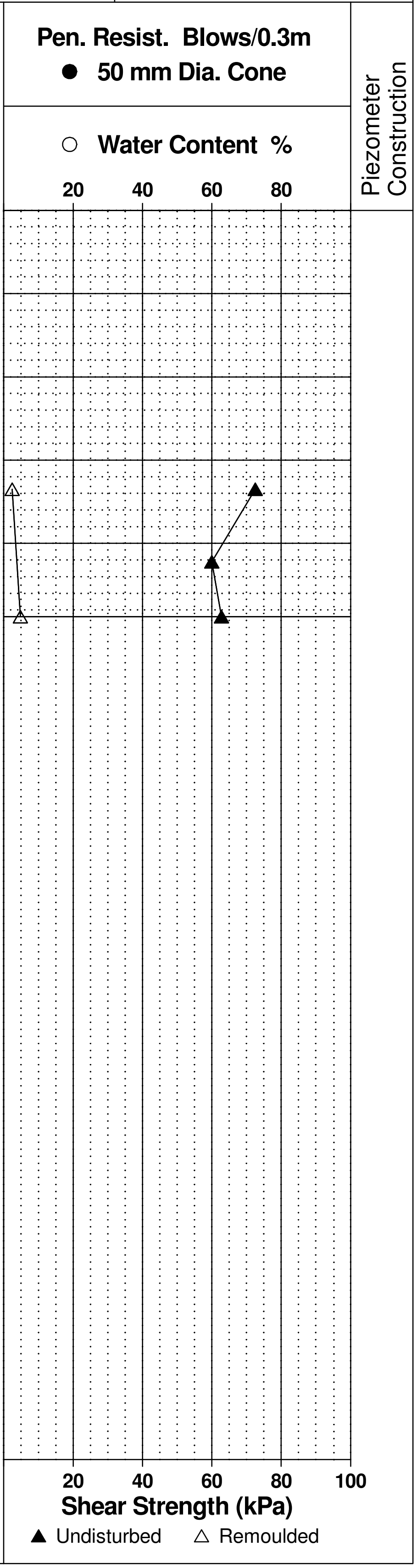
REMARKS

HOLE NO. BH52A-17

BORINGS BY CME 55 Power Auger

DATE April 3, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.29
TOPSOIL 0.25							
						1	88.29
Hard to very stiff, brown **SILTY CLAY,** some sand						2	87.29
- stiff and grey by 3.2m depth						3	86.29
		TW	1	67		4	85.29
4.88 End of Borehole							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. **PG4008**

REMARKS

HOLE NO. **BH53-17**

BORINGS BY CME 55 Power Auger

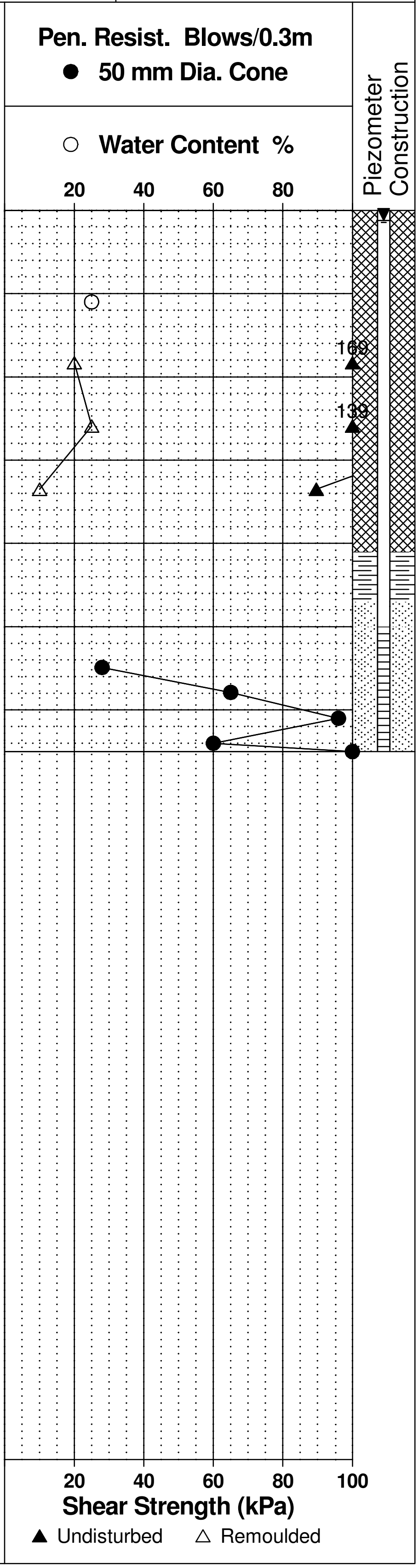
DATE March 31, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.54
TOPSOIL 0.15		SS	1	79	4		
		SS	2	100	6	1	88.54
Very stiff, brown **SILTY CLAY,** some sand						2	87.54
2.90							
Stiff, brown **CLAYEY SILT,** trace sand 3.66						3	86.54
GLACIAL TILL: Grey silty sand, some gravel, cobbles and boulders		SS	3	17	12	4	85.54
5.18		SS	4	67	35	5	84.54
Dynamic Cone Penetration Test (DCPT) commenced at 5.18m depth. Inferred **GLACIAL TILL** 6.50						6	83.54

End of Borehole

Practical DCPT refusal at 6.50m depth

(GWL @ 0.12m - April 13, 2017)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

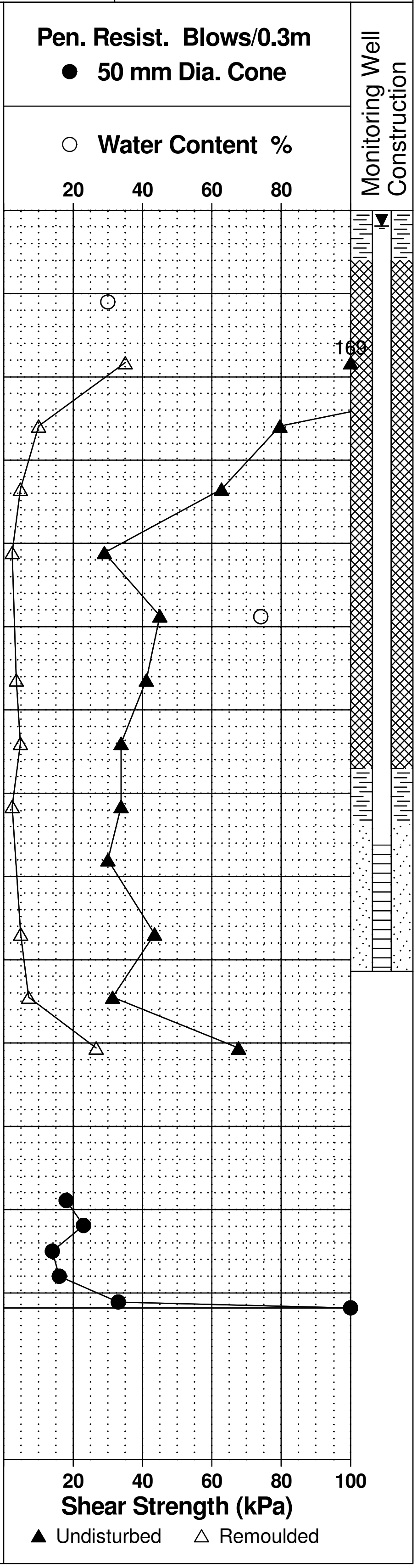
BORINGS BY CME 55 Power Auger

DATE March 31, 2017

FILE NO. PG4008

HOLE NO. BH54-17

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.19
TOPSOIL 0.20	SS	1	54	3		
	SS	2	100	4	1	88.19
Very stiff to stiff, brown **SILTY CLAY** with sand seams					2	87.19
- stiff to firm and grey by 2.7m depth					3	86.19
					4	85.19
	TW	3	100		5	84.19
					6	83.19
					7	82.19
	TW	4	71		8	81.19
8.38						
Firm, grey **CLAYEY SILT,** trace sand					9	80.19
10.06					10	79.19
Dynamic Cone Penetration Test commenced at 10.06m depth. Cone pushed to 11.6m depth.					11	78.19
					12	77.19
					13	76.19
13.18						
End of Borehole Practical DCPT refusal at 13.18m depth (GWL @ 0.19m - April 13, 2017)						



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. **PG4008**

REMARKS

HOLE NO. **BH55-17**

BORINGS BY CME 55 Power Auger

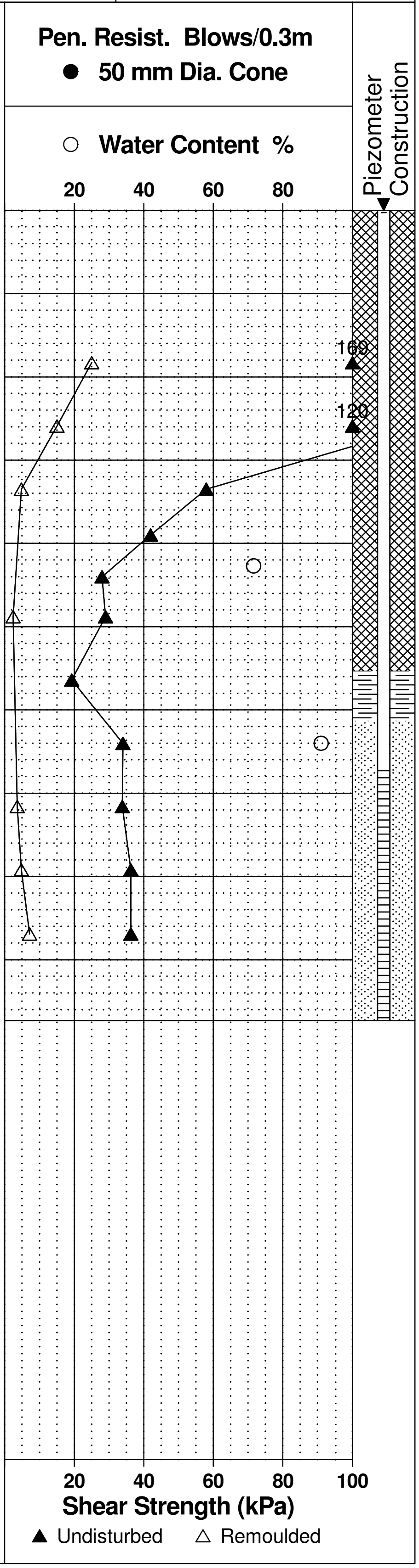
DATE March 31, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.20
TOPSOIL 0.23		SS	1	88	8		
		SS	2	96	5	1	88.20
Very stiff, brown **SILTY CLAY,** trace sand						2	87.20
- stiff to firm and grey by 2.7m depth						3	86.20
		TW	3	100		4	85.20
						5	84.20
		TW	4	100		6	83.20
						7	82.20
8.76						8	81.20
GLACIAL TILL: Grey silty sand, some gravel, cobbles and boulders 9.73		SS	5	36	50+	9	80.20

End of Borehole

Practical refusal to augering at 9.73m depth

(GWL @ 0.22m above ground surface - April 13, 2017)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

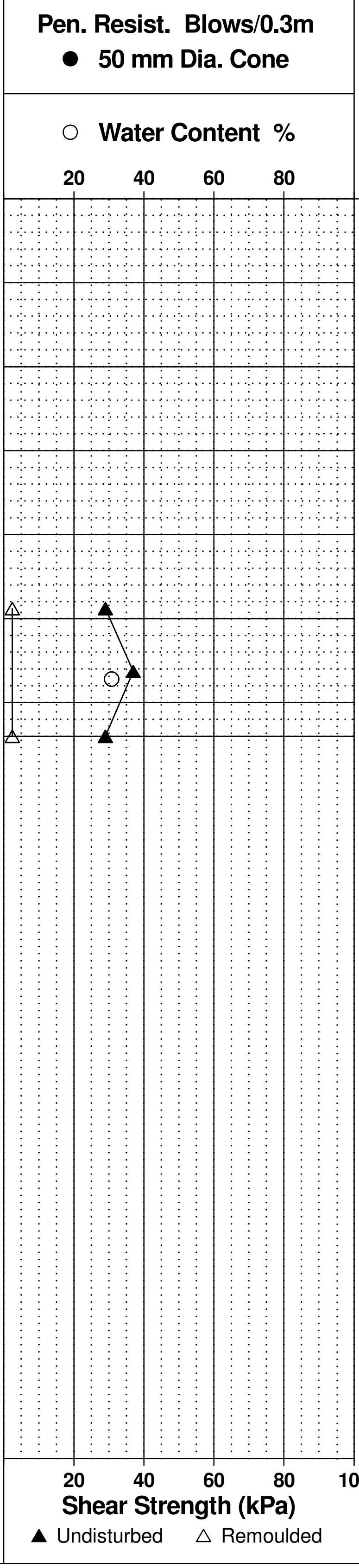
DATE April 3, 2017

FILE NO. PG4008

HOLE NO. BH55A-17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.20
TOPSOIL 0.23							
						1	88.20
						2	87.20
Very stiff to stiff, brown **SILTY CLAY,** trace sand						3	86.20
						4	85.20
- firm and grey by 4.6m depth						5	84.20
		TW	1	100			
						6	83.20
6.40 End of Borehole							

Piezometer Construction



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

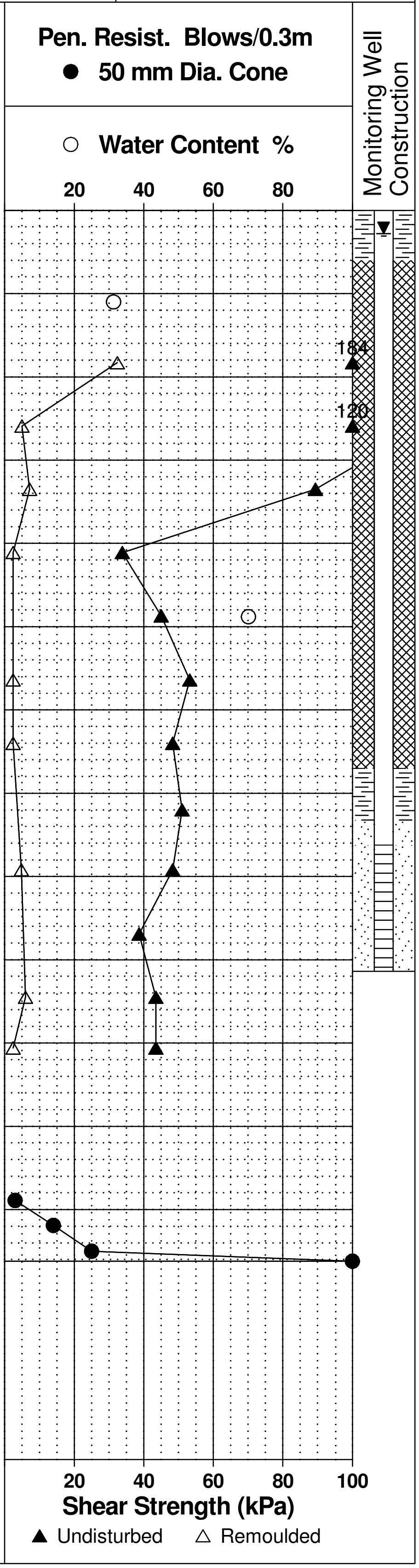
BORINGS BY CME 55 Power Auger

DATE March 31, 2017

FILE NO. PG4008

HOLE NO. BH56-17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.84
TOPSOIL 0.25		SS	1	67	6		
		SS	2	83	8	1	87.84
						2	86.84
Very stiff to stiff, brown **SILTY CLAY,** some sand						3	85.84
- firm and grey by 3.8m depth						4	84.84
		TW	3	100		5	83.84
						6	82.84
		TW	4	100		7	81.84
						8	80.84
						9	79.84
10.06						10	78.84
Dynamic Cone Penetration Test commenced at 10.06m depth. Cone pushed to 11.8m depth.						11	77.84
						12	76.84
12.62							
End of Borehole Practical DCPT refusal at 12.62m depth (GWL @ 0.28m - April 13, 2017)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

FILE NO. **PG4008**

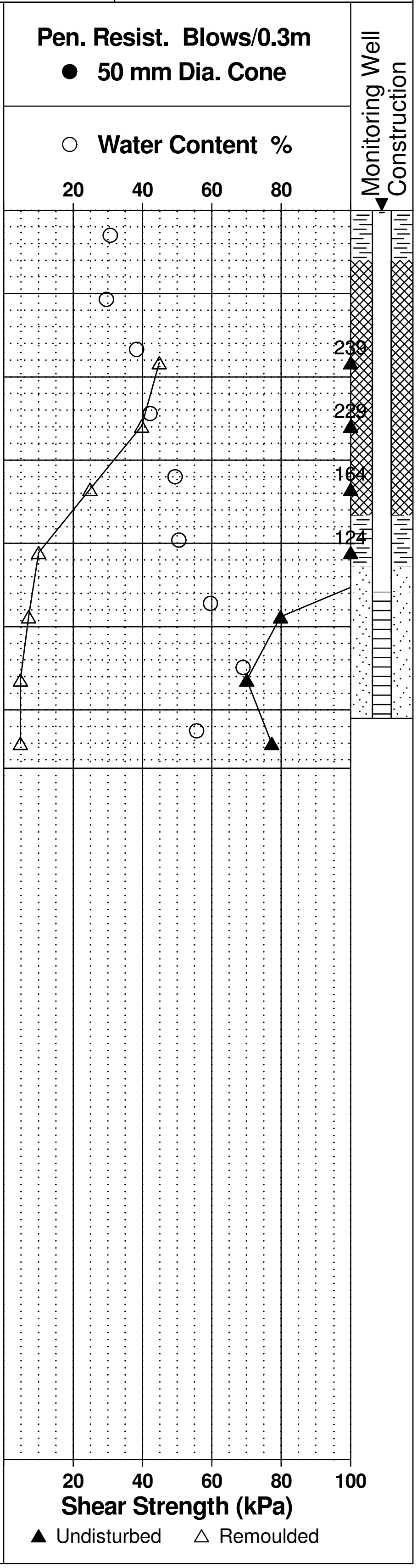
REMARKS

HOLE NO. **BH57-17**

BORINGS BY CME 55 Power Auger

DATE March 30, 2017

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.55
TOPSOIL 0.30		SS	1	100	8		
		SS	2	100	6	1	87.55
						2	86.55
Hard to very stiff, brown **SILTY CLAY,** trace sand						3	85.55
						4	84.55
- stiff and grey by 4.6m depth						5	83.55
						6	82.55
6.70							
End of Borehole (GWL @ 0.19m above ground surface - April 13, 2017)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 30, 2017

FILE NO. PG4008

HOLE NO. BH58-17

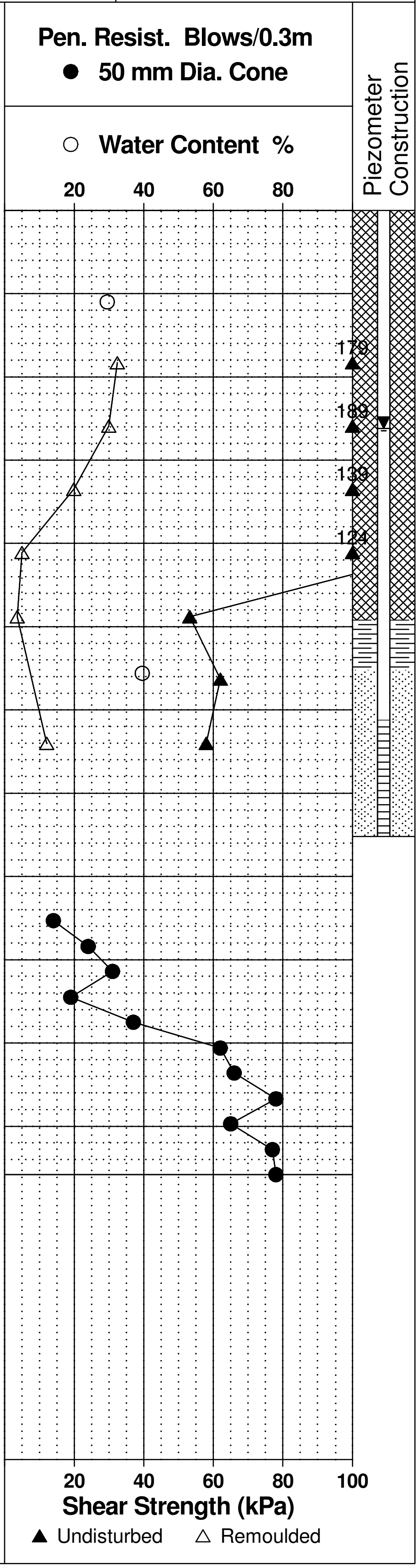
SOIL DESCRIPTION	Depth to base (m)	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20	SS	1	50	8
Very stiff, brown **SILTY CLAY,** trace sand - stiff and grey by 4.3m depth	6.70	SS TW	2 3	100 83	6
GLACIAL TILL: Grey silty sand with gravel, some cobbles and boulders	7.62	SS	4	100	13
Dynamic Cone Penetration Test (DCPT) commenced at 7.62m depth	11.58				

End of Borehole

Practical DCPT refusal at 11.58m depth

(GWL @ 2.62m - April 13, 2017)

DEPTH (m)	ELEV. (m)
0	89.03
1	88.03
2	87.03
3	86.03
4	85.03
5	84.03
6	83.03
7	82.03
8	81.03
9	80.03
10	79.03
11	78.03



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Residential Dev. - Mahogany Community Stages 2 to 4
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE March 30, 2017

FILE NO. PG4008

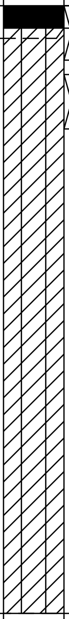
HOLE NO. BH59-17

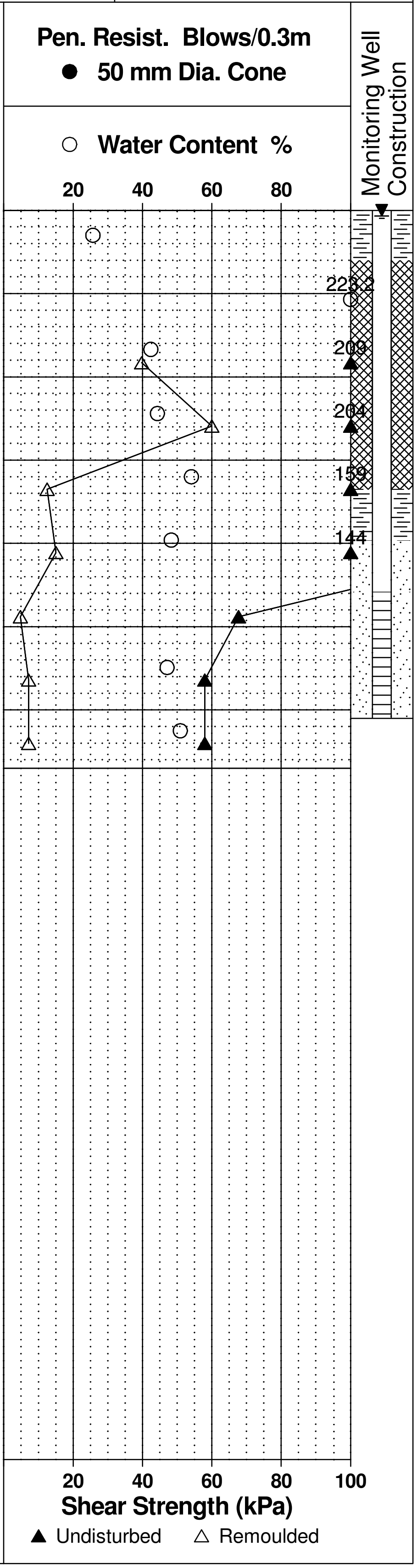
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.78
TOPSOIL 0.25	SS	1	96	5		
	SS	2	100	6	1	87.78
					2	86.78
Hard to very stiff, brown **SILTY CLAY,** some sand seams					3	85.78
					4	84.78
- stiff and grey by 4.3m depth					5	83.78
6.70					6	82.78

End of Borehole

(GWL @ 0.07m - April 13, 2017)

STRATA PLOT





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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

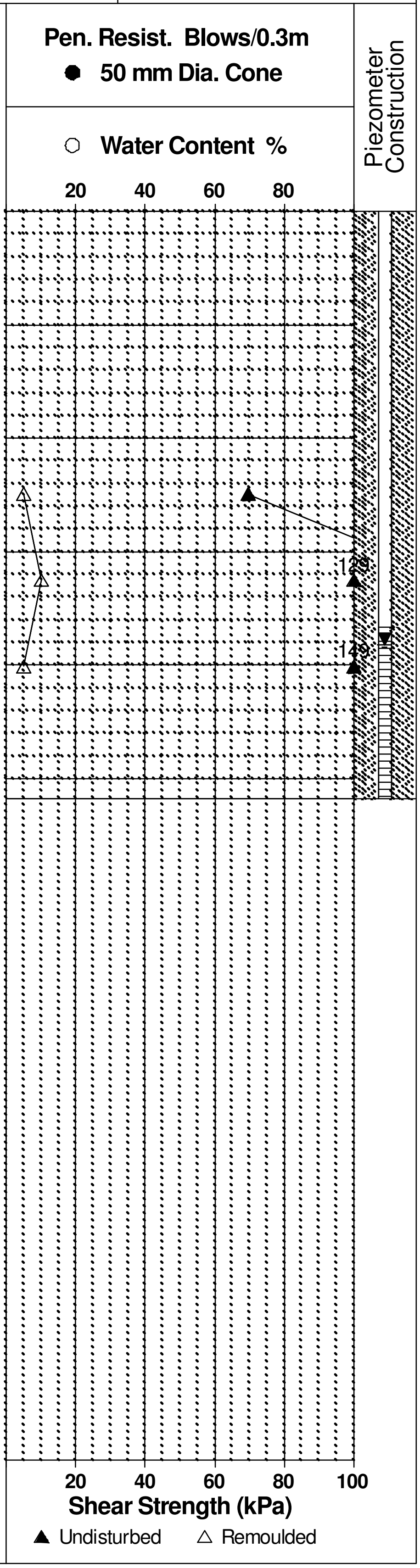
BORINGS BY CME 45 Power Auger

DATE 16 Jul 07

FILE NO. PG0675

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	89.78
TOPSOIL 0.20							
Loose, brown **SILTY SAND**, trace clay 1.07		SS	1	100	5	1	88.78
Stiff, brown **SILTY CLAY**, some sand seams		SS	2	100	3	2	87.78
- very stiff and grey by 2.7m depth						3	86.78
						4	85.78
5.18		SS	3	100	2	5	84.78
End of Borehole (GWL @ 3.82m-July 23/07)							



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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

HOLE NO. BH 2

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	95.80
TOPSOIL 0.15						
GLACIAL TILL: Brown sand with gravel and cobbles	AU	1				
1.09	AU	2			1	94.80
End of Borehole Practical refusal to augering @ 1.09m depth (GWL @ 0.87m-July 23/07)						

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

○ **Water Content %**

20 40 60 80

Piezometer Construction

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 45 Power Auger **DATE** 11 Jul 07

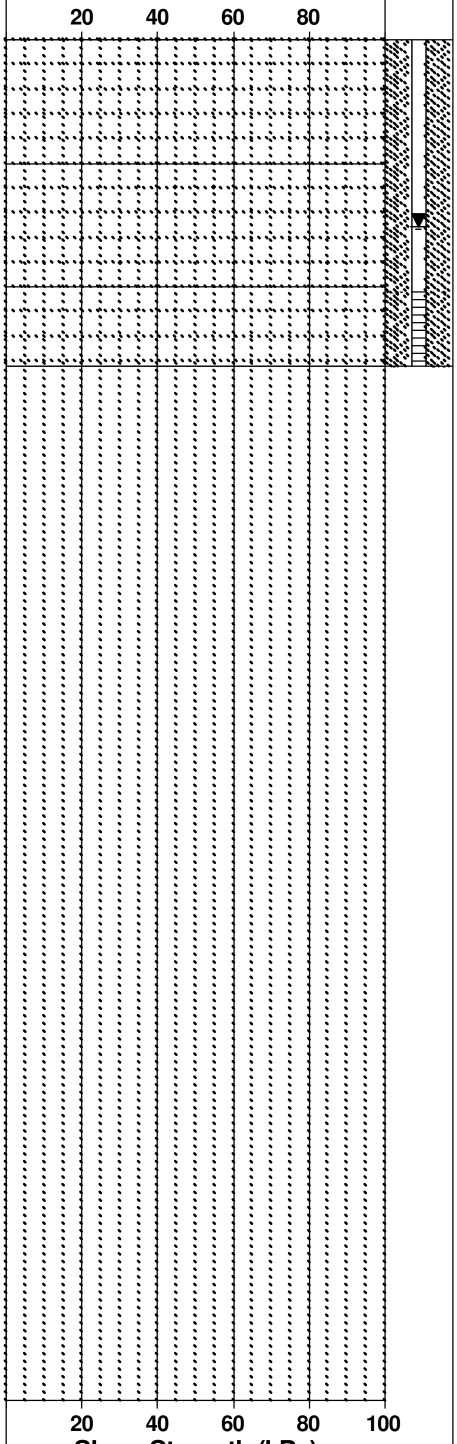
FILE NO. PG0675

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	93.70
TOPSOIL 0.13							
		AU	1				
GLACIAL TILL: Brown silty sand with gravel and cobbles						1	92.70
		SS	2	67	50+		
						2	91.70
2.64							
End of Borehole Practical refusal to augering @ 2.64m depth (GWL @ 1.51m-July 23/07)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

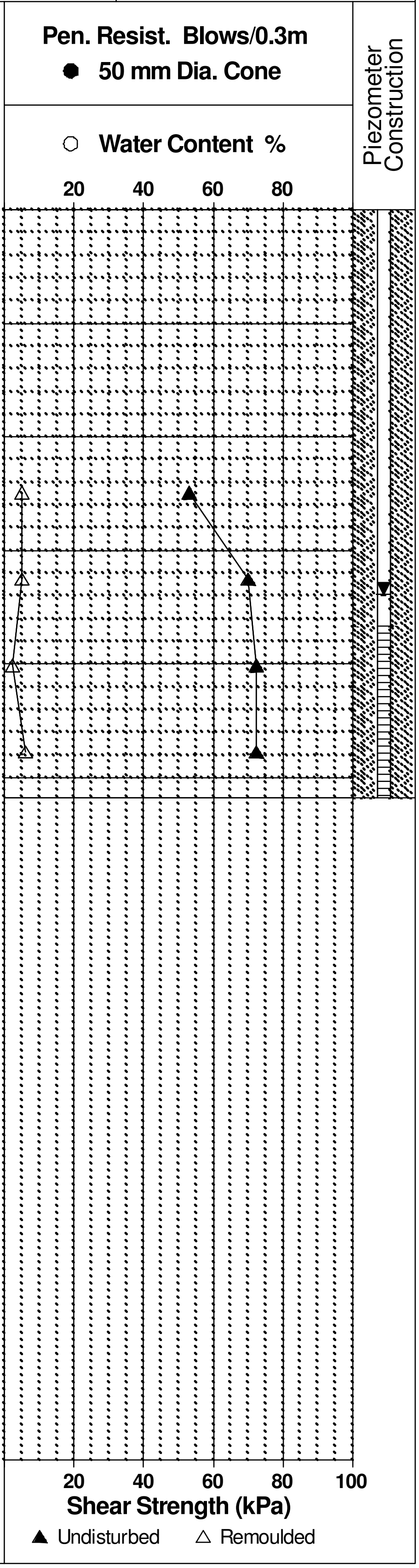
BORINGS BY CME 45 Power Auger

DATE 16 Jul 07

FILE NO. PG0675

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.16
TOPSOIL 0.20							
Loose, brown **SAND** 1.07		SS	1	50	5	1	85.16
		SS	2	100	1		
						2	84.16
Stiff, grey **SILTY CLAY**, some sand						3	83.16
						4	82.16
5.18						5	81.16
End of Borehole (GWL @ 3.38m-July 23/07)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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REMARKS

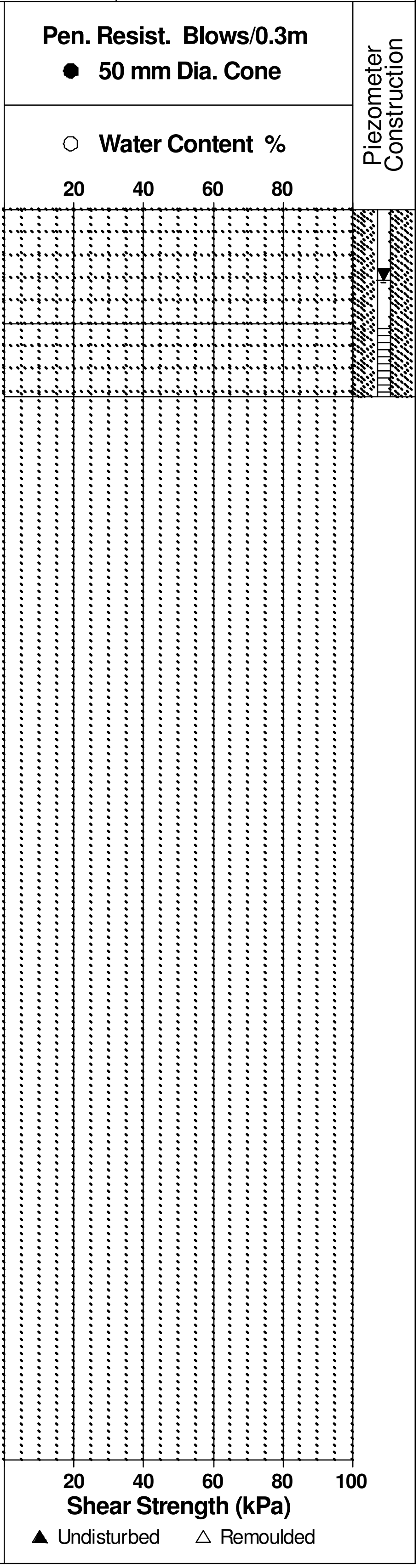
BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

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	92.62
TOPSOIL 0.15							
GLACIAL TILL: Dense to very dense, brown silty sand with gravel and cobbles		AU	1				
		AU	2			1	91.62
1.65		SS	3		50+		
End of Borehole Practical refusal to augering @ 1.65m depth (GWL @ 0.62m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

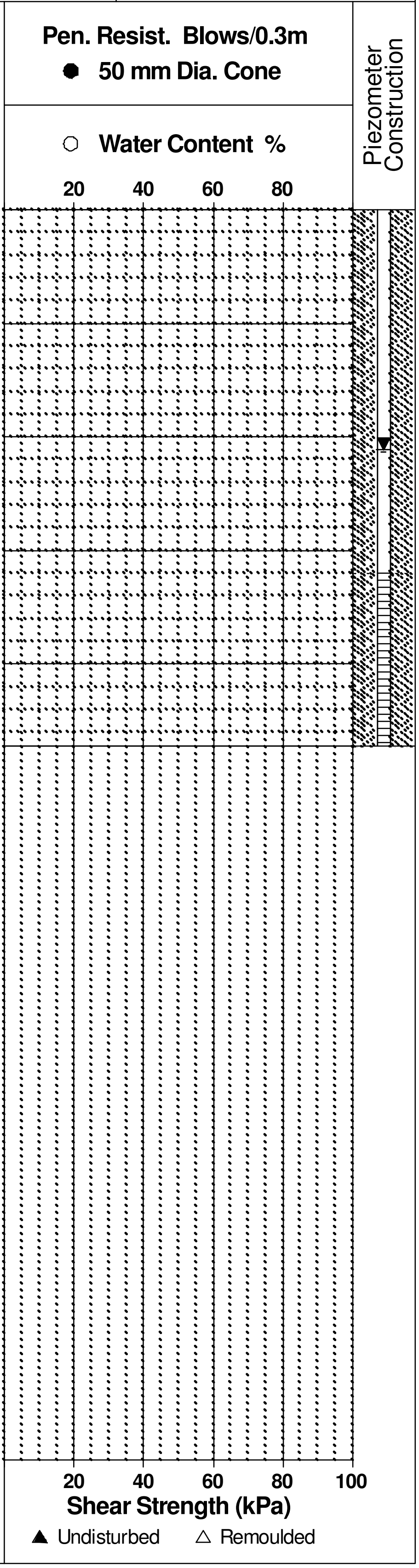
HOLE NO. BH 6

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.29
TOPSOIL	0.23						
Compact, brown **SANDY SILT**, some clay	0.46						
Stiff, brown **SILTY CLAY** with sand seams	1.22	SS	1	100	11	1	89.29
Compact to loose, brown **SANDY SILT** with clay	2.13	SS	2	100	6	2	88.29
GLACIAL TILL: Loose to compact, brown silty sand with gravel and cobbles		SS	3	25	12	3	87.29
		SS	4	75	22	4	86.29
	4.72	SS	5	100	50+		

End of Borehole

Practical refusal to augering @ 4.72m depth

(GWL @ 2.11m-July 23/07)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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Ottawa, Ontario

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REMARKS

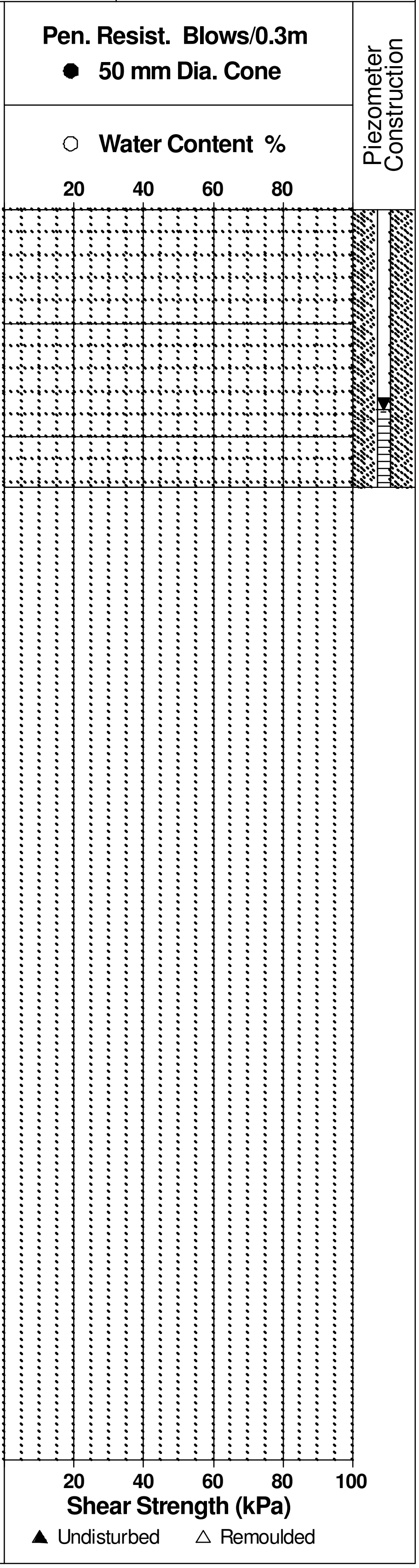
BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.63
TOPSOIL 0.20							
GLACIAL TILL: Loose, brown silty sand with gravel and cobbles		SS	1	75	7	1	89.63
		SS	2	75	4	2	88.63
2.44 End of Borehole Practical refusal to augering @ 2.44m depth (GWL @ 1.76m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

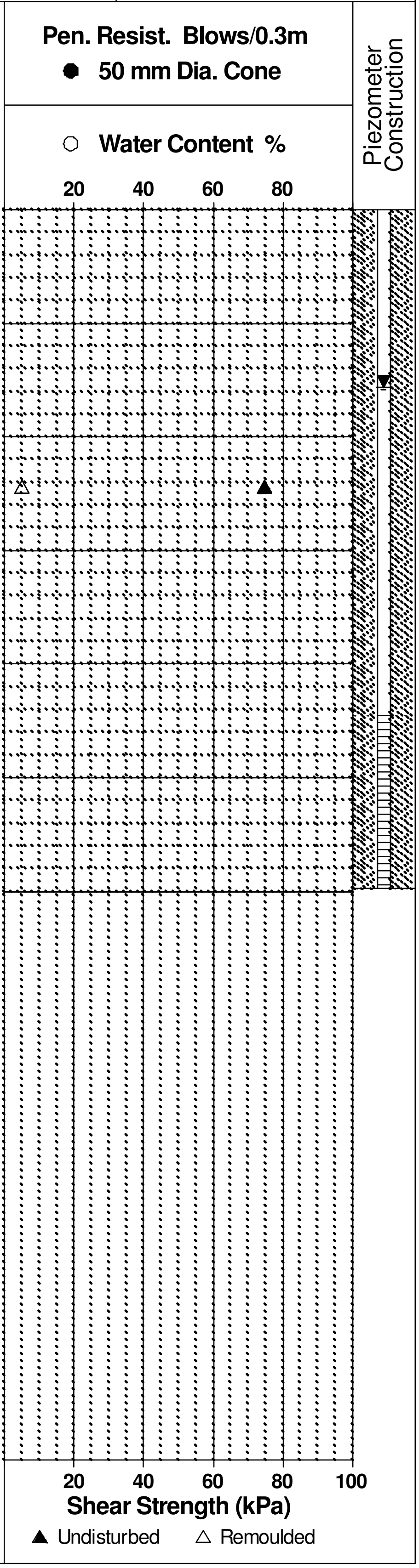
FILE NO. PG0675

HOLE NO. BH 8

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.98
TOPSOIL	0.18						
Loose, brown **SILTY SAND**, some clay	0.60	AU	1				
		SS	2	100	10	1	87.98
Stiff, brown **SILTY CLAY**, some sand seams		SS	3	100	7		
	2.74					2	86.98
		SS	4	100	20	3	85.98
GLACIAL TILL: Compact to dense, brown silty sand with gravel and cobbles						4	84.98
		SS	5	50	48	5	83.98
	5.97					6	82.98
End of Borehole							

Practical refusal to augering @ 5.97m depth

(GWL @ 1.56m-July 23/07)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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Ottawa, Ontario

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FILE NO. **PG0675**

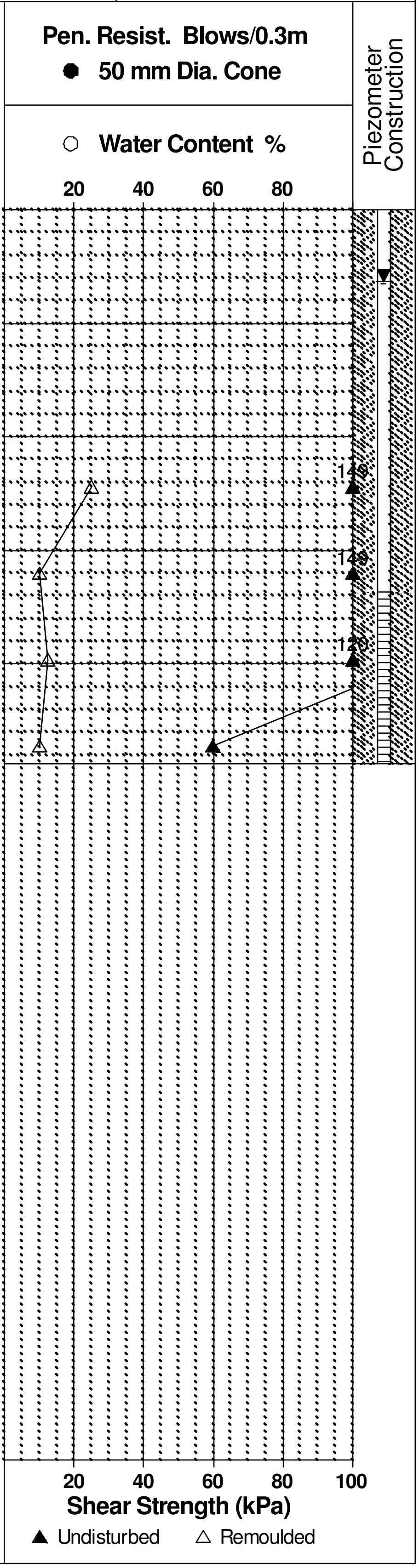
REMARKS

HOLE NO. **BH 9**

BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.56
TOPSOIL	0.25	AU	1				
Compact, brown **SILTY SAND**, trace clay	0.46						
		SS	2	100	10	1	87.56
Very stiff, brown **SILTY CLAY**, some sand seams		SS	3	100	9		
						2	86.56
						3	85.56
- very stiff to stiff and grey by 3.4m depth							
						4	84.56
	4.88						
End of Borehole							
(GWL @ 0.63m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 45 Power Auger

DATE 16 Jul 07

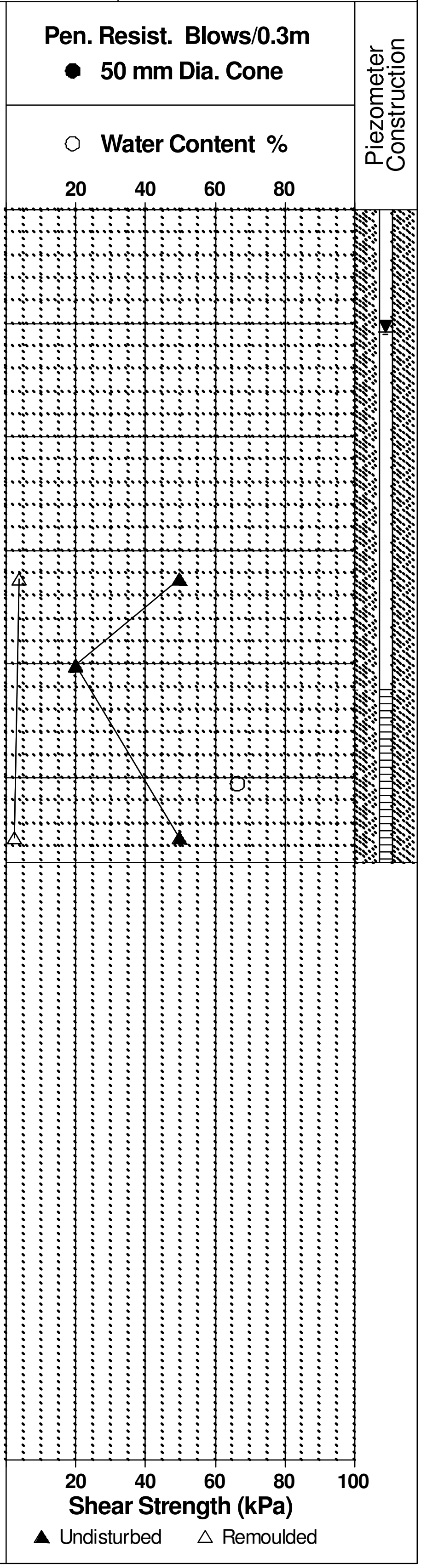
FILE NO. PG0675

HOLE NO. BH10

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.20
Loose to very loose, brown **SILTY SAND**, some clay and seashells	2.13
Firm, brown **SILTY CLAY** - soft to firm and grey by 3.7m depth	5.74
End of Borehole (GWL @ 1.08m-July 23/07)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	6
SS	2	100	3
SS	3	100	4
TW	4	88	

DEPTH (m)	ELEV. (m)
0	89.21
1	88.21
2	87.21
3	86.21
4	85.21
5	84.21



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REMARKS

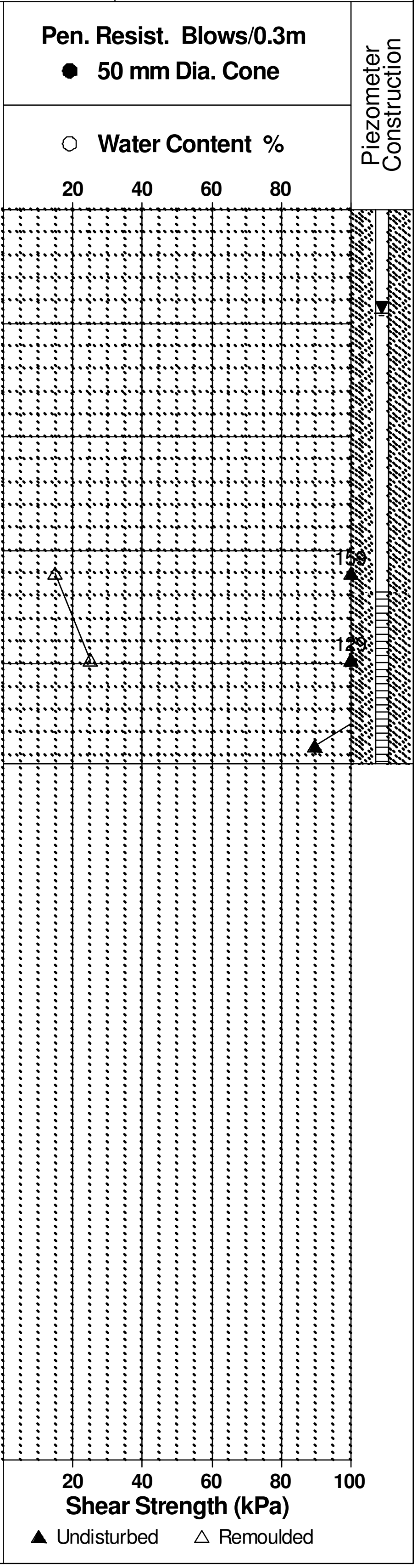
BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

HOLE NO. BH11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.57
TOPSOIL 0.20		AU	1				
Compact, brown **SILTY SAND**, trace clay 0.46							
		SS	2	100	16	1	87.57
		SS	3	100	12		
						2	86.57
Very stiff to stiff, brown **SILTY CLAY**		SS	4	100	7		
						3	85.57
						4	84.57
4.88		AU	5				
End of Borehole (GWL @ 0.91m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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REMARKS

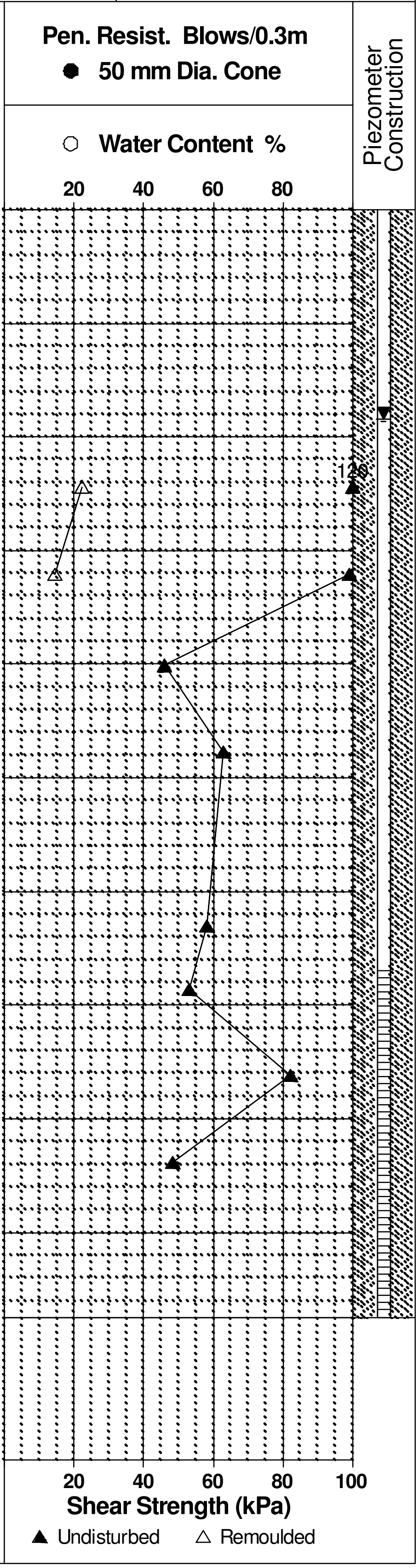
BORINGS BY CME 45 Power Auger

DATE 9 Jul 07

FILE NO. PG0675

HOLE NO. BH12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	88.60
TOPSOIL 0.20							
Compact, brown **SILTY SAND**, trace clay 1.07		SS	1	100	10	1	87.60
Stiff, brown **SILTY CLAY**, some sand seams - firm to stiff and grey by 3.7m depth		SS	2	100	3	2	86.60
						3	85.60
						4	84.60
						5	83.60
						6	82.60
						7	81.60
						8	80.60
						9	79.60
9.75		SS	3	100	1		
End of Borehole (GWL @ 1.84m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

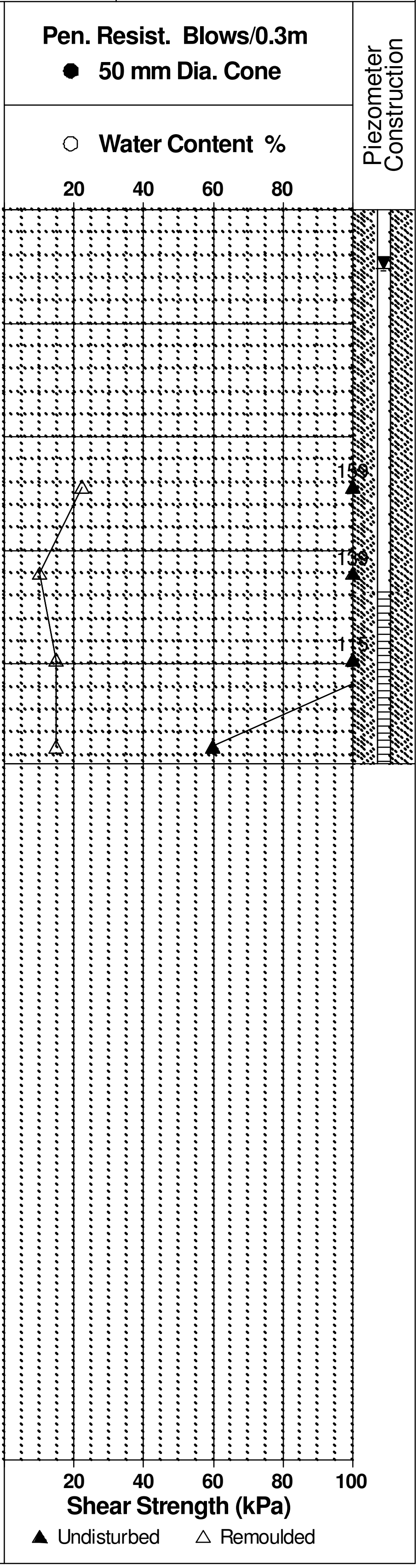
BORINGS BY CME 45 Power Auger

DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH13

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.11
TOPSOIL 0.25						
Compact to loose, brown **SILTY SAND**, trace clay 1.07	SS	1	100	8	1	88.11
Very stiff, brown **SILTY CLAY**, some sand seams	SS	2	100	8	2	87.11
					3	86.11
- stiff and grey by 4.3m depth 4.88					4	85.11
End of Borehole (GWL @ 0.52m-July 23/07)						



SOIL PROFILE AND TEST DATA

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REMARKS

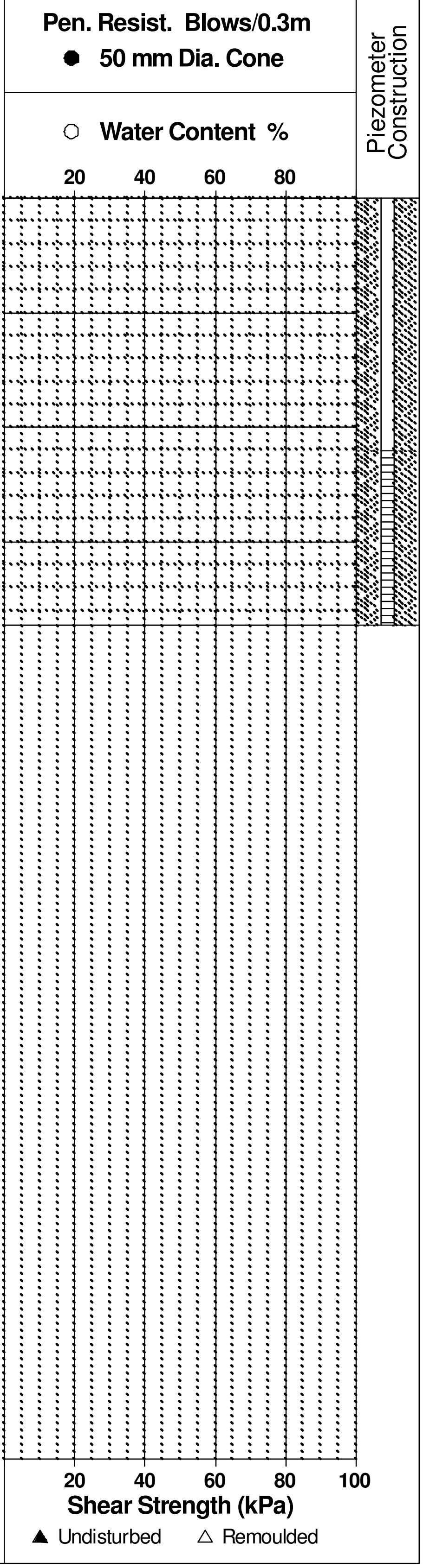
BORINGS BY CME 45 Power Auger

DATE 16 Jul 07

FILE NO. PG0675

HOLE NO. BH14

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	90.97
TOPSOIL	0.15		AU	1				
GLACIAL TILL: Dense, brown silty sand with gravel and cobbles			SS	2	75	90+	1	89.97
			SS	3	67	53	2	88.97
							3	87.97
	3.73		SS	4	50	54		
End of Borehole Practical refusal to augering @ 3.73m depth (BH dry-July 23/07)								



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

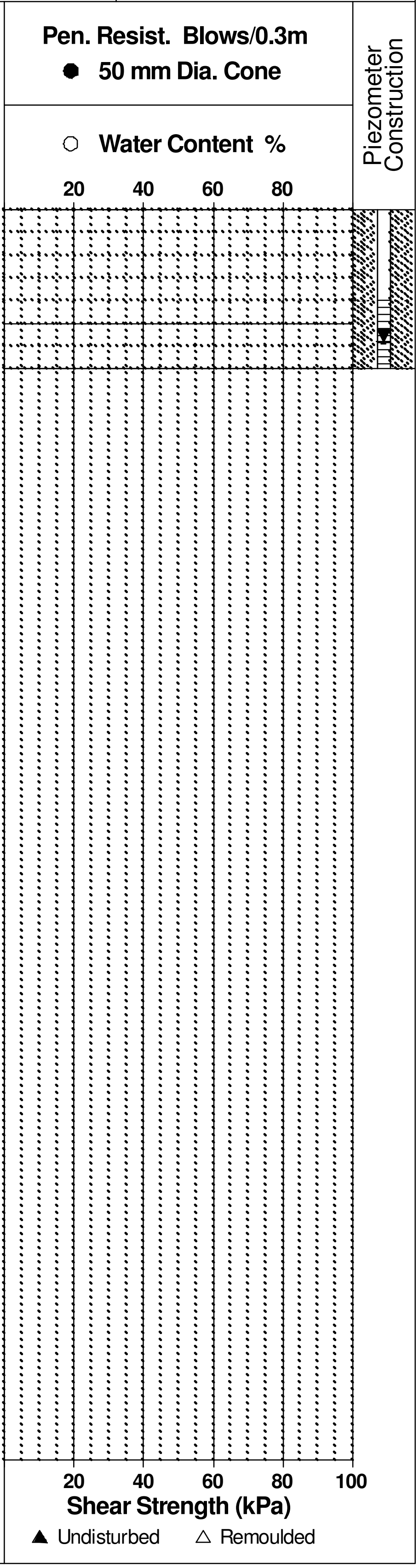
BORINGS BY CME 45 Power Auger

DATE 16 Jul 07

FILE NO. PG0675

HOLE NO. BH15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.78
TOPSOIL 0.18							
GLACIAL TILL: Very dense, brown silty sand with gravel and cobbles 1.40		SS	1	67	50+	1	89.78
End of Borehole Practical refusal to augering @ 1.40m depth (GWL @ 1.16m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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REMARKS

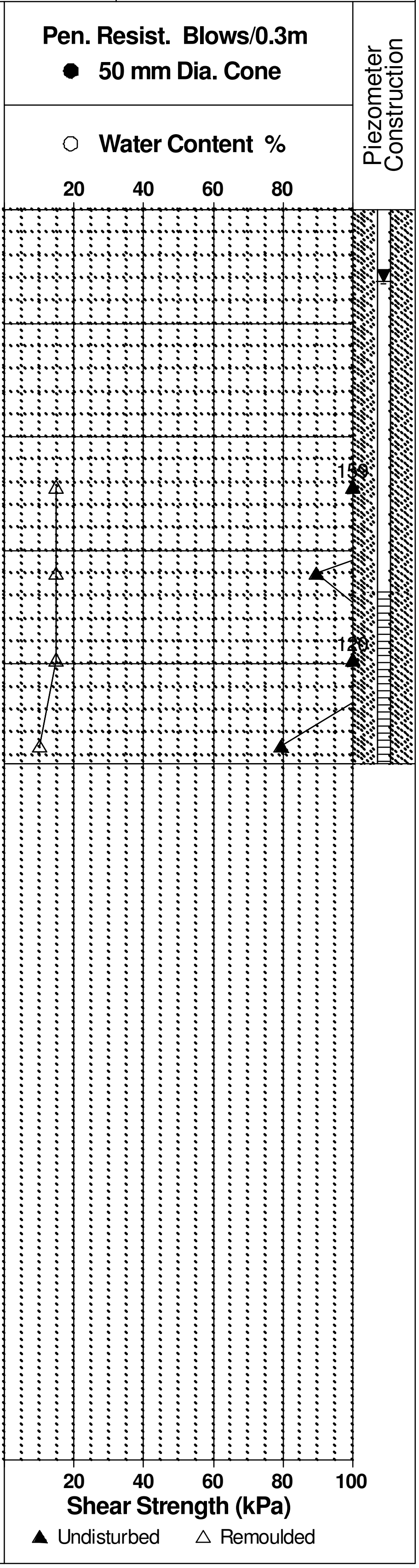
BORINGS BY CME 45 Power Auger

DATE 11 Jul 07

FILE NO. PG0675

HOLE NO. BH16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.57
TOPSOIL 0.23							
Loose, brown **SILTY SAND**, trace clay 1.22		SS	1	100	4	1	88.57
Very stiff to stiff, brown **SILTY CLAY** - grey by 3.4m depth 4.88		SS	2	100	4	2	87.57
						3	86.57
						4	85.57
End of Borehole (GWL @ 0.63m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 45 Power Auger

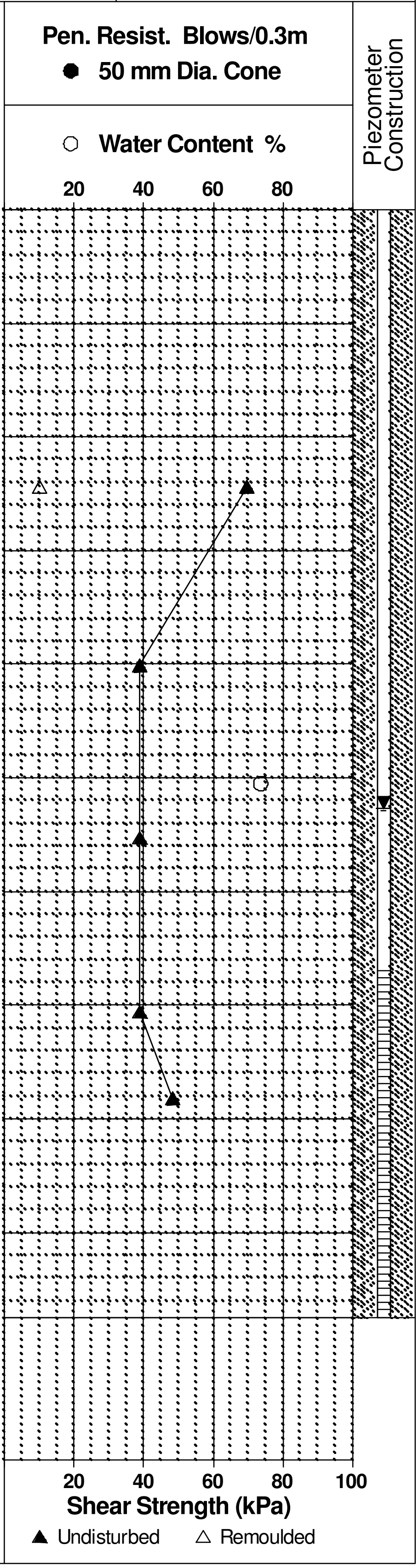
DATE 9 Jul 07

FILE NO. PG0675

HOLE NO. BH17

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20				
Brown **SILTY CLAY**	0.60	AU	1		
Loose, grey-brown **SANDY SILT**, trace clay	1.22	SS	2	100	7
Stiff, brown **SILTY CLAY**, some sand seams - firm and grey by 2.7m depth	8.84	SS	3	100	5
		SS	4	100	1
		TW	5	100	
		TW	6	100	
		SS	7	100	11
GLACIAL TILL: Stiff, grey silty clay with gravel and cobbles	9.75	SS	8	75	16
End of borehole (GWL @ 5.27m-July 23/07)					

DEPTH (m)	ELEV. (m)
0	89.07
1	88.07
2	87.07
3	86.07
4	85.07
5	84.07
6	83.07
7	82.07
8	81.07
9	80.07



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SOIL PROFILE AND TEST DATA

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REMARKS

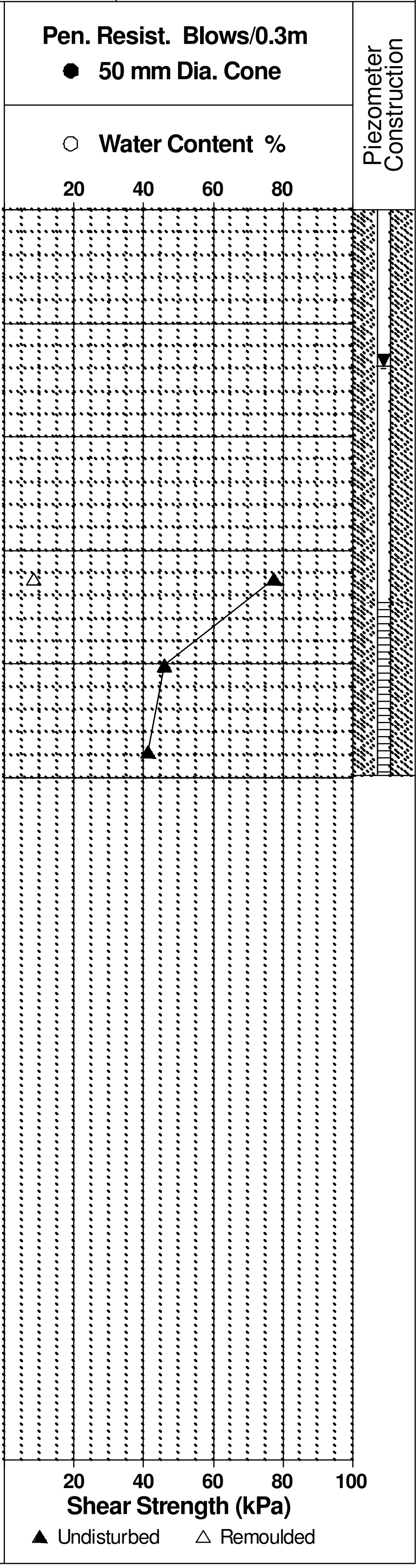
BORINGS BY CME 45 Power Auger

DATE 9 Jul 07

FILE NO. PG0675

HOLE NO. BH18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.00
TOPSOIL 0.20						
Compact, brown **SILTY SAND**, some clay 1.06	SS	1	100	10	1	88.00
	SS	2	100	7	2	87.00
Stiff, brown **SILTY CLAY**, some sand seams	SS	3	100	4		
					3	86.00
- firm and grey by 3.7m depth					4	85.00
4.98					5	84.00
End of Borehole						
(GWL @ 1.38m-July 23/07)						



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 55 Power Auger **DATE** 10 Jul 07

FILE NO. PG0675

HOLE NO. BH19

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	90.68
TOPSOIL	0.20							
Loose, brown **SILTY SAND**, trace clay	1.37		SS	1	100	9	1	89.68
GLACIAL TILL: Compact to very dense, brown silty sand with clay, gravel and cobbles			SS	2	50	22		
							2	88.68
			SS	3	50	69		
							3	87.68
			SS	4	50	25		
	4.52						4	86.68

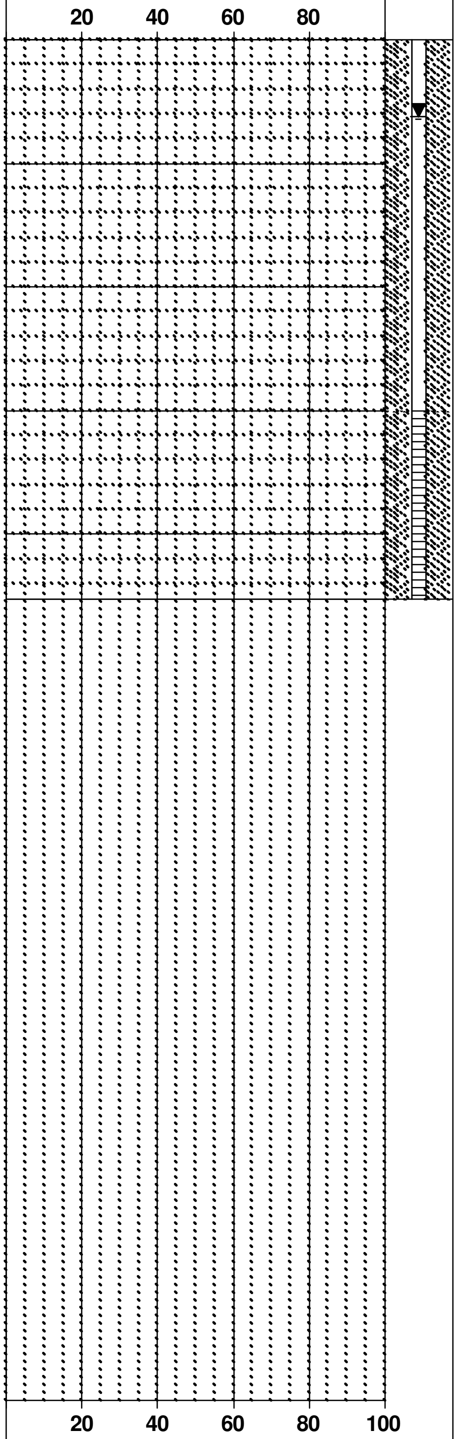
End of Borehole

Practical refusal to augering @ 4.52m depth

(GWL @ 0.62m-July 23/07)

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

○ **Water Content %**



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 45 Power Auger

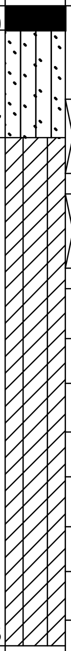
DATE 16 Jul 07

FILE NO. PG0675

HOLE NO. BH20

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.20
Loose, brown **SILTY SAND**, trace clay	1.07
Very stiff, brown **SILTY CLAY**, some sand seams - stiff to very stiff and grey by 3.7m depth	5.18
End of Borehole (GWL @ 2.17m-July 23/07)	

STRATA PLOT

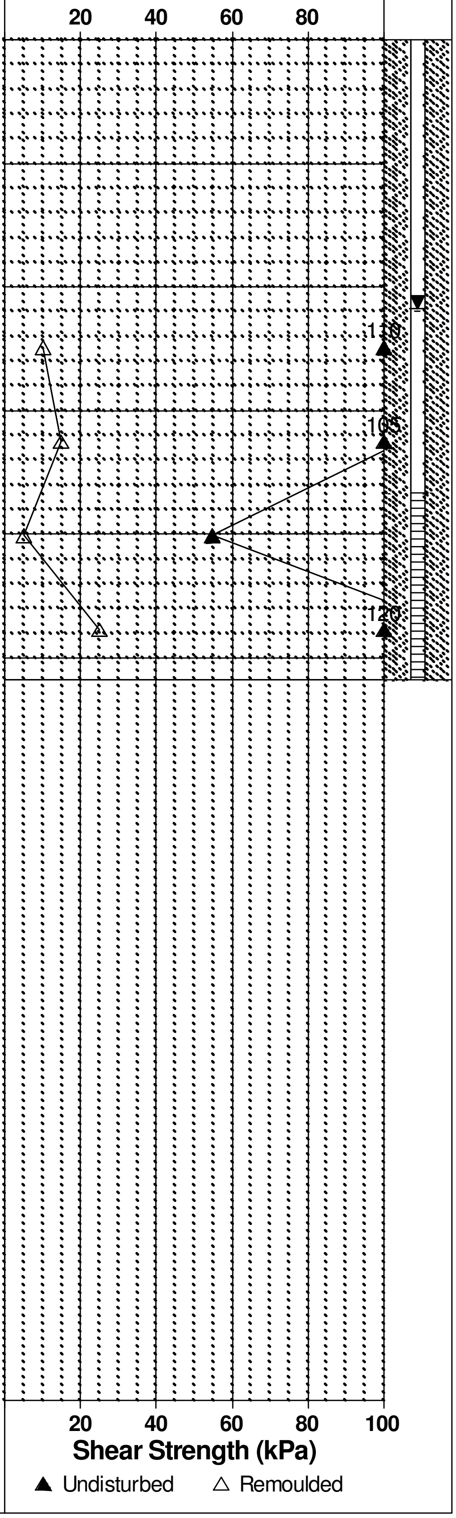


SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	7
SS	2	100	4

DEPTH (m)	ELEV. (m)
0	89.62
1	88.62
2	87.62
3	86.62
4	85.62
5	84.62

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

○ Water Content %



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

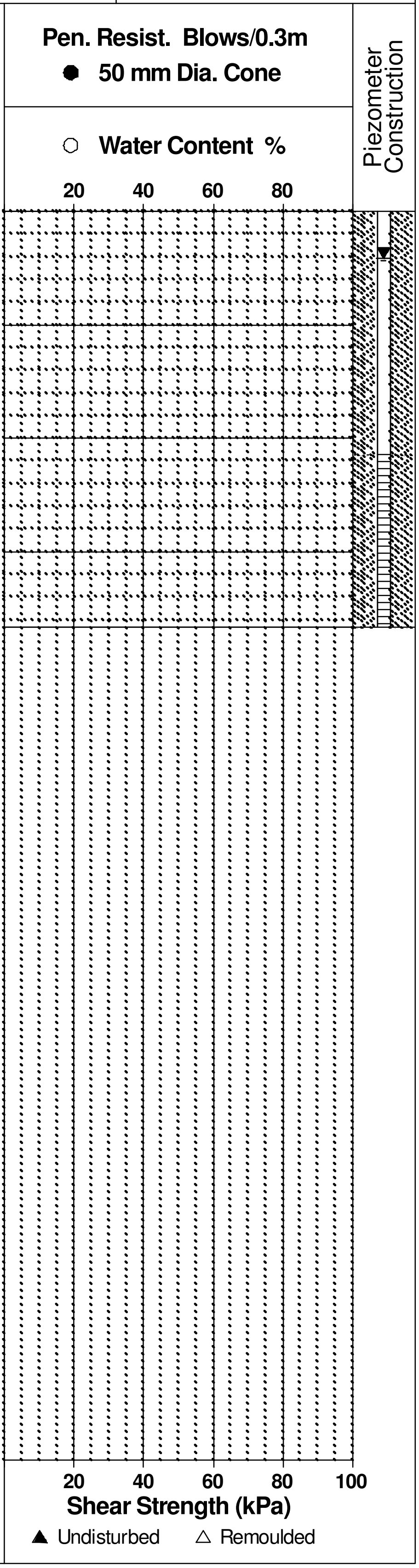
BORINGS BY CME 45 Power Auger

DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.97
TOPSOIL 0.20							
Very stiff, brown **SILTY CLAY** - some gravel by 0.5m depth		SS	1	75	12	1	89.97
1.52		SS	2	100	50+		
GLACIAL TILL: Compact, brown silty sand with clay, gravel and cobbles						2	88.97
						3	87.97
		SS	3	50	15		
3.66							
End of Borehole Practical refusal to augering @ 3.66m depth (GWL @ 0.42m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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FILE NO. **PG0675**

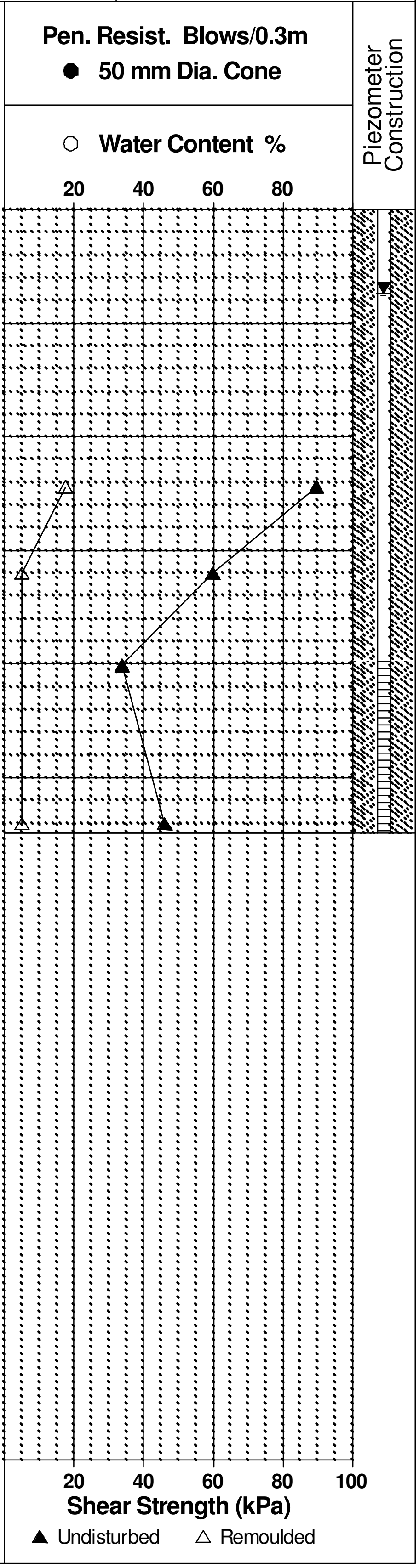
REMARKS

HOLE NO. **BH22**

BORINGS BY CME 45 Power Auger

DATE 9 Jul 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.30
TOPSOIL 0.25							
Loose, brown **SILTY SAND**, trace clay 0.90							
		SS	1	100	7	1	88.30
		SS	2	100	3	2	87.30
Stiff, brown **SILTY CLAY**, trace sand							
						3	86.30
- firm and grey by 3.4m depth							
						4	85.30
		TW	3	100			
						5	84.30
5.49							
End of Borehole							
(0.74m-July 23/07)							



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

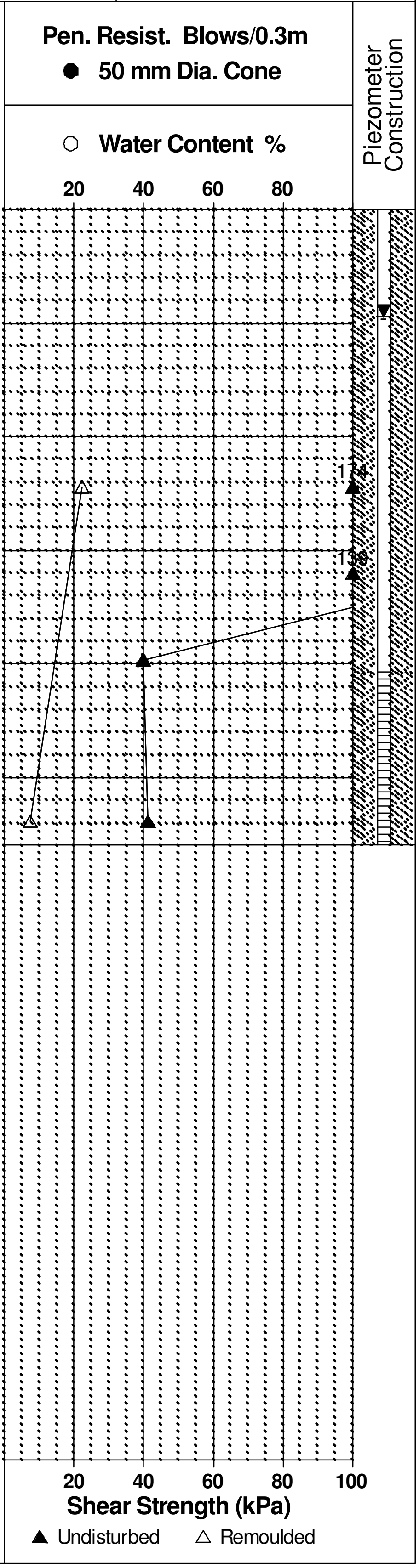
BORINGS BY CME 45 Power Auger

DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.41
TOPSOIL 0.20		AU	1				
		SS	2	100	6	1	88.41
		SS	3	100	6	2	87.41
Very stiff to stiff, brown **SILTY CLAY**, trace sand - stiff to firm and grey by 3.4m depth						3	86.41
						4	85.41
		TW	4	98		5	84.41
5.59							
End of Borehole (GWL @ 0.94m-July 23/07)							



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FILE NO. **PG0675**

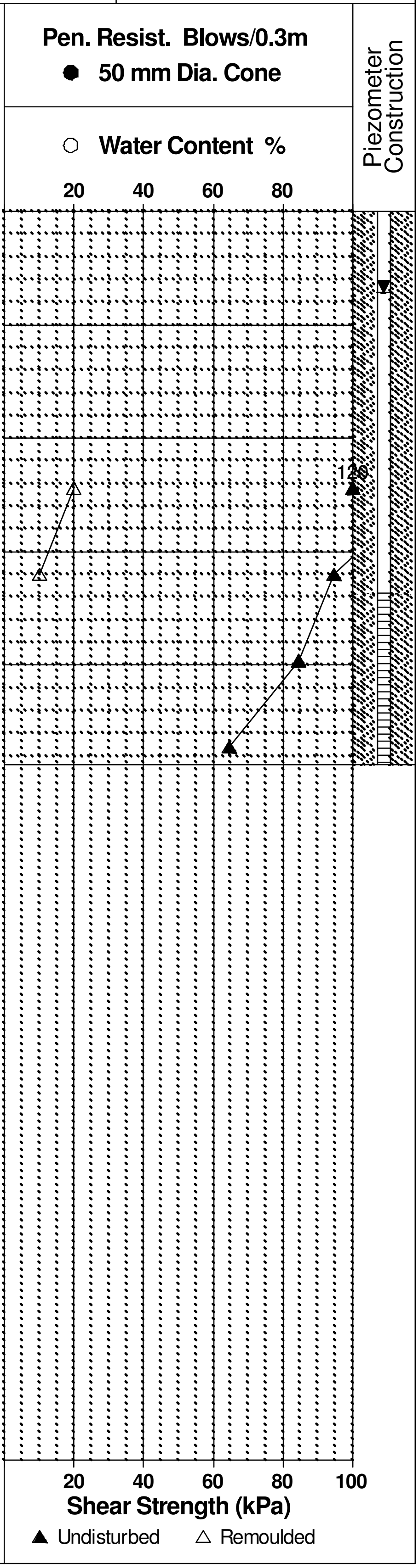
REMARKS

HOLE NO. **BH24**

BORINGS BY CME 45 Power Auger

DATE 10 Jul 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.56
TOPSOIL 0.25							
		SS	1	100	4	1	88.56
		SS	2	100	6		
Very stiff to stiff, brown **SILTY CLAY**, some sand seams						2	87.56
						3	86.56
- stiff and grey by 3.7m depth						4	85.56
4.88							
End of Borehole (GWL @ 0.71m-July 23/07)							



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REMARKS

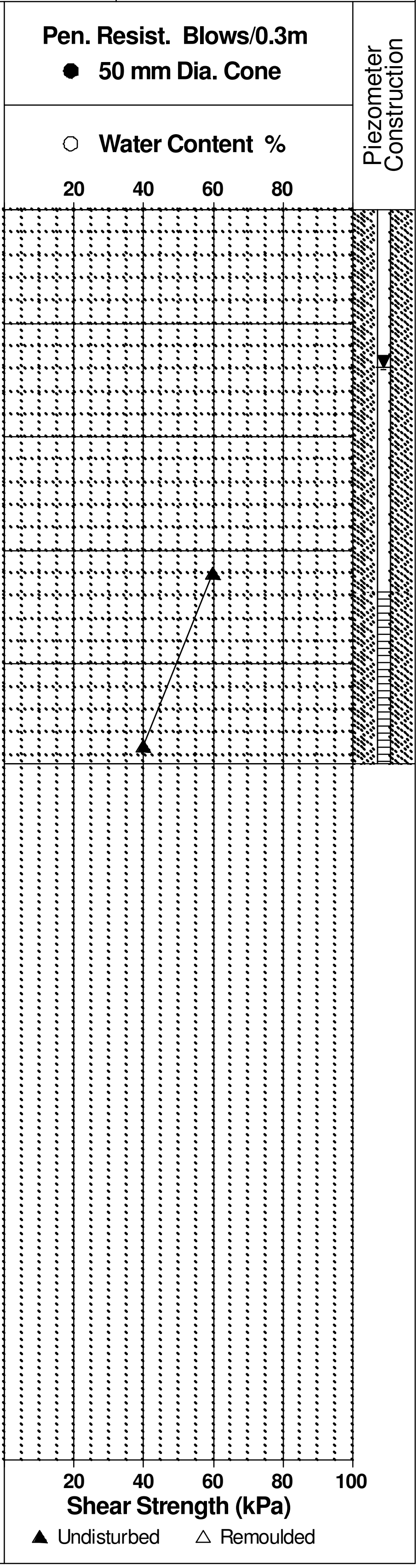
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.49
TOPSOIL 0.25							
Very dense, brown **SILTY SAND**, trace clay and gravel 1.22		SS	1	67	50+		
						1	87.49
Stiff, brown **SILTY CLAY**		SS	2	0	1		
						2	86.49
		SS	3	100	4		
- stiff to firm and grey by 3.0m depth						3	85.49
						4	84.49
4.88		TW	4	100			
End of Borehole							
(GWL @ 1.39m-July 23/07)							



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REMARKS

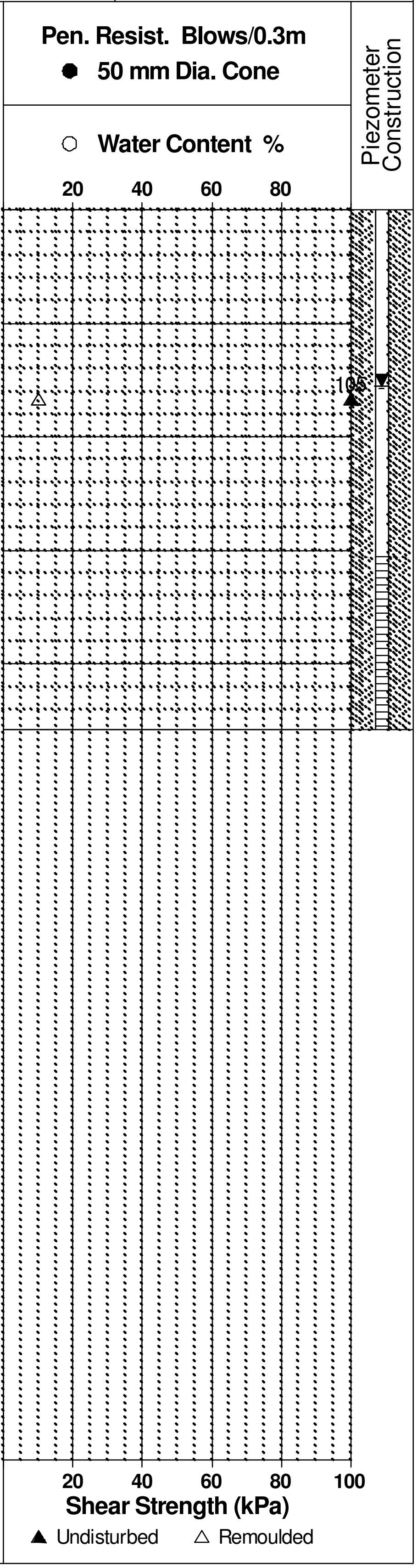
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH26

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.38
TOPSOIL 0.18						
Very stiff, brown **SILTY CLAY**, some sand seams	SS	1	100	6	1	87.38
1.98					2	86.38
Loose, brown **SANDY SILT** 2.59	SS	2	12	6		
GLACIAL TILL: Compact, grey sandy silt with gravel and cobbles	SS	3	42	18	3	85.38
	SS	4	38	13	4	84.38
4.57						
End of Borehole Practical refusal to augering @ 4.57m depth (GWL @ 1.55m-July 23/07)						



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REMARKS

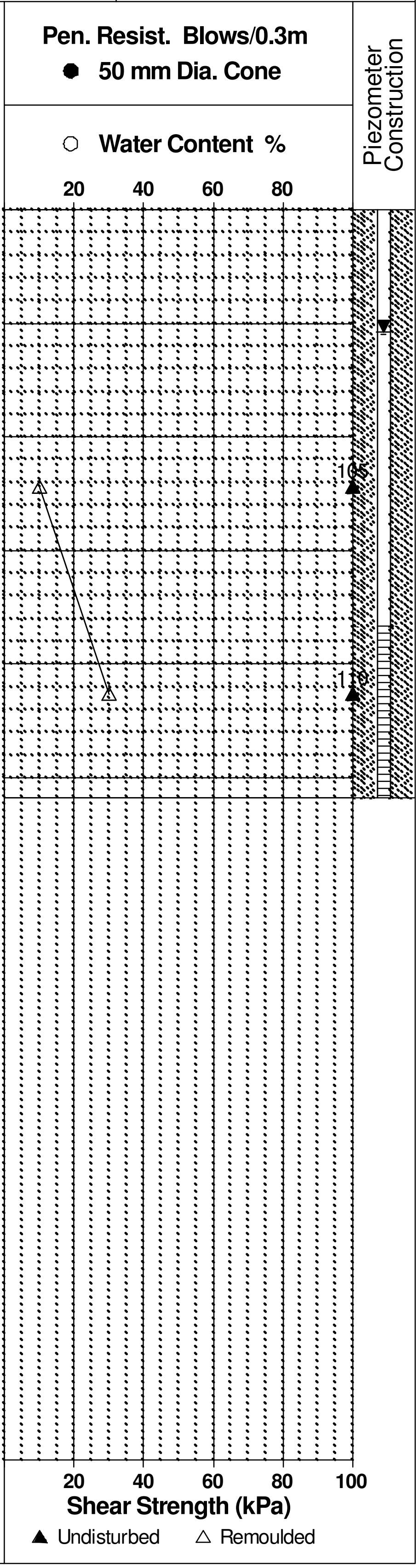
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH27

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.49
TOPSOIL 0.20						
	SS	1	100	6	1	88.49
	SS	2	100	5	2	87.49
Very stiff, brown **SILTY CLAY**, some sand seams - grey by 2.7m depth						
	SS	3	50	1	3	86.49
					4	85.49
5.18	SS	4	0	1	5	84.49
End of Borehole (GWL @ 1.08m-July 23/07)						



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SOIL PROFILE AND TEST DATA

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REMARKS

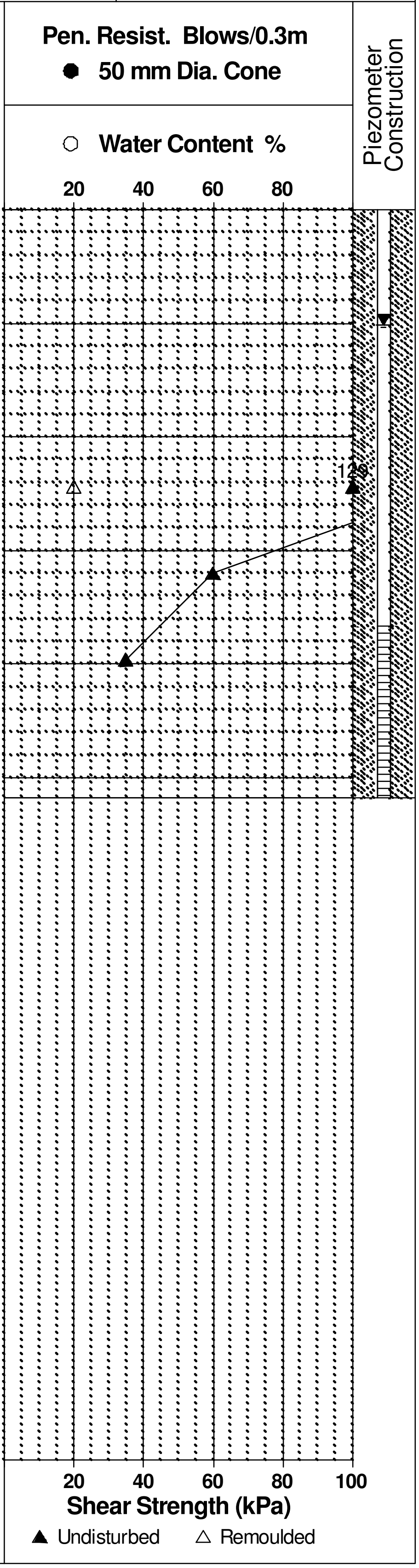
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH28

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.34
TOPSOIL 0.20						
Compact, brown **SILTY SAND**, trace clay 0.90						
	SS	1	50	10	1	88.34
Very stiff to stiff, brown **SILTY CLAY**, some sand seams	SS	2	100	4		
					2	87.34
					3	86.34
- stiff to firm and grey by 3.4m depth						
					4	85.34
5.18	TW	3	96		5	84.34
End of Borehole (GWL @ 1.02m-July 23/07)						



SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

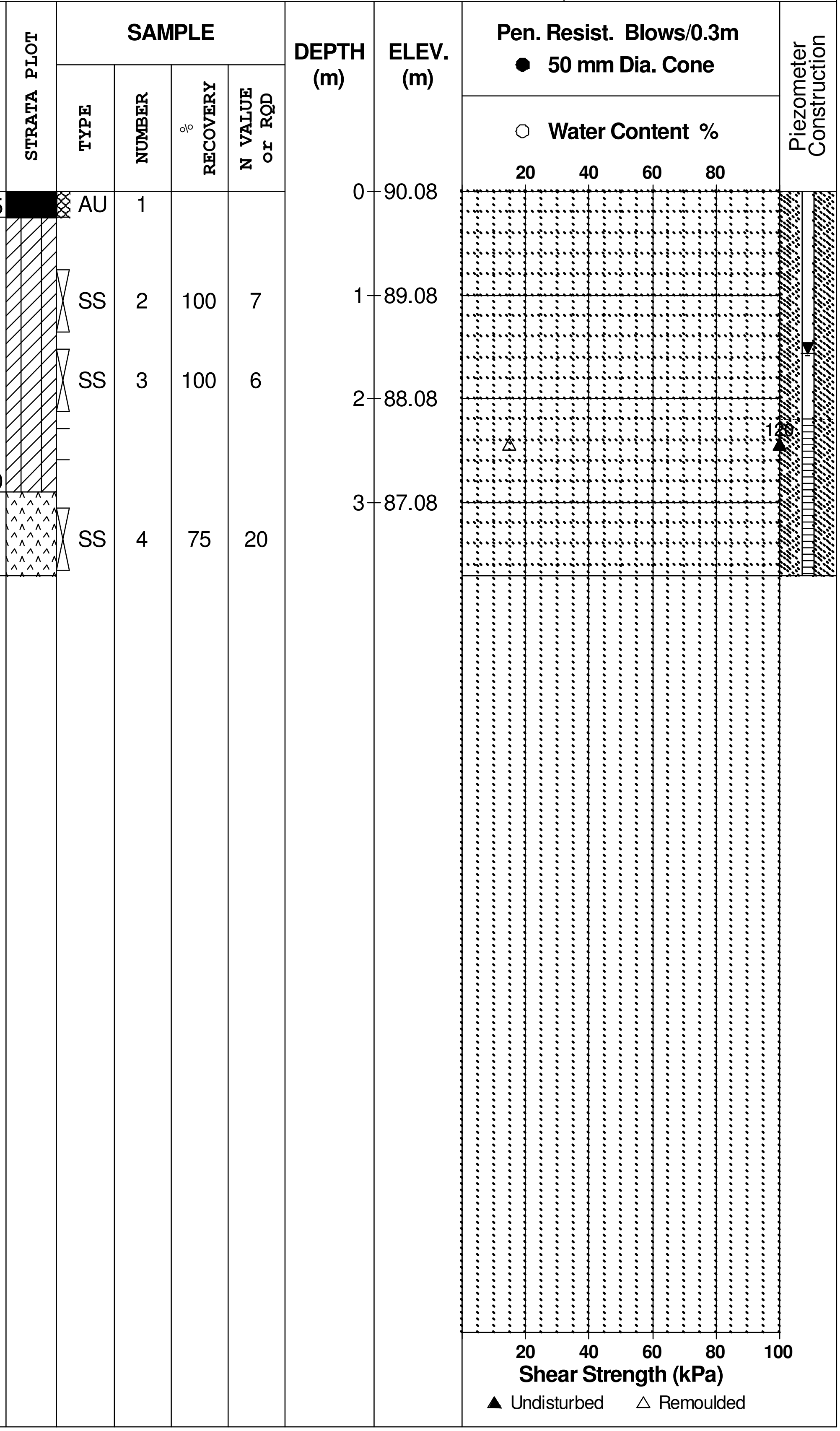
HOLE NO. BH29

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	90.08
TOPSOIL 0.25	AU	1				
Very stiff, brown **SILTY CLAY**, some sand	SS	2	100	7	1	89.08
	SS	3	100	6	2	88.08
2.90						
GLACIAL TILL: Very stiff, brown silty clay with sand, gravel and cobbles					3	87.08
3.71	SS	4	75	20		

End of Borehole

Practical refusal to augering @ 3.71m depth

(GWL @ 1.56m-July 23/07)



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REMARKS

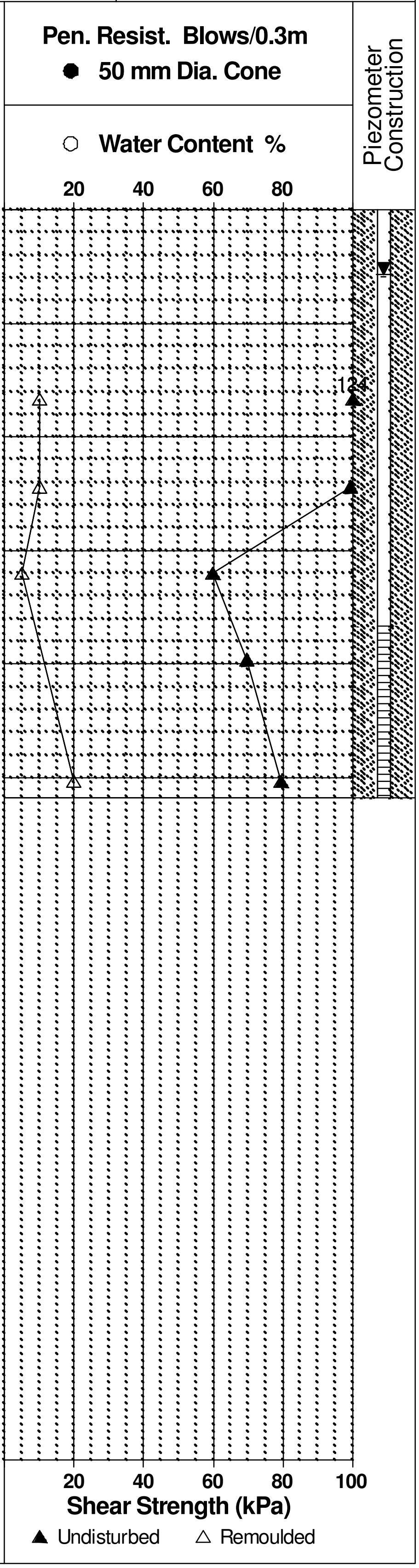
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.40
TOPSOIL 0.20							
		SS	1	100	5	1	87.40
Very stiff to stiff, brown **SILTY CLAY**, some sand seams							
						2	86.40
- stiff and grey by 2.7m depth							
						3	85.40
						4	84.40
						5	83.40
5.18							
End of Borehole (GWL @ 0.57m-July 23/07)							



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REMARKS

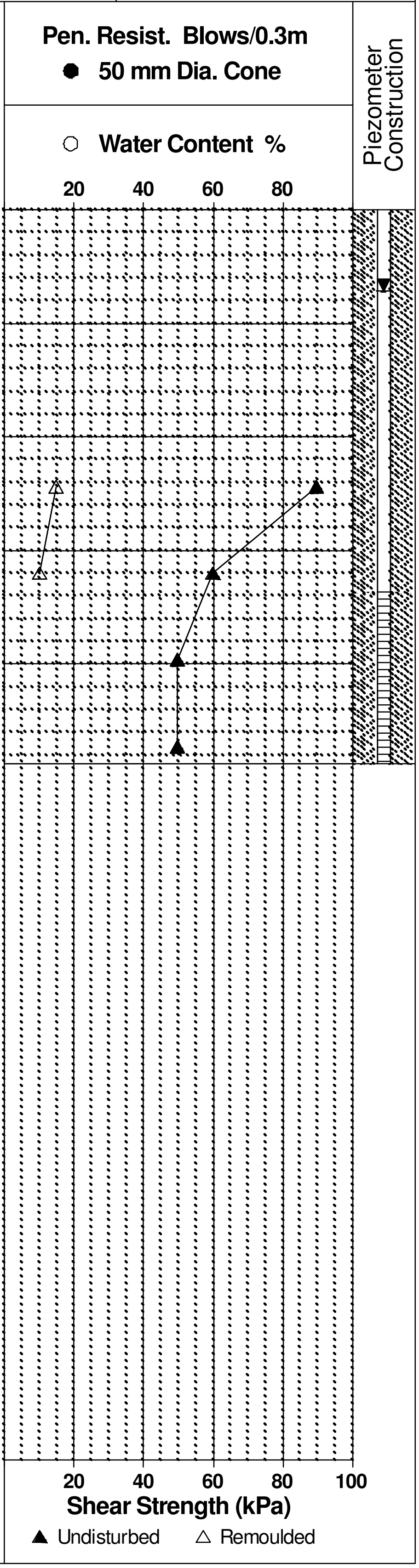
BORINGS BY CME 45 Power Auger

DATE 13 Jul 07

FILE NO. PG0675

HOLE NO. BH31

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.00
TOPSOIL	0.20						
Loose, brown **SILTY SAND**, trace clay	0.90						
		SS	1	100	5	1	88.00
		SS	2	100	4		
Stiff, brown **SILTY CLAY**, some sand seams						2	87.00
						3	86.00
- firm and grey by 3.4m depth							
	4.88					4	85.00
End of Borehole (GWL @ 0.71m-July 23/07)							



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REMARKS

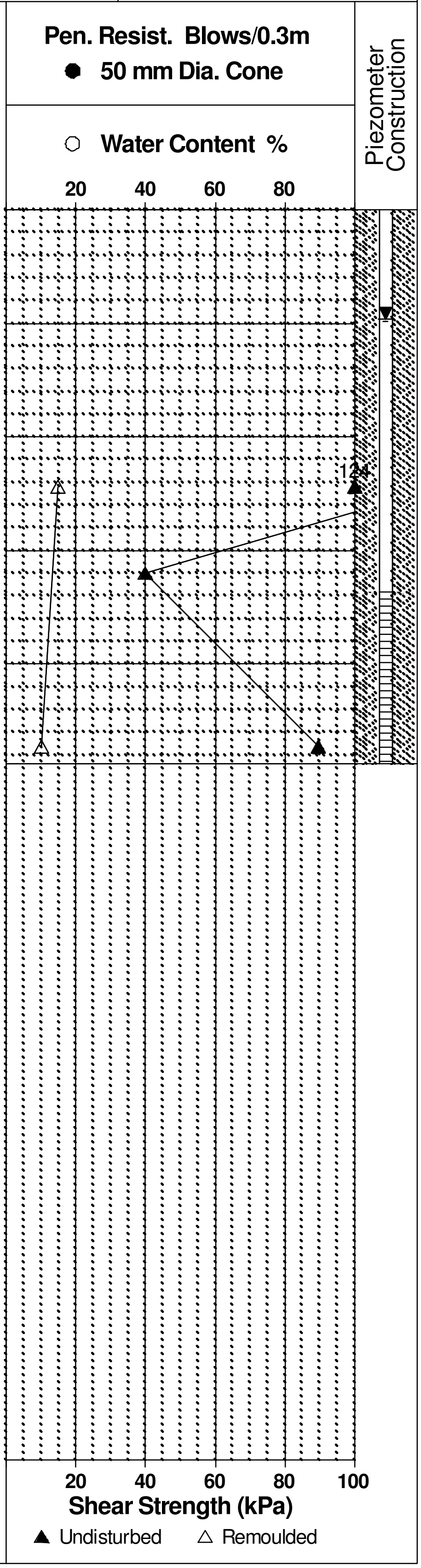
BORINGS BY CME 45 Power Auger

DATE 13 Jul 07

FILE NO. PG0675

HOLE NO. BH32

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.21
TOPSOIL 0.23							
Loose, brown **SILTY SAND**, trace clay 0.60							
		SS	1	100	4	1	88.21
Very stiff to firm, brown **SILTY CLAY**, some sand seams		SS	2	100	6		
						2	87.21
						3	86.21
- firm to stiff and grey by 3.4m depth							
		TW	3	100		4	85.21
4.88							
End of Borehole (GWL @ 0.96m-July 23/07)							



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REMARKS

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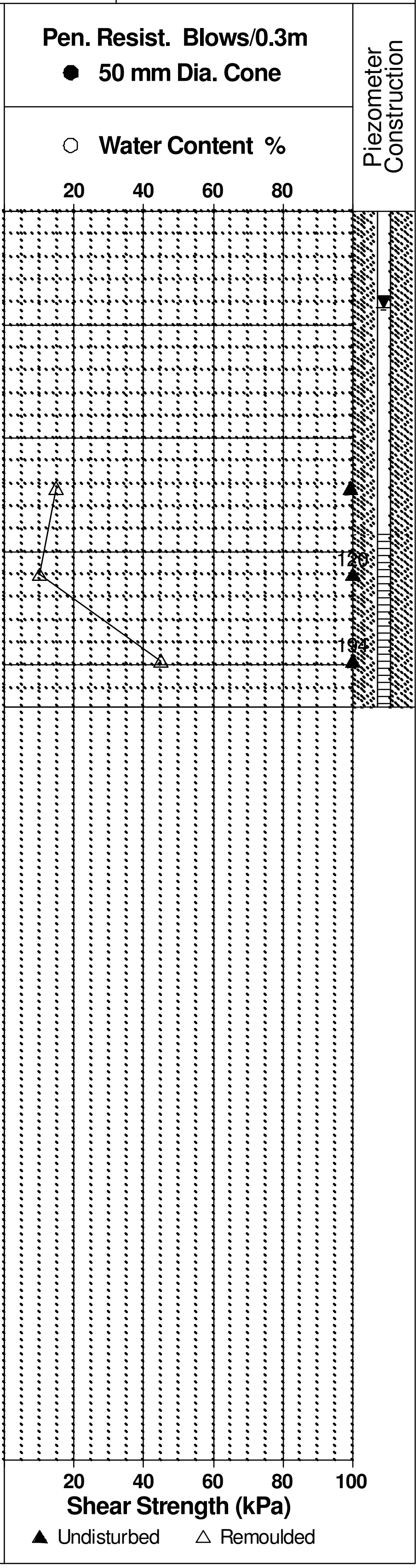
DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH33

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.36
TOPSOIL 0.25							
Very stiff, brown **SILTY CLAY**, some sand seams		SS	1	100	11	1	89.36
		SS	2	100	6	2	88.36
						3	87.36
- grey by 3.5m depth						4	86.36
4.37							
End of Borehole (GWL @ 0.85m-July 23/07)							



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REMARKS

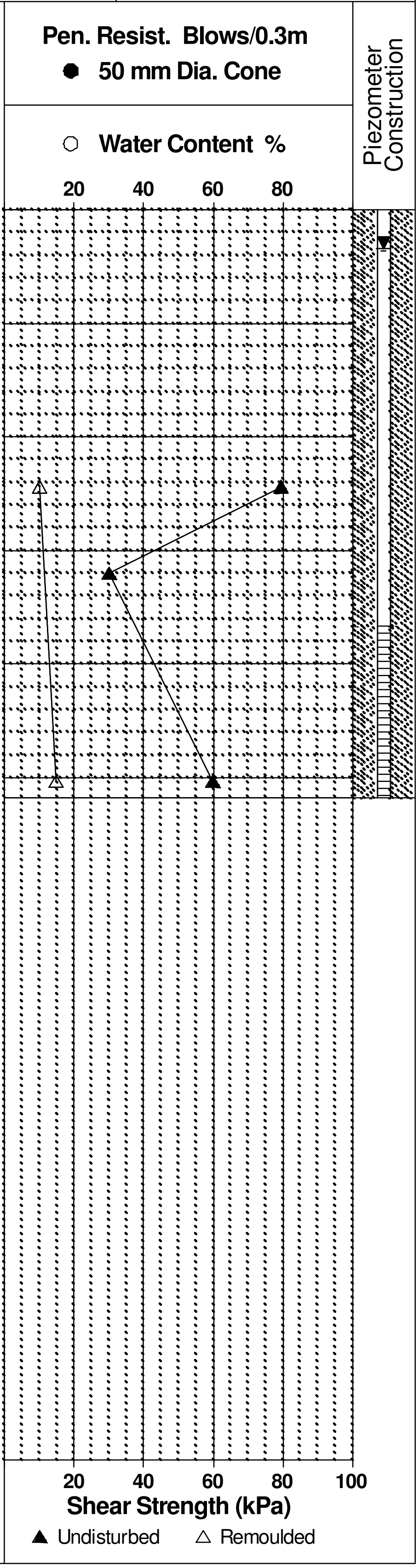
BORINGS BY CME 45 Power Auger

DATE 13 Jul 07

FILE NO. PG0675

HOLE NO. BH34

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.91
TOPSOIL 0.20						
Loose, brown **SILTY SAND**, some clay 1.07	SS	1	100	7	1	87.91
Stiff, brown **SILTY CLAY**, some sand seams - firm to stiff and grey by 2.7m depth	SS	2	100	5	2	86.91
					3	85.91
	TW	3	100		4	84.91
5.18					5	83.91
End of Borehole (GWL @ 0.34m-July 23/07)						



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REMARKS

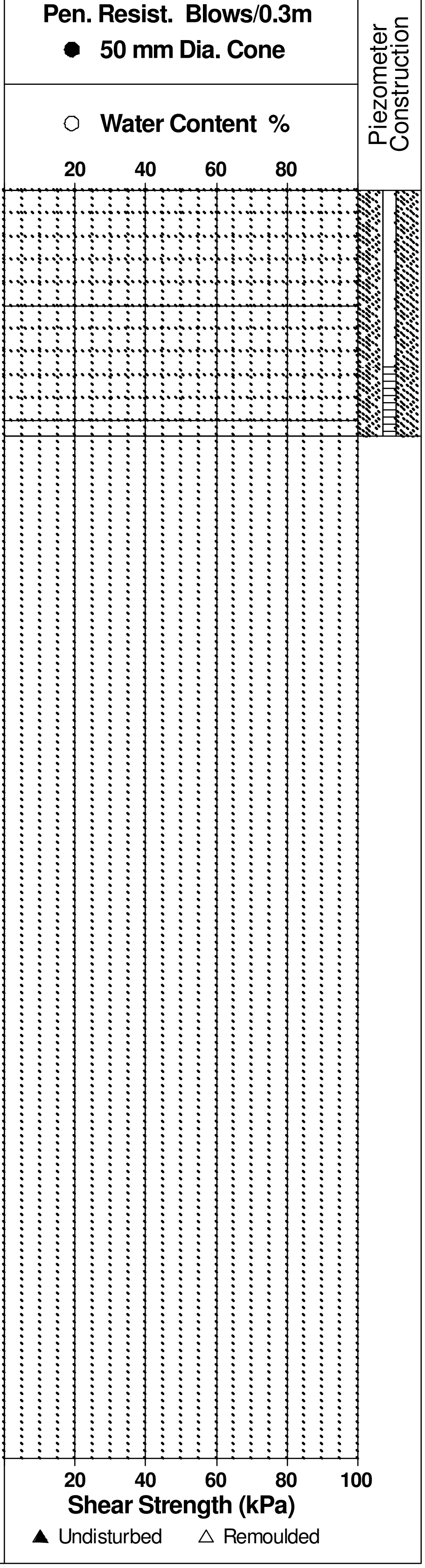
BORINGS BY CME 45 Power Auger

DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH35

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	90.63
TOPSOIL	0.25						
Very stiff, brown **SILTY CLAY**, some sand seams	1.52	SS	1		14	1	89.63
GLACIAL TILL: Very stiff, brown silty clay with sand, gravel and cobbles	2.13	SS	2		18	2	88.63
End of Borehole Practical refusal to augering @ 2.13m depth (BH dry-July 23/07)							



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REMARKS

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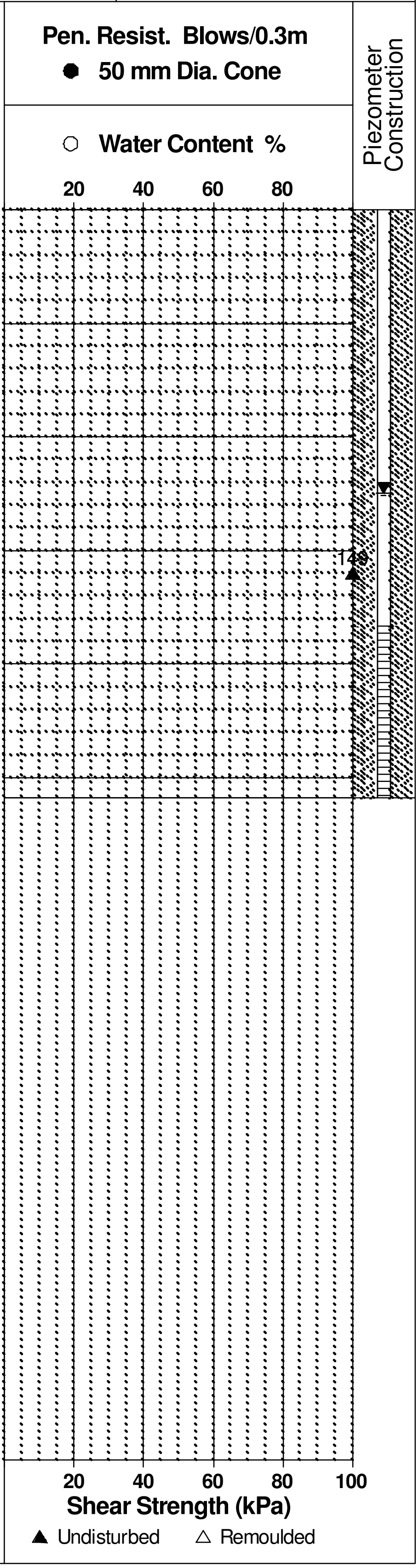
DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH36

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	90.60
TOPSOIL 0.25							
Stiff, brown **SILTY CLAY**, some sand seams		SS	1	100	11	1	89.60
1.98		SS	2	100	23	2	88.60
GLACIAL TILL: Very stiff, brown clayey silt with sand, gravel and cobbles						3	87.60
						4	86.60
5.18		SS	3	50	22	5	85.60
End of Borehole (GWL @ 2.50m-July 23/07)							



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REMARKS

BORINGS BY CME 45 Power Auger

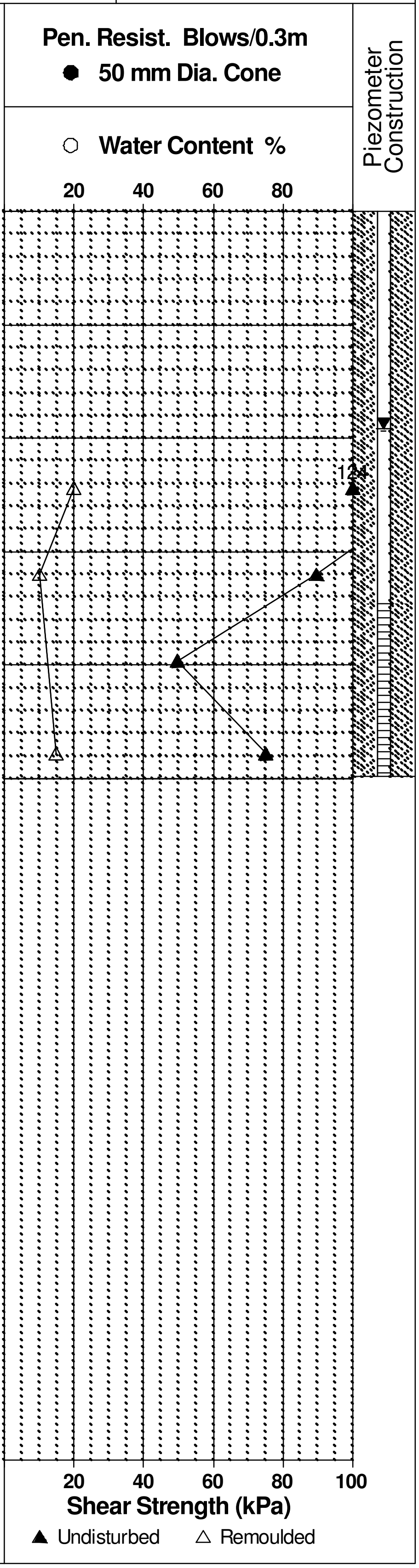
DATE 10 Jul 07

FILE NO. PG0675

HOLE NO. BH37

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.20					
Very stiff to firm, brown **SILTY CLAY**, trace sand		SS	1	100	8
		SS	2	100	6
- stiff and grey by 4.3m depth 4.98					
End of Borehole (GWL @ 1.92m-July 23/07)					

DEPTH (m)	ELEV. (m)
0	90.15
1	89.15
2	88.15
3	87.15
4	86.15
5	85.15



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REMARKS

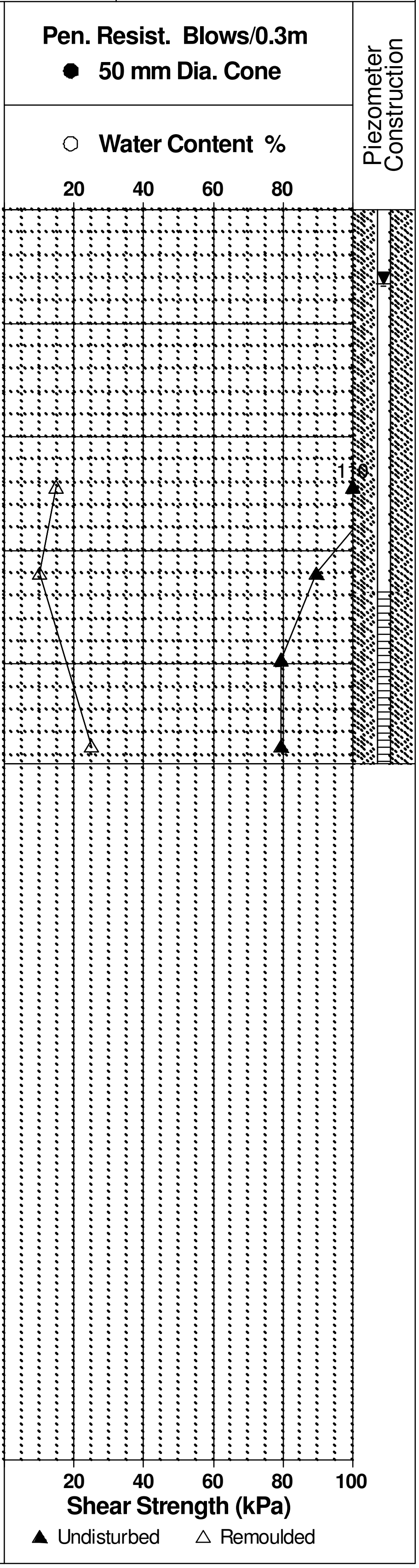
BORINGS BY CME 45 Power Auger

DATE 12 Jul 07

FILE NO. PG0675

HOLE NO. BH38

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.94
TOPSOIL	0.25						
Loose, brown **SILTY SAND**, trace clay	1.07	SS	1	100	4	1	88.94
Very stiff to stiff, brown **SILTY CLAY**, some sand - stiff and grey by 3.5m depth	4.88	SS	2	100	3	2	87.94
						3	86.94
						4	85.94
End of Borehole (GWL @ 0.65m-July 23/07)							



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REMARKS

BORINGS BY CME 45 Power Auger

DATE 13 Jul 07

FILE NO. PG0675

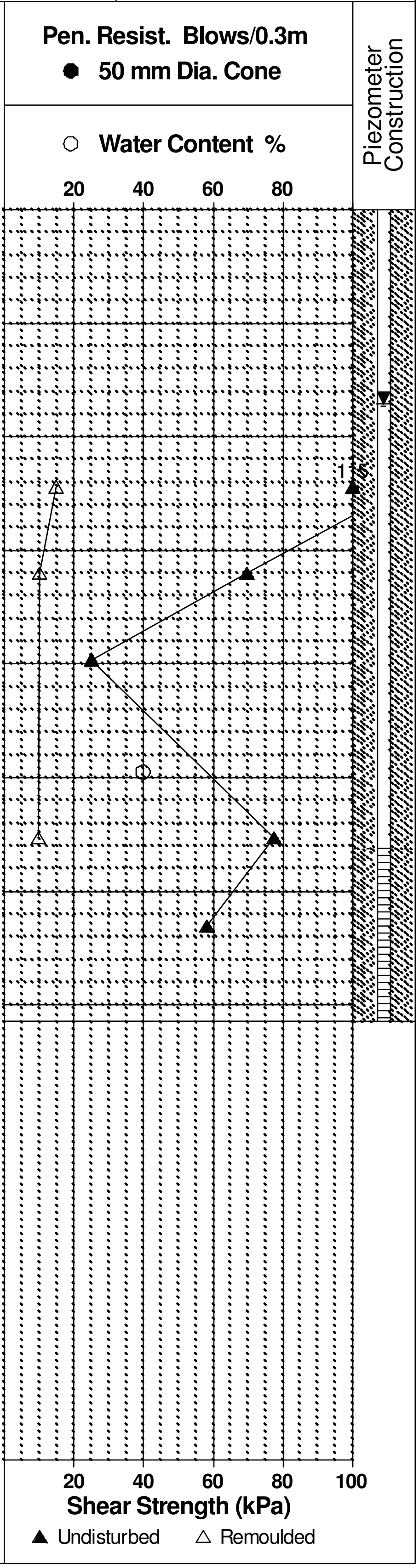
HOLE NO. BH39

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.59
TOPSOIL 0.23	AU	1				
Loose, brown **SILTY SAND**, trace clay 0.90					1	88.59
	SS	2	100	6		
	SS	3	100	5	2	87.59
Very stiff to stiff, brown **SILTY CLAY**, some sand seams					3	86.59
- firm to stiff and grey by 3.4m depth					4	85.59
	TW	4	100		5	84.59
6.40					6	83.59
GLACIAL TILL: Very stiff, grey silty clay with gravel and cobbles 7.14	SS	5	33	50+	7	82.59

End of Borehole

Practical refusal to augering @ 7.14m depth

(GWL @ 1.71m-July 23/07)



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

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

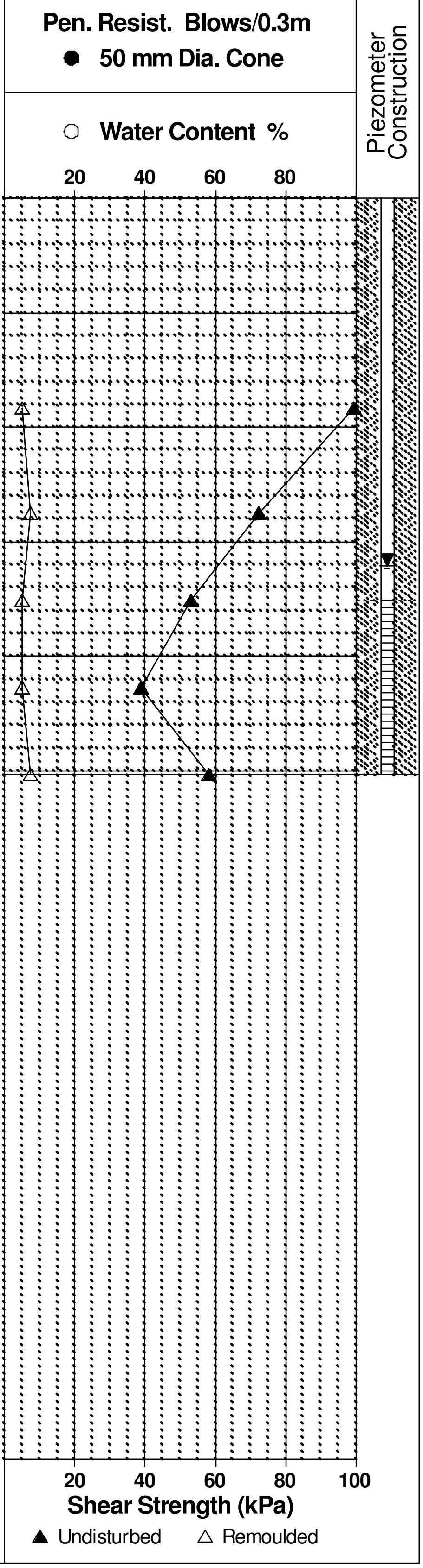
BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

FILE NO. PG0675

HOLE NO. BH40

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.10
TOPSOIL 0.20		AU	1				
Very stiff, brown **SILTY CLAY**, some sand		SS	2	100	4	1	88.10
- stiff by 1.5m depth		SS	3	100	3	2	87.10
- stiff to firm and grey by 2.7m depth						3	86.10
						4	85.10
5.03						5	84.10
End of Borehole (GWL @ 3.21m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

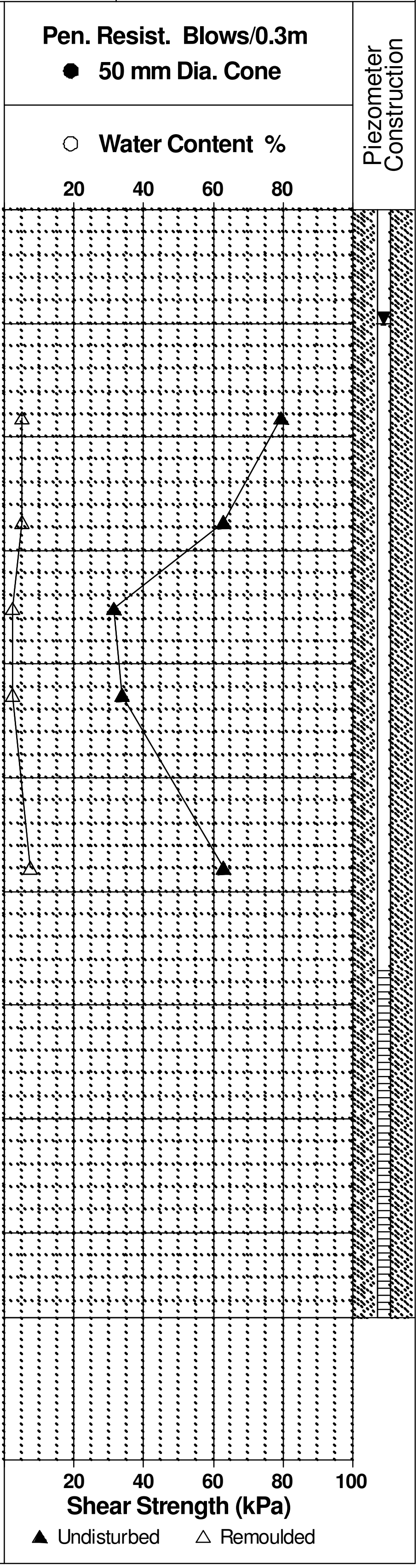
FILE NO. PG0675

HOLE NO. BH41

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	89.29
TOPSOIL 0.15	AU	1				
Very stiff to stiff, brown **SILTY CLAY**, some sand - firm to stiff and grey by 3.0m depth	SS	2	100	3	1	88.29
	SS	3	100	3	2	87.29
					3	86.29
					4	85.29
	TW	4	100		5	84.29
					6	83.29
6.70	SS	5	100	4		
Loose, grey **SANDY SILT**	SS	6	67	9	7	82.29
8.53	SS	7	50	5	8	81.29
Dense, grey **SILTY SAND**					9	80.29
9.75	SS	8	100	23		

End of Borehole

(GWL @ 1.00m-Jan. 25/08)



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

FILE NO. PG0675

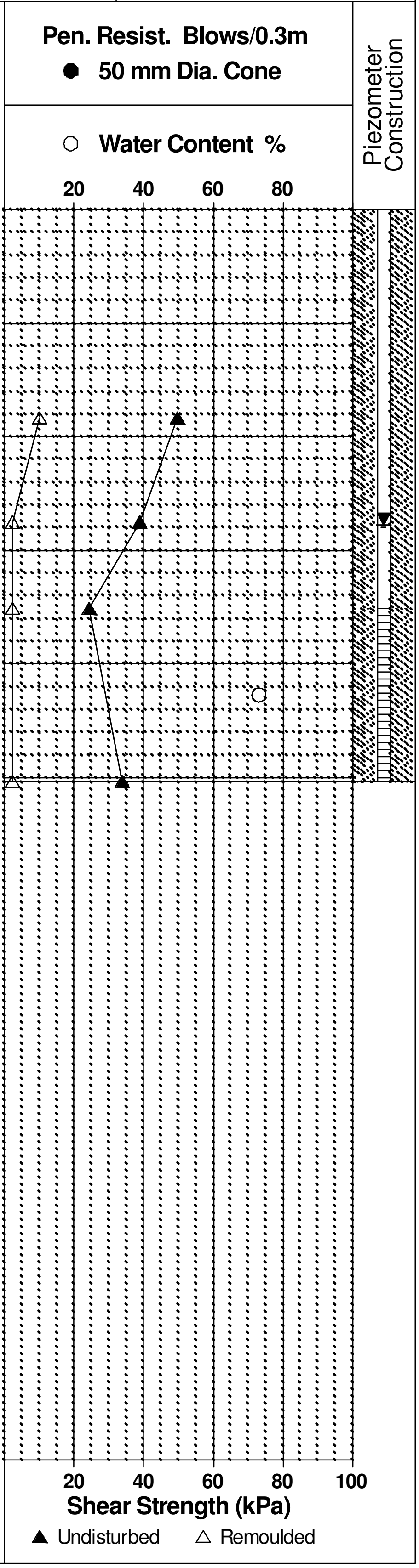
REMARKS

HOLE NO. BH42

BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.10
TOPSOIL 0.18		AU	1				
Stiff, brown **SILTY CLAY**		SS	2	100	4	1	88.10
- firm by 1.2m depth		SS	3	50	2	2	87.10
- soft to firm and grey by 2.9m depth						3	86.10
		TW	4	100		4	85.10
5.03						5	84.10
End of Borehole (GWL @ 2.77m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

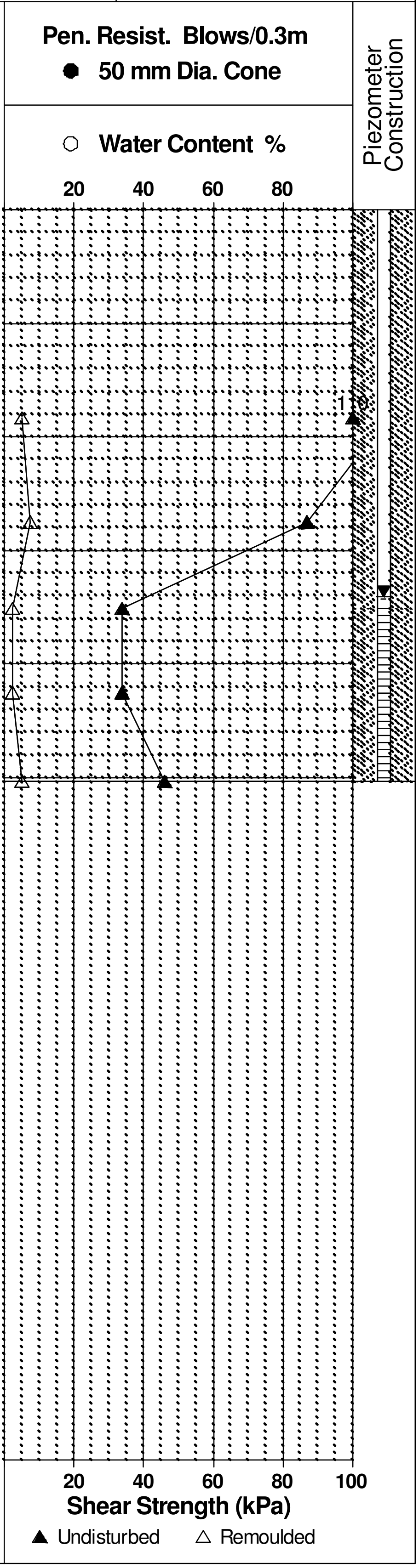
BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

FILE NO. PG0675

HOLE NO. BH43

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.52
TOPSOIL 0.15		AU	1				
Very stiff, brown **SILTY CLAY**, some sand		SS	2	100	4	1	88.52
- stiff by 1.8m depth		SS	3	100	3	2	87.52
- firm and grey by 2.7m depth						3	86.52
						4	85.52
5.03						5	84.52
End of Borehole							
(GWL @ 3.41m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE 15 Jan 08

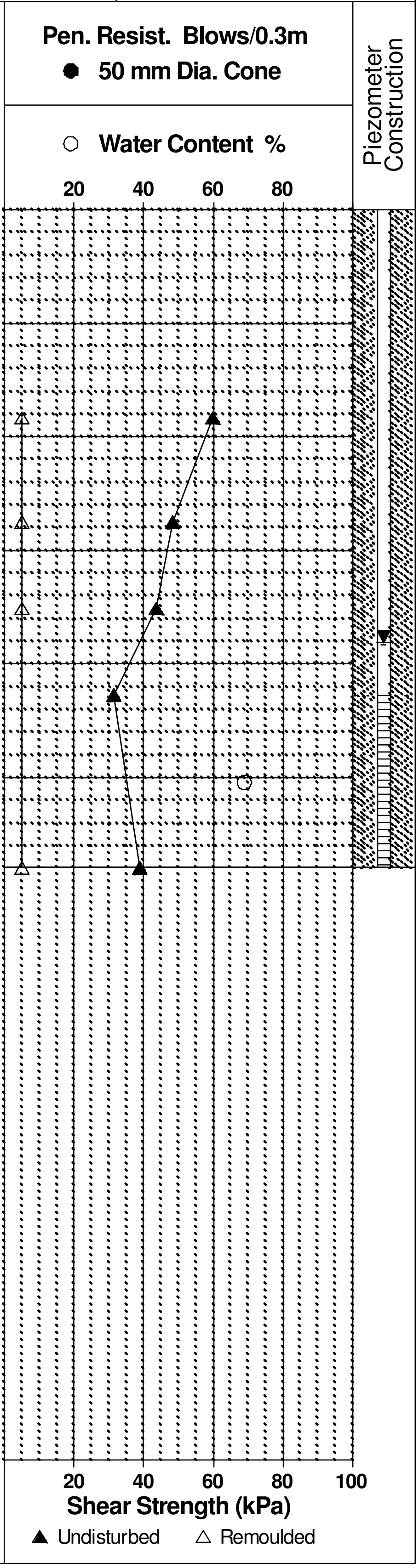
FILE NO. PG0675

HOLE NO. BH44

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.43
TOPSOIL 0.18		AU	1				
Very stiff to stiff, brown **SILTY CLAY**, some sand		SS	2	100	5	1	88.43
- firm by 1.5m depth		SS	3	100	3	2	87.43
- grey by 3.0m depth						3	86.43
						4	85.43
		TW	4	100		5	84.43
5.79							

End of Borehole

(GWL @ 3.81m-Jan. 25/08)



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

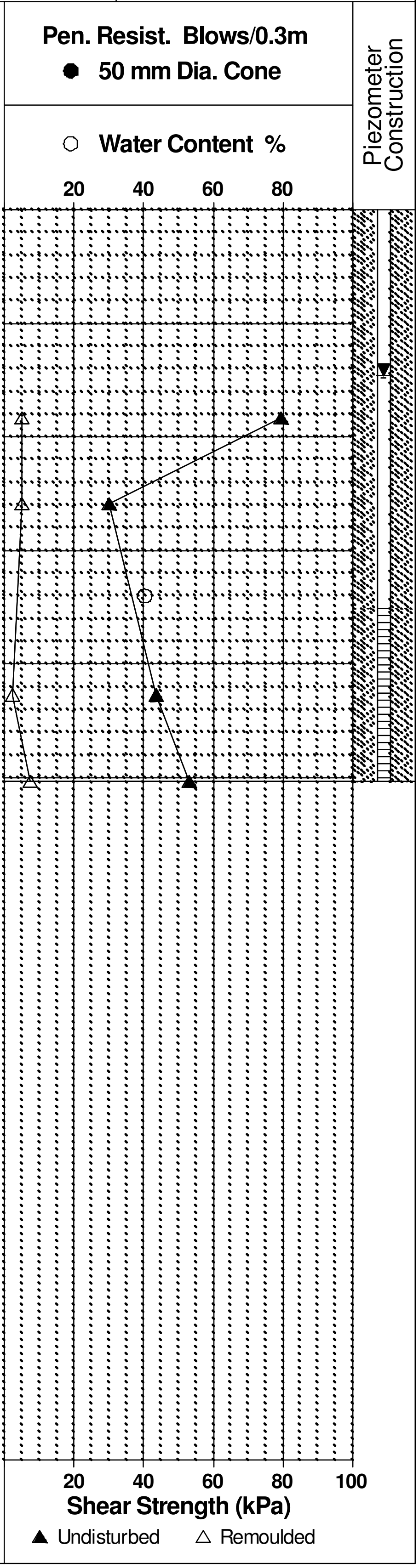
BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

FILE NO. PG0675

HOLE NO. BH45

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.35
TOPSOIL 0.15		AU	1				
Loose, brown **SILTY SAND**, trace clay 1.22		SS	2	100	5	1	88.35
Stiff, brown **SILTY CLAY**		SS	3	100	3		
- soft to firm and grey by 2.1m depth						2	87.35
						3	86.35
		TW	4	100			
						4	85.35
- stiff by 4.4m depth 5.03						5	84.35
End of Borehole							
(GWL @ 1.46m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

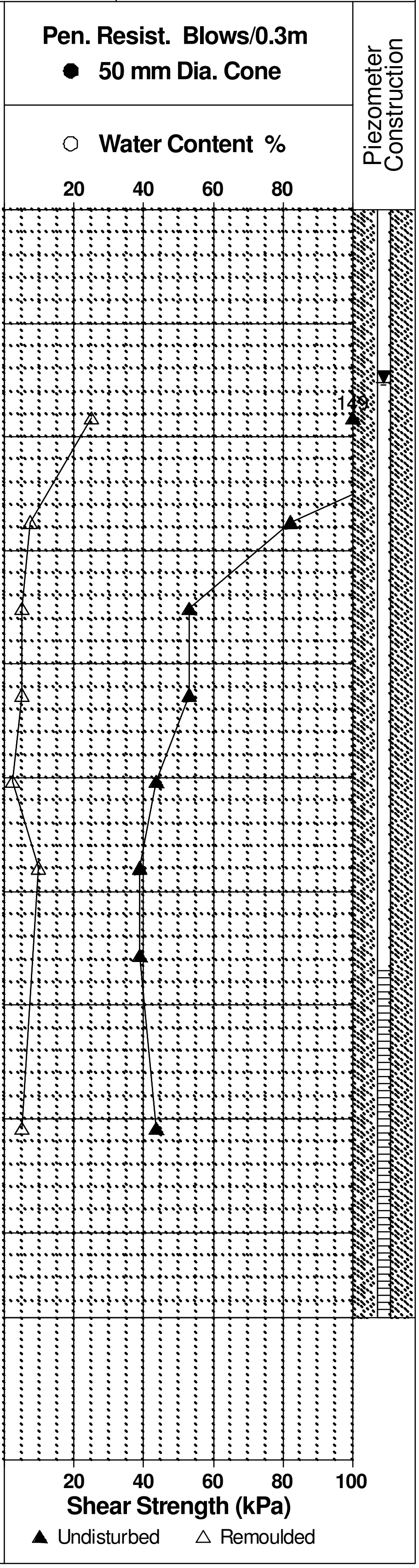
BORINGS BY CME 55 Power Auger

DATE 15 Jan 08

FILE NO. PG0675

HOLE NO. BH46

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.03
TOPSOIL 0.15		AU	1				
		SS	2	100	6	1	88.03
Very stiff to stiff, brown **SILTY CLAY**, some sand - stiff to firm and grey by 3.0m depth		SS	3	100	3	2	87.03
						3	86.03
						4	85.03
						5	84.03
						6	83.03
		SS	4	100	1	7	82.03
8.53						8	81.03
Loose, grey **SILTY SAND**, some gravel						9	80.03
9.75		SS	5	42	6		
End of Borehole (GWL @ 1.52m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

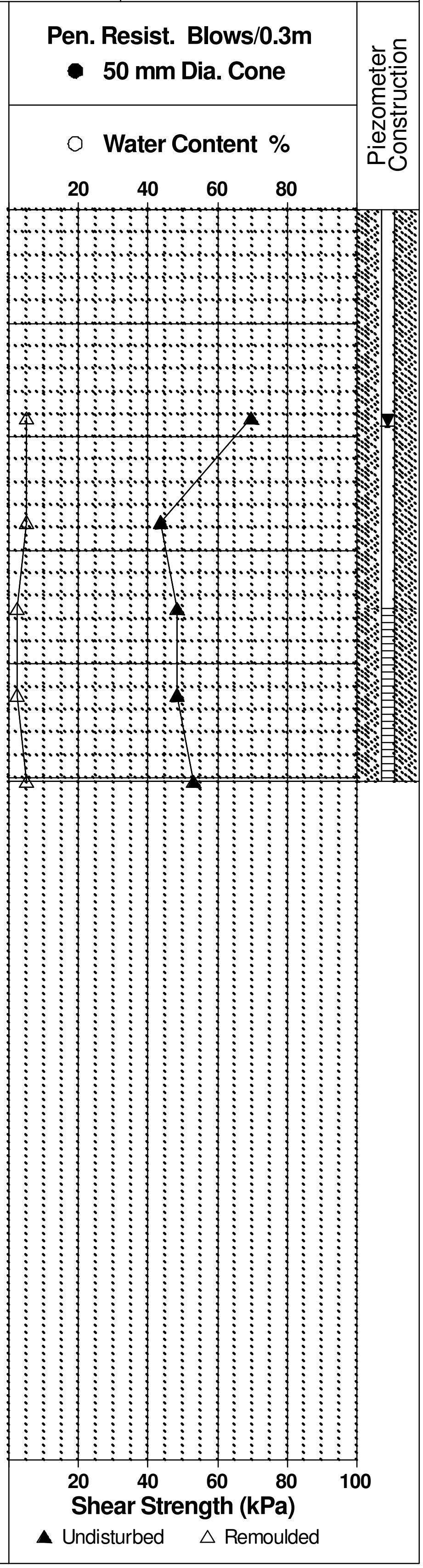
BORINGS BY CME 55 Power Auger

DATE 15 Jan 08

FILE NO. PG0675

HOLE NO. BH47

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	88.91
TOPSOIL 0.20	▇	AU	1				
Stiff, brown **SILTY CLAY**, some sand	▨	SS	2	50	6	1	87.91
- stiff to firm by 1.5m depth	▨	SS	3	100	3	2	86.91
- grey by 2.9m depth	▨					3	85.91
	▨					4	84.91
- stiff by 4.4m depth 5.03	▨					5	83.91
End of Borehole							
(GWL @ 1.90m-Jan. 25/08)							



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

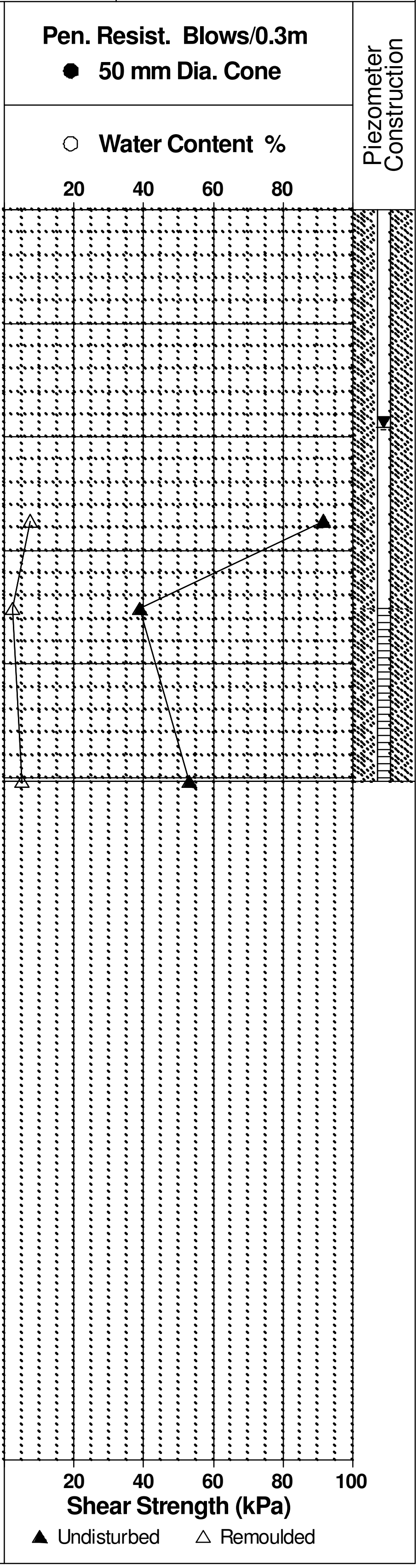
BORINGS BY CME 55 Power Auger

DATE 14 Jan 08

FILE NO. PG0675

HOLE NO. BH48

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.95
TOPSOIL 0.18						
Loose, brown **SILTY SAND**, trace clay 0.60	AU	1				
	SS	2	100	5	1	87.95
Very stiff to stiff, brown **SILTY CLAY**, some sand	SS	3	100	4	2	86.95
- firm to stiff and grey by 2.7m depth					3	85.95
	TW	4	100		4	84.95
5.03					5	83.95
End of Borehole (GWL @ 1.92m-Jan. 25/08)						



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Mahogany Community - First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 15 Jan 08

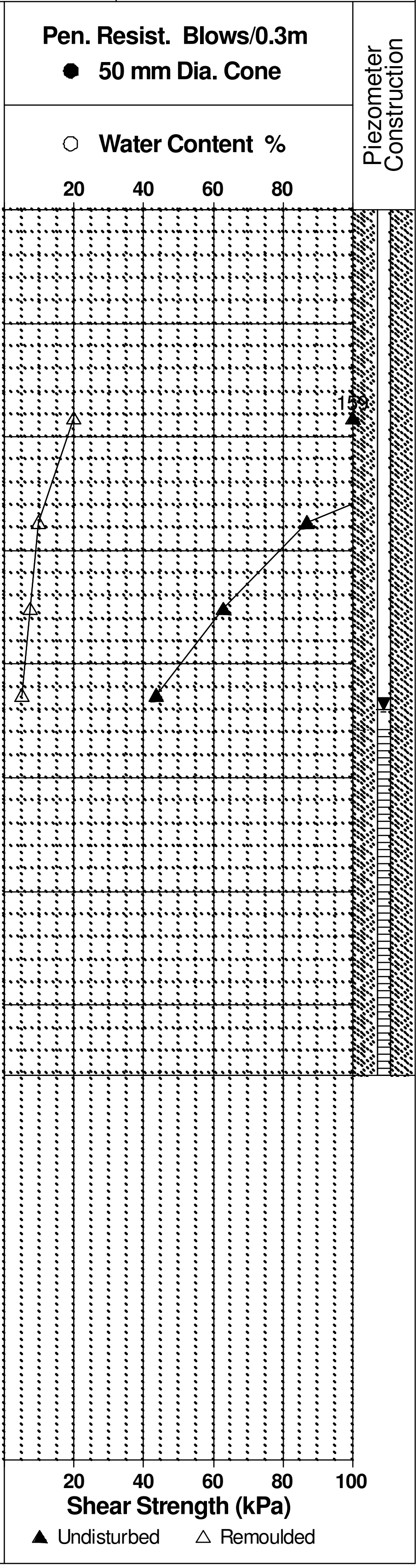
FILE NO. PG0675

HOLE NO. BH49

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.20
Very stiff to stiff, brown **SILTY CLAY**, some sand - stiff to firm and grey by 3.0m depth	5.33
Compact to dense, grey **SILTY** fine **SAND**	7.62
End of Borehole (GWL @ 4.40m-Jan. 25/08)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	7
SS	3	100	2
SS	4	100	4
SS	5	25	12
SS	6	75	50+

DEPTH (m)	ELEV. (m)
0	89.59
1	88.59
2	87.59
3	86.59
4	85.59
5	84.59
6	83.59
7	82.59



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154 Colonnade Road, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

FILE NO. **PG0834**

REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 75 Power Auger

DATE Jun 15, 06

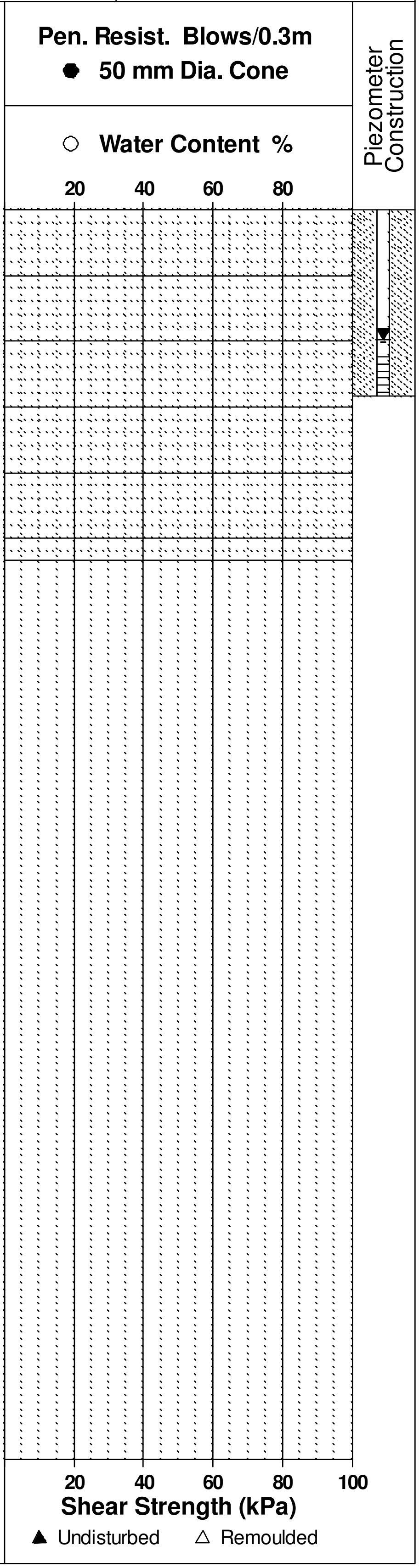
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	90.61
TOPSOIL 0.25						
Compact, brown **SILTY SAND**	SS	1	75	11	1	89.61
	SS	2	80	50+		
- boulder from 1.8 to 2.7m depth 2.74					2	88.61
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders	SS	3	75	85+	3	87.61
					4	86.61
5.33					5	85.61

End of Borehole

Practical refusal to augering @ 5.33m depth

(GWL @ 1.98m-June 30/06)

Probehole drilled 1m north of BH 1, practical refusal to augering @ 2.84m depth



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154 Colonnade Road, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

REMARKS

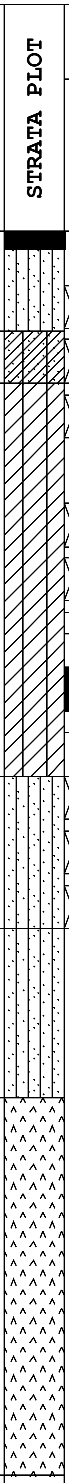
BORINGS BY CME 75 Power Auger

DATE Jun 16, 06

FILE NO. PG0834

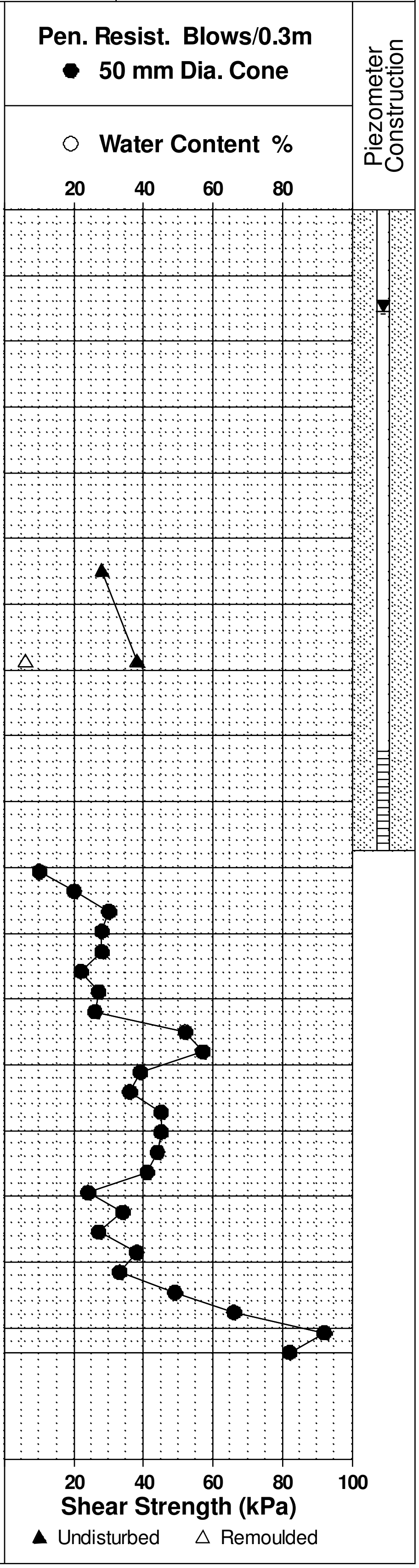
HOLE NO. BH 2

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.25
Loose to very loose, brown **SANDY SILT**	1.40
Brown interbedded **CLAYEY SILT** and **SILTY SAND**	2.13
Firm, brown **CLAYEY SILT** to **SILTY CLAY**, some sand - grey by 3.7m depth	7.62
Loose to compact, grey **SANDY SILT** with some clay to 8.2m depth	9.75
Dynamic Cone Penetration Test commenced @ 9.75m depth Inferred **SANDY SILT**	12.10
Inferred **GLACIAL TILL**	17.37
End of Borehole (GWL @ 1.55m-June 30/06)	



SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	67	6
SS	2	100	3
SS	3	100	3
SS	4	100	1
SS	5	100	1
TW	6	100	
SS	7	83	7
SS	8	67	14
SS	9	100	15

DEPTH (m)	ELEV. (m)
0	89.77
1	88.77
2	87.77
3	86.77
4	85.77
5	84.77
6	83.77
7	82.77
8	81.77
9	80.77
10	79.77
11	78.77
12	77.77
13	76.77
14	75.77
15	74.77
16	73.77
17	72.77



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE Jun 19, 06

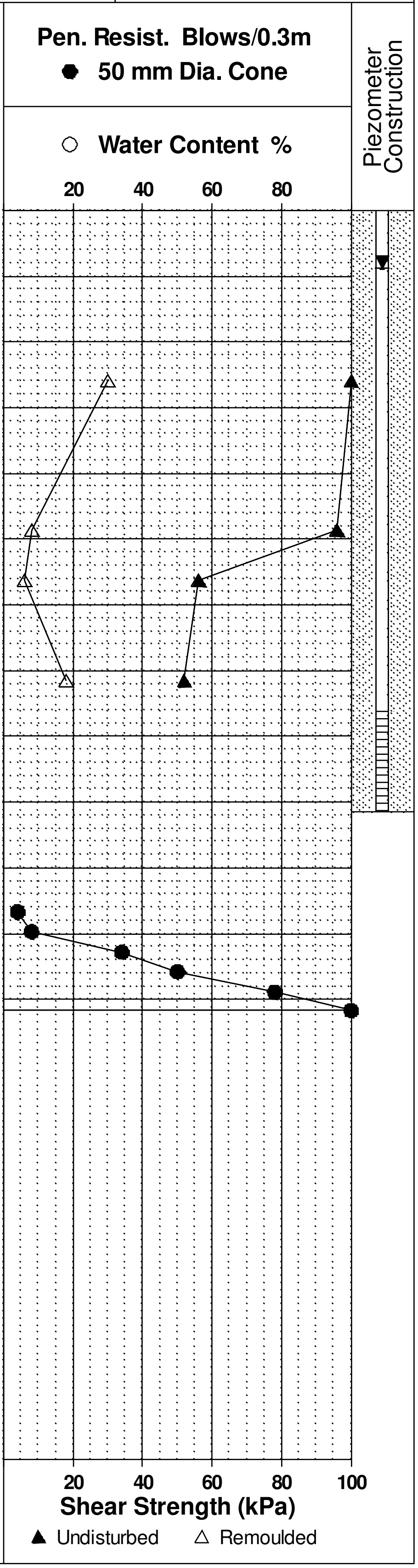
FILE NO. PG0834

HOLE NO. BH 3

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.25
Very loose, brown **SANDY SILT**	1.37
Very stiff, brown **SILTY CLAY** - stiff and grey by 2.9m depth - sand pockets from 6.1 to 6.7m depth	7.46
Loose to very loose, grey **SILTY SAND**	8.68
GLACIAL TILL: Compact, grey silty sand with gravel, cobbles and boulders	9.75
Dynamic Cone Penetration Test commenced @ 9.75m depth Inferred **GLACIAL TILL**	12.17
End of Borehole DCPT refusal @ 12.17m depth (GWL @ 0.87m-June 30/06)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	2
SS	2	100	2
SS	3	100	1
SS	4	100	1
SS	5	100	1
SS	6	50	6
SS	7	100	1
SS	8	100	21

DEPTH (m)	ELEV. (m)
0	88.56
1	87.56
2	86.56
3	85.56
4	84.56
5	83.56
6	82.56
7	81.56
8	80.56
9	79.56
10	78.56
11	77.56
12	76.56



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

DATE Jun 19, 06

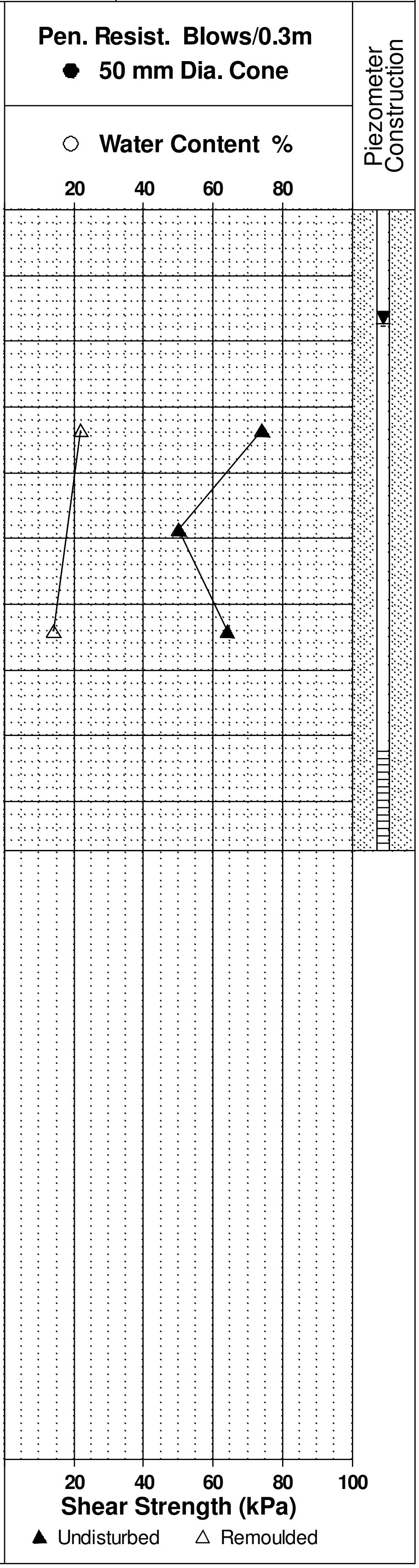
FILE NO. PG0834

HOLE NO. BH 4

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.25
Very loose, brown **SANDY SILT**	2.13
Stiff, brown **SILTY CLAY**, some sand seams - grey by 3.7m depth	6.70
Very loose to loose, grey **SILTY SAND** with clay seams and gravel	9.75
End of Borehole (GWL @ 1.73m-June 30/06)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	1
SS	2	100	1
SS	3	100	1
SS	4	100	1
TW	5	92	
SS	6	100	1
SS	7	75	12
SS	8	12	9
SS	9	75	7

DEPTH (m)	ELEV. (m)
0	89.47
1	88.47
2	87.47
3	86.47
4	85.47
5	84.47
6	83.47
7	82.47
8	81.47
9	80.47



SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

REMARKS

BORINGS BY CME 55 Power Auger

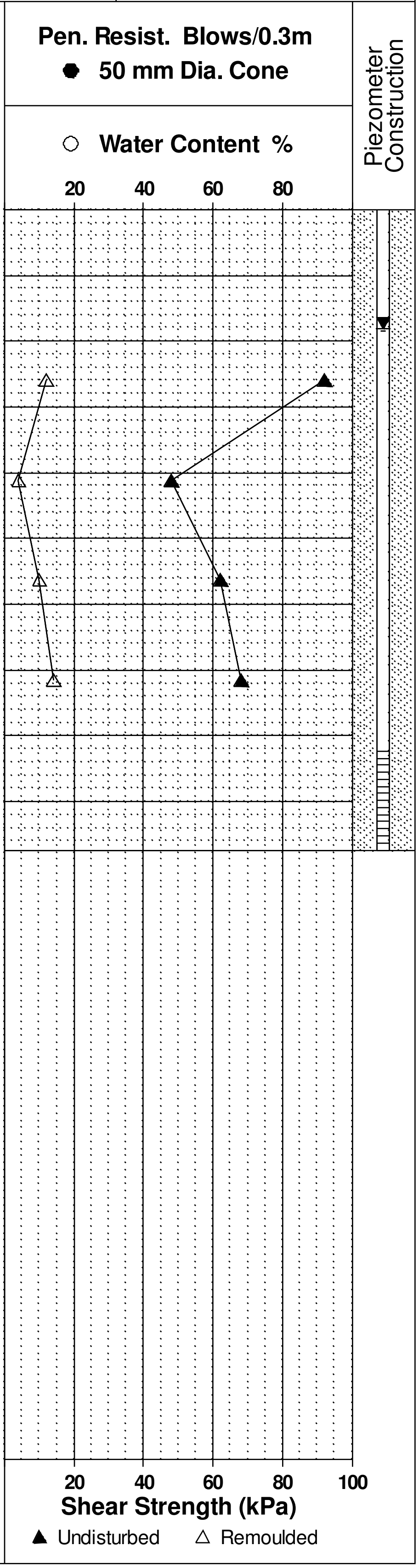
DATE Jun 19, 06

FILE NO. PG0834

HOLE NO. BH 5

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
Very loose, brown **SILTY SAND** with clay	1.37	SS	1	100	3
Stiff, brown **SILTY CLAY** with sand seams and sea shells - grey by 2.9m depth	7.92	SS	2	100	2
		SS	3	100	1
		TW	4	88	
		SS	5	100	3
		SS	6	100	1
Very loose, grey **SILTY SAND** with clay seams	9.75	SS	7	100	1
		SS	8	100	1
End of Borehole (GWL @ 1.81m-June 30/06)					

DEPTH (m)	ELEV. (m)
0	89.77
1	88.77
2	87.77
3	86.77
4	85.77
5	84.77
6	83.77
7	82.77
8	81.77
9	80.77



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
First Line Road
Ottawa, Ontario

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

FILE NO. **PG0834**

REMARKS

HOLE NO. **BH 6**

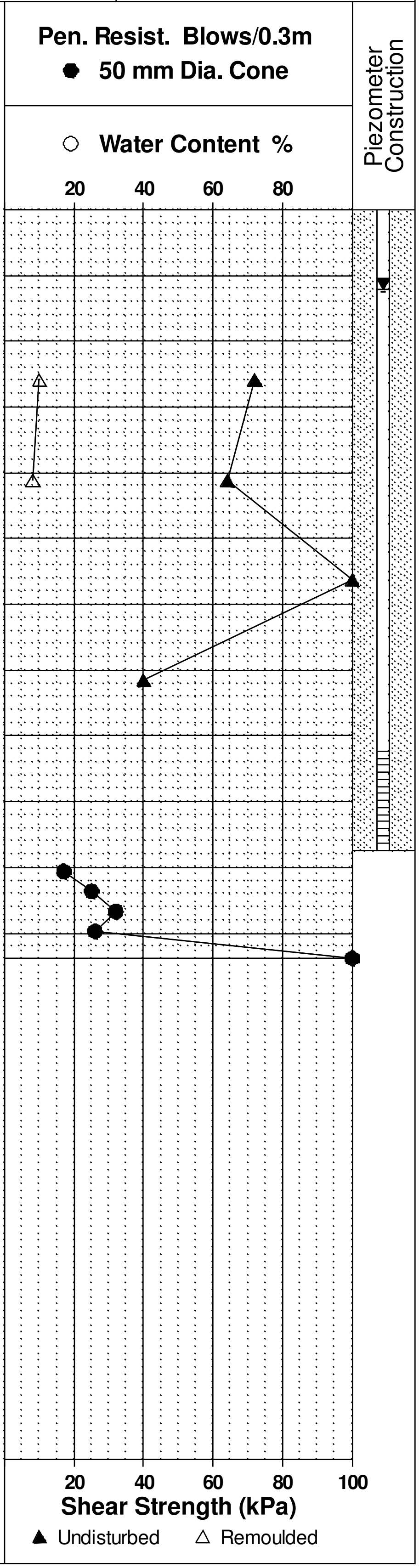
BORINGS BY CME 55 Power Auger

DATE Jun 20, 06

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.28
Very loose, brown **SILTY SAND** with clay	1.37
Stiff to very stiff, brown **SILTY CLAY** with occasional sand seams - grey by 2.9m depth - firm by 7.0m depth	8.23
GLACIAL TILL: Loose to very loose, grey silty sand with gravel, cobbles and boulders	10.06
Dynamic Cone Penetration Test commenced @ 10.06m depth	11.38
Inferred **GLACIAL TILL**	
End of Borehole DCPT refusal @ 11.38m depth (GWL @ 1.22m-June 30/06)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	75	3
SS	2	100	4
SS	3	100	1
SS	4	100	1
SS	5	100	1
TW	6	100	
SS	7	75	7
SS	8	75	1

DEPTH (m)	ELEV. (m)
0	89.18
1	88.18
2	87.18
3	86.18
4	85.18
5	84.18
6	83.18
7	82.18
8	81.18
9	80.18
10	79.18
11	78.18



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

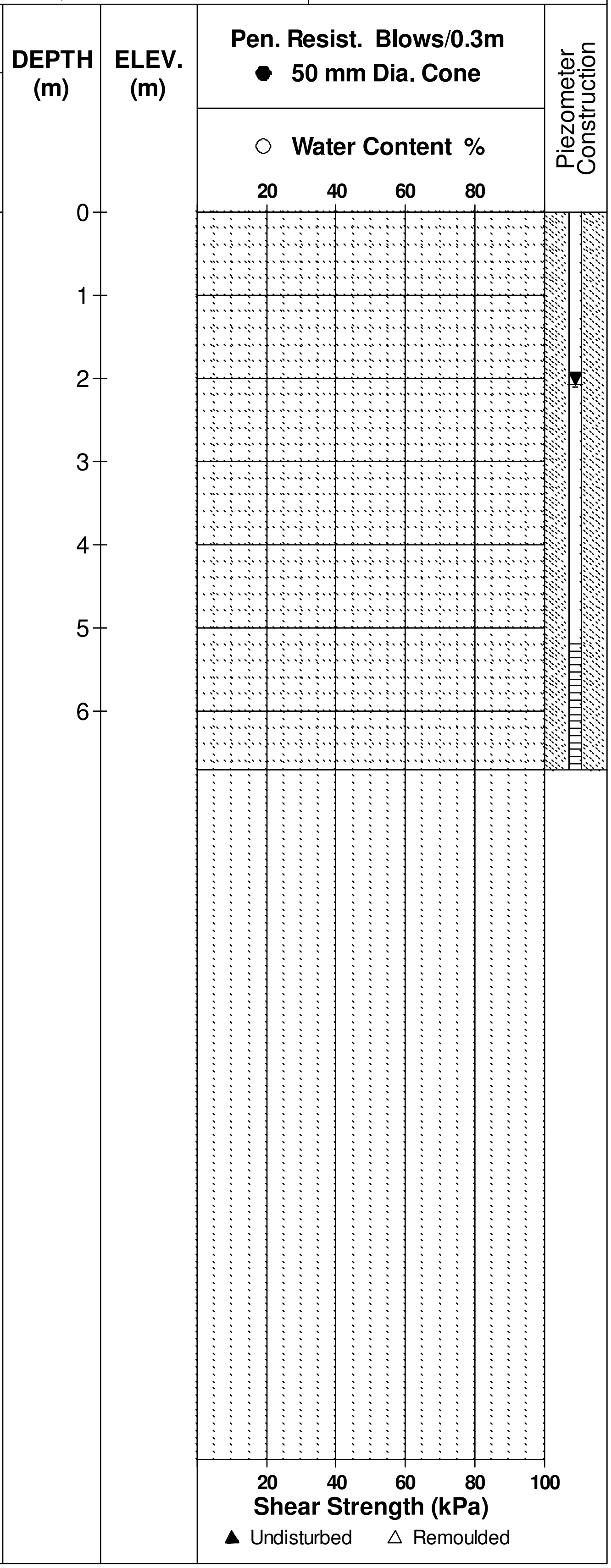
BORINGS BY CME 55 Power Auger

DATE Jul 15, 04

FILE NO. PG0328

HOLE NO. BH 1

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20				
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, cobbles and boulders		SS	1	50	46
		SS	2	46	52
		SS	3	58	42
		SS	4	58	44
	4.47	SS	5	54	46
Compact, grey **SANDY SILT**, trace gravel	5.49	SS	6	58	24
Dense, grey **SILTY SAND**	6.71	SS	7	75	49
End of Borehole (GWL @ 2.07-July 23/O4)					



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154 Colonnade Road, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE Jul 15, 04

FILE NO. PG0328

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0			
TOPSOIL 0.15									
GLACIAL TILL: Dense to very dense, brown silty sand with gravel, cobbles and boulders		SS	1	54	43	1			
1.93		SS	2		62+				
End of Borehole Practical refusal to augering @ 1.93m depth. Two probeholes drilled beside BH 2, refusal to augering @ 1.22m and 1.37m depth. (BH dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

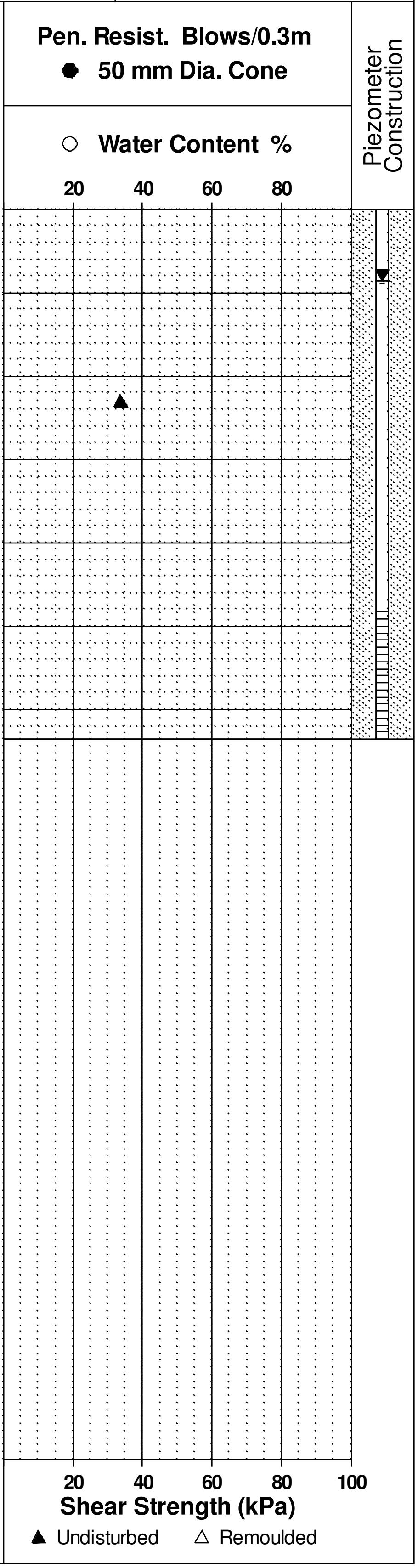
BORINGS BY CME 55 Power Auger

DATE Jul 15, 04

FILE NO. PG0328

HOLE NO. BH 3

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL	0.18						
Firm, brown-grey **SILTY CLAY**		SS	1	100	2	1	
		SS	2	100	1	2	
	3.04					3	
Grey **SILT**	3.10	SS	3	38	23		
GLACIAL TILL: Compact, grey silty sand with gravel, cobbles and boulders		SS	4	29	12	4	
		SS	5	29	15	5	
	6.35	SS	6	40	50+	6	
End of Borehole							
(GWL @ 0.86-July 23/04)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE Jul 15, 04

FILE NO. PG0328

HOLE NO. BH 4

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL — 0.23

Loose, brown **SILTY SAND**, some clay — 1.52

Very stiff, brown **SILTY CLAY**, trace fine sand

- firm and grey by 3.5m depth

- stiff by 6.7m depth

— 10.80

Dynamic Cone Penetration Test commenced @ 10.80m depth
Inferred **SILTY CLAY** — 12.65

End of Borehole

Refusal to DCPT @ 12.65m depth

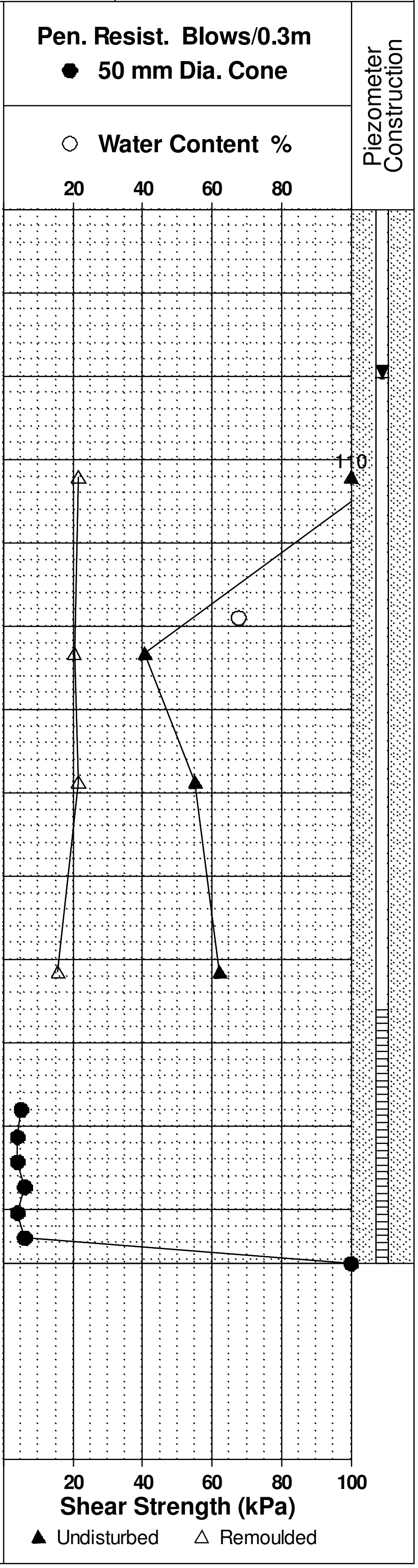
(GWL @ 2.01-July 23/04)

SAMPLE

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
SS	1	100	4
SS	2	100	6
SS	3	100	2
SS	4	100	W
TW	1		
SS	5	100	W
SS	6	100	W

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

ELEV. (m)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

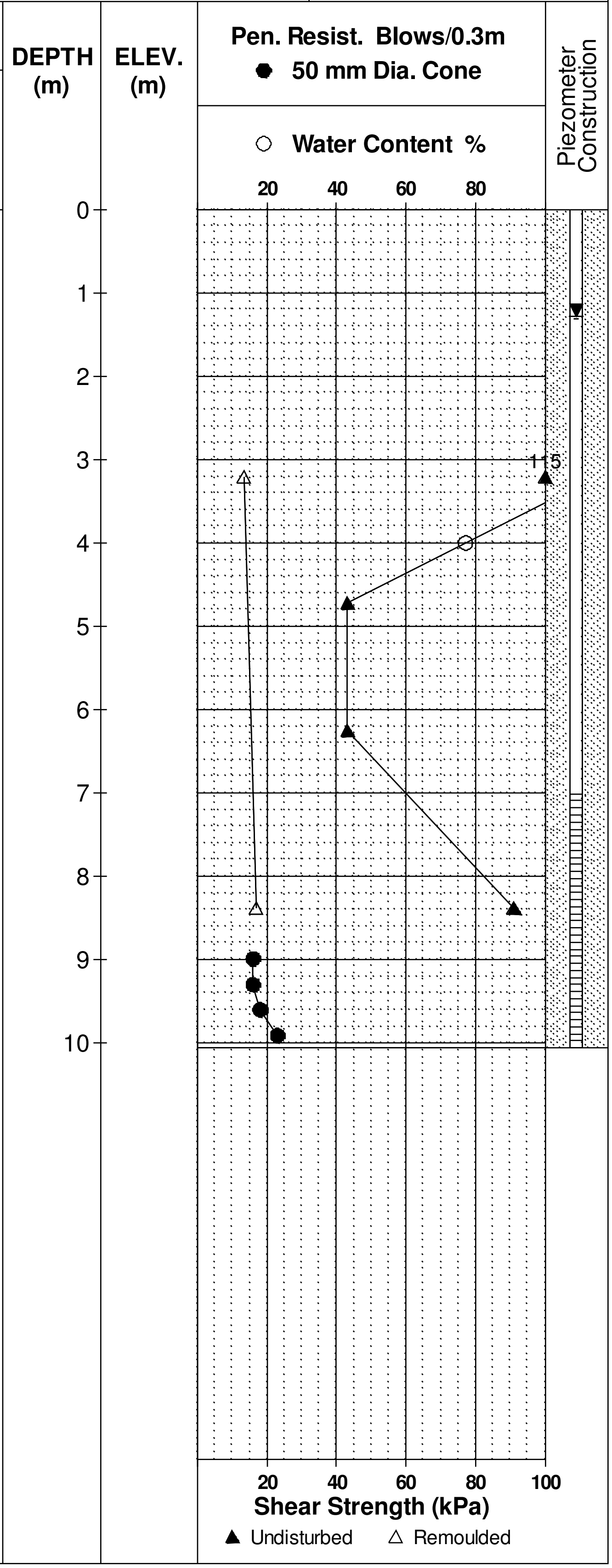
BORINGS BY CME 55 Power Auger

DATE Jul 15, 04

FILE NO. PG0328

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.20					
Very loose, brown **SILTY SAND**, some clay 1.42		SS	1	100	2
Very stiff, brown **SILTY CLAY**		SS	2	100	2
		SS	3	100	2
- firm and grey by 3.0m depth					
		TW	1		
		SS	4	100	W
- occasional silt layers		SS	5	100	1
		TW	2		
- stiff by 8.0m depth 8.84					
Dynamic Cone Penetration Test commenced @ 8.84m depth 10.06					
Inferred **GLACIAL TILL** or **SILT**					
End of Borehole					
(GWL @ 1.28-July 23/04)					



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Percival Property, Main Street at Century Road
Ottawa (Manotick), Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE Jul 16, 04

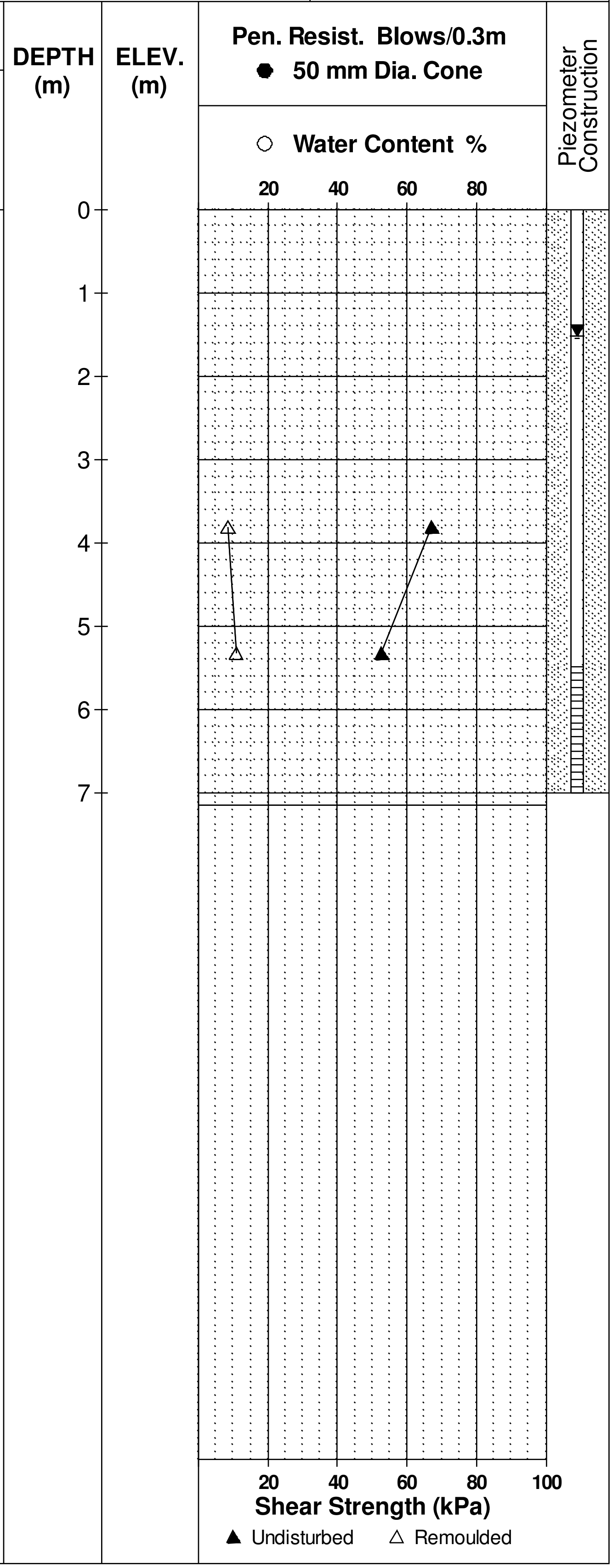
FILE NO. PG0328

HOLE NO. BH 6

SOIL DESCRIPTION		STRATA PLOT	SAMPLE			
			TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
TOPSOIL	0.30					
Very loose, brown **SILTY FINE SAND**, some clay	1.32		SS	1	100	3
Stiff, brown **SILTY CLAY**, trace sand			SS	2	100	2
			SS	3	100	1
- grey by 3.0m depth			SS	4	100	1
			TW	1		
	6.25					
Start of DCPT @ 7.0m depth			SS	5	79	5
GLACIAL TILL: Loose, grey silty sand with gravel, cobbles and boulders	7.14					
Refusal to DCPT @ 7.14 m depth						

End of Borehole

(GWL @ 1.52-July 23/04)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

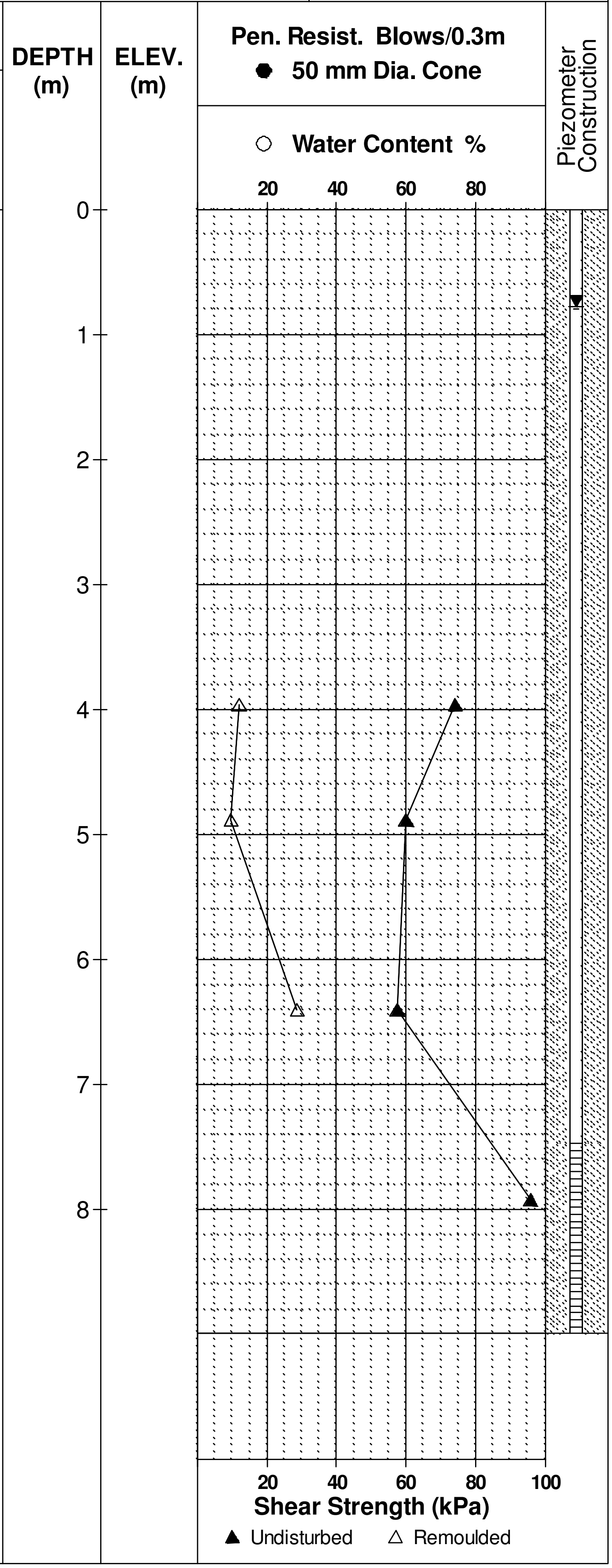
BORINGS BY CME 55 Power Auger

DATE May 7, 04

FILE NO. PG0219

HOLE NO. BH 1

SOIL DESCRIPTION		SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Cultivated silty clay	0.15				
		AU	1		
Very stiff to stiff, brown **SILTY CLAY**		SS	2	79	10
		SS	3	100	7
		SS	4	100	5
- grey by 3.0m depth		SS	5	100	3
		SS	4	100	1
		SS	5	100	W
	7.92				
GLACIAL TILL: Compact, grey clayey silt with gravel, cobbles and boulders		SS	6	29	11
	8.89				
End of Borehole					
(GWL @ 0.78m-May 19/04)					



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

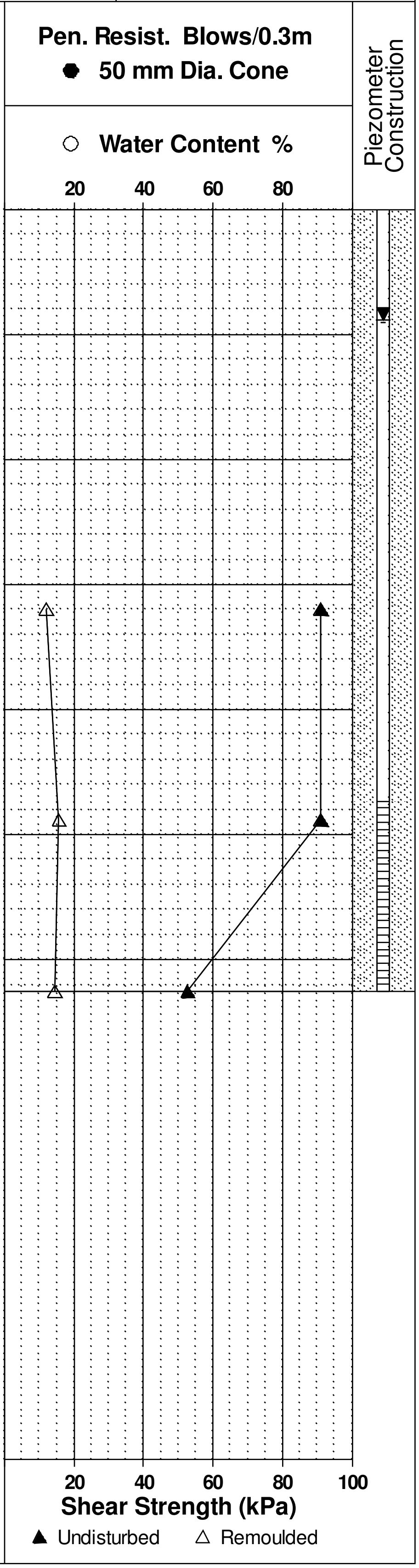
BORINGS BY CME 55 Power Auger

DATE May 7, 04

FILE NO. PG0219

HOLE NO. BH 2

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
Cultivated silty clay 0.20	AU	1				
Very stiff to stiff, brown **SILTY CLAY**	SS	2	100	6	1	
	SS	3	100	6	2	
- grey by 2.9m depth	SS	4	100	7	3	
	TW	5			4	
					5	
6.25	SS	6	100	1	6	
End of Borehole (GWL @ 0.88m-May 19/04)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

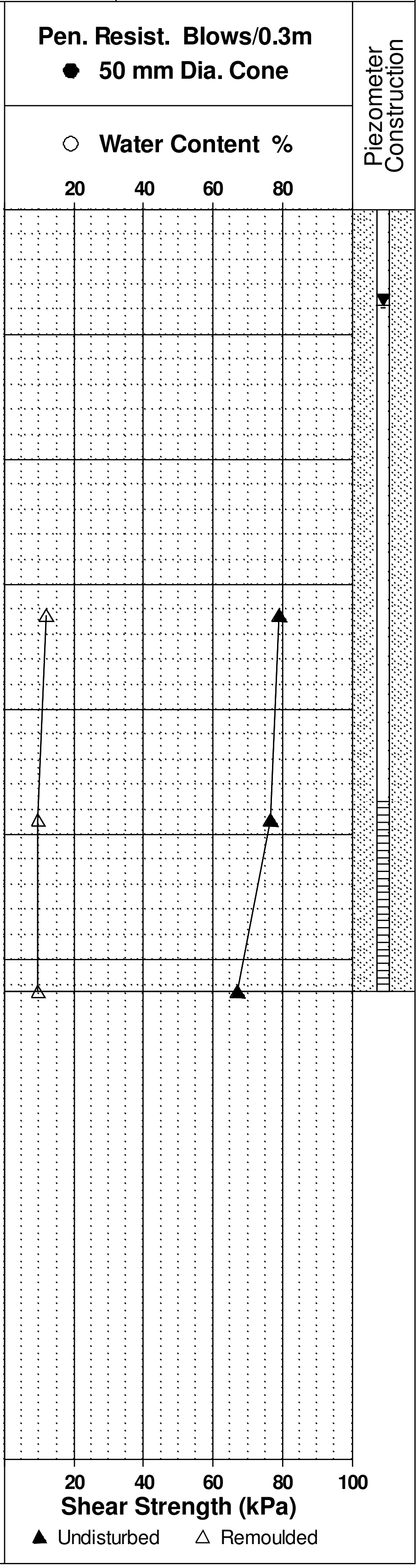
BORINGS BY CME 55 Power Auger

DATE May 7, 04

FILE NO. PG0219

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Cultivated silty clay 0.15							
		SS	1	100	6	1	
Very stiff to stiff, brown **SILTY CLAY**, trace sand seams		SS	2	100	6	2	
		SS	3	100	4		
- grey by 2.9m depth						3	
						4	
						5	
		SS	4	100	2	6	
6.25							
End of Borehole							
(GWL @ 0.77m-May 19/04)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

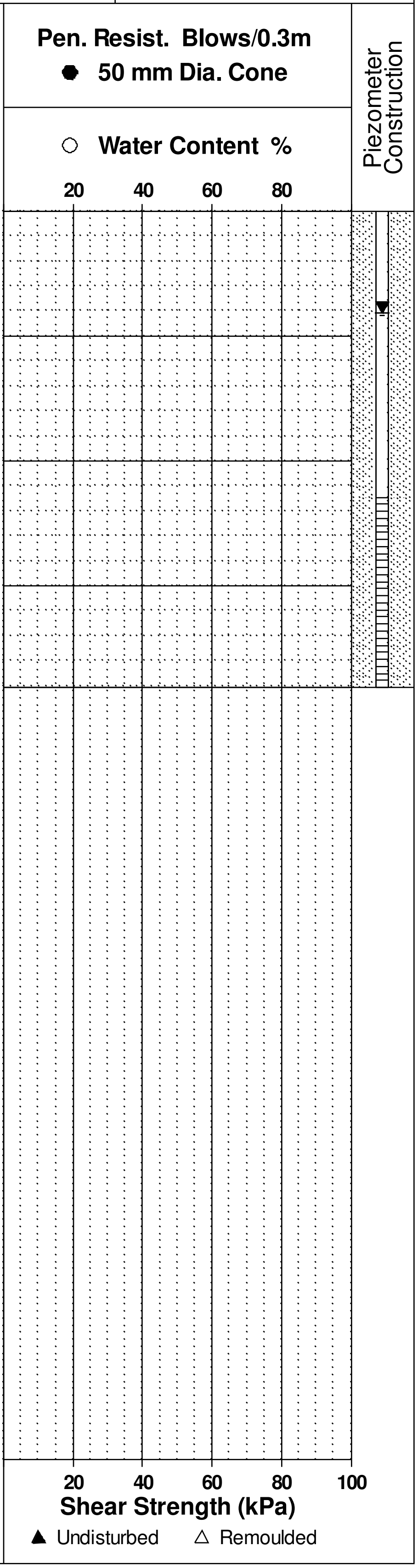
BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. PG0219

HOLE NO. BH 4

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Cultivated silty clay	0.15						
Very stiff, brown **SILTY CLAY**	0.76						
GLACIAL TILL: Dense, grey-brown clayey silt with sand, gravel and cobbles	1.01	SS	1	42	23	1	
GLACIAL TILL: Compact to very dense, grey-brown sandy silt with gravel, cobbles and boulders		SS	2	42	24	2	
						3	
	3.81	SS	3	75	59		
End of Borehole (GWL @ 0.82m-May 19/04)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE May 7, 04

FILE NO. PG0219

HOLE NO. BH 5

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	
Cultivated silty clay 0.09						
Stiff, brown **SILTY CLAY**, trace sand seams	AU	1				
1.17	SS	2	83	13	1	
GLACIAL TILL: Compact, brown sandy silt with gravel, cobbles and boulders	SS	3	17	9	2	
	SS	4	21	11		
3.05					3	
GLACIAL TILL: Dense, brown clayey silt with gravel, cobbles and boulders	SS	5	50	30		
	SS	6	33	29	4	
					5	
5.94	SS	7	50	33		
End of Borehole						
(GWL @ 1.35m-May 19/04)						

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

○ **Water Content %**
20 40 60 80

Piezometer Construction

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. PG0219

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	
Cultivated silty clay 0.15							
Very stiff to stiff, brown **SILTY CLAY**		SS	1	100	7	1	
		SS	2	100	5	2	
2.90		SS	3	100	16		
GLACIAL TILL: Compact to very dense, grey sandy silt with gravel, cobbles and boulders		SS	4	58	28	3	
						4	
5.18		SS	5	62	44	5	
GLACIAL TILL: Grey clayey silt with gravel, cobbles and boulders 5.59		SS	6	100	65+		
End of Borehole							
(GWL @ 0.93m-May 19/04)							

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

○ **Water Content %**

20 40 60 80

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

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

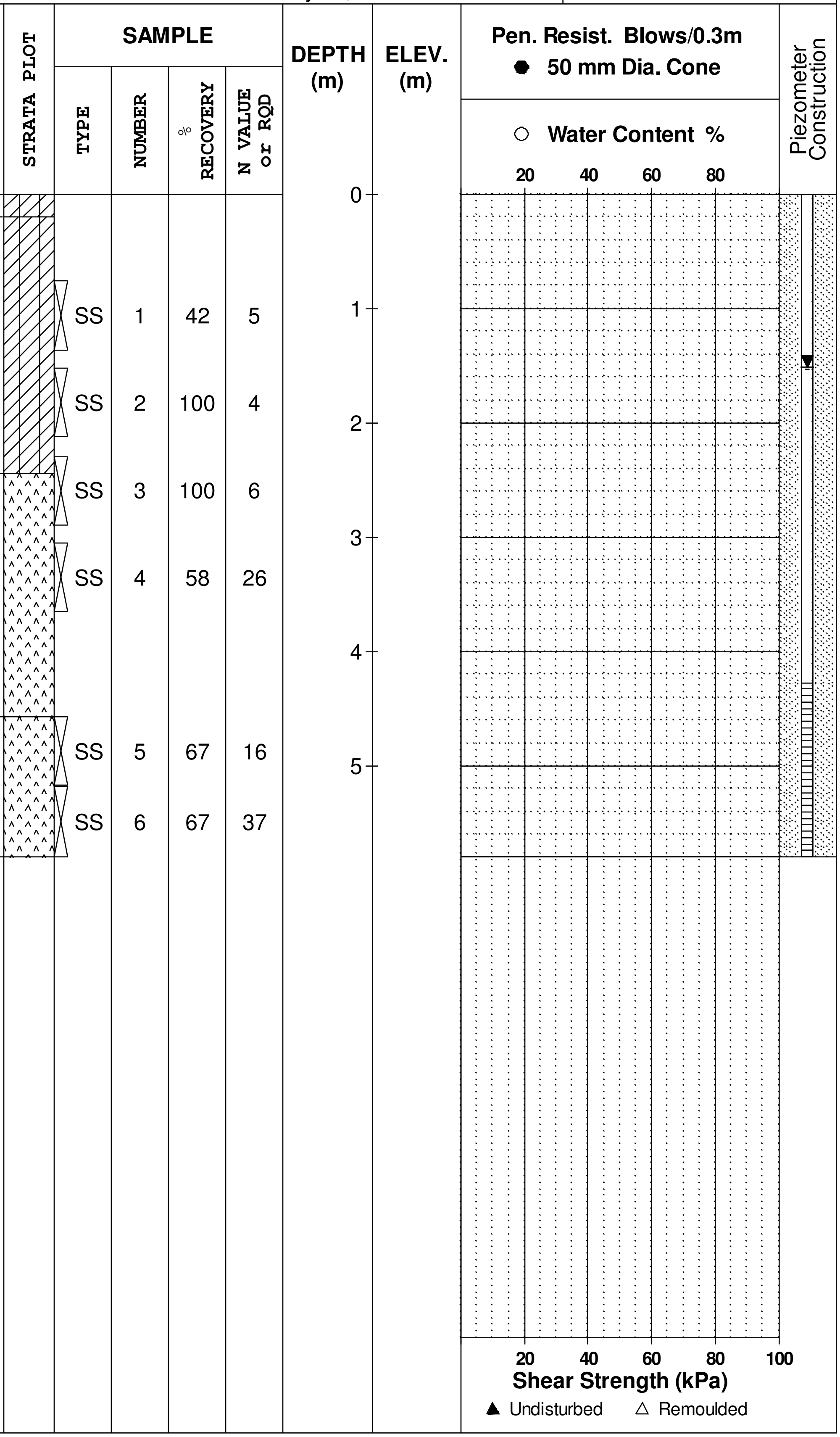
BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. PG0219

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Cultivated silty clay	0.20				
Very stiff to stiff, brown **SILTY CLAY**		SS	1	42	5
		SS	2	100	4
	2.44				
GLACIAL TILL: Compact, brown sandy silt with gravel, cobbles and boulders		SS	3	100	6
		SS	4	58	26
	4.57				
GLACIAL TILL: Dense to compact, grey-brown clayey silt with gravel, cobbles and boulders		SS	5	67	16
		SS	6	67	37
	5.79				
End of Borehole					
(GWL @ 1.51m-May 19/04)					



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

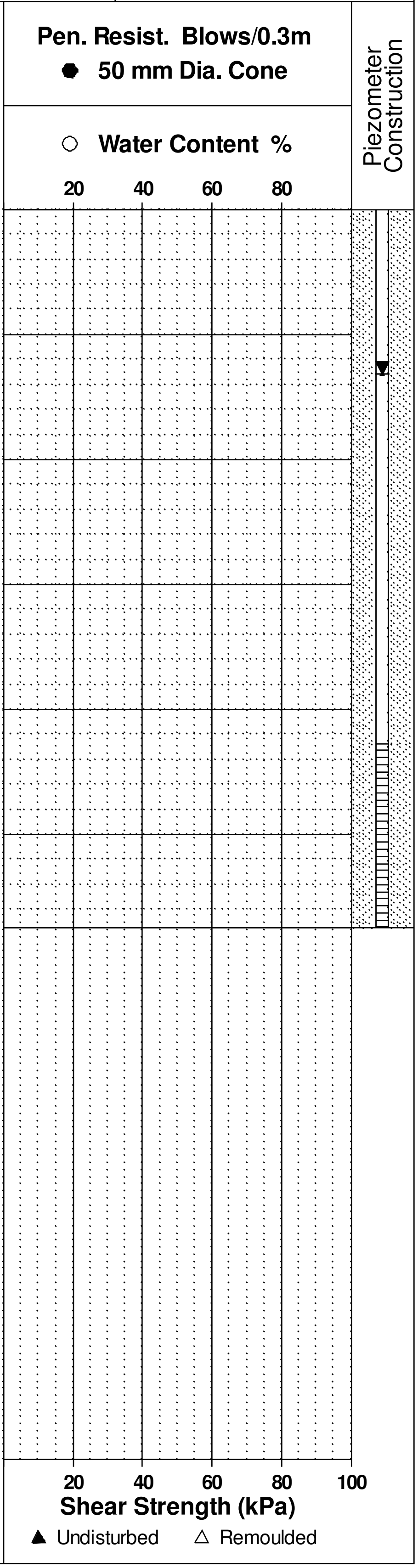
BORINGS BY CME 55 Power Auger

DATE May 11, 04

FILE NO. PG0219

HOLE NO. BH 8

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Cultivated silty clay	0.20						
Very stiff, brown **SILTY CLAY**		AU	1				
	1.12	SS	2	83	21	1	
GLACIAL TILL: Compact, brown sandy silt with gravel, cobbles and boulders		SS	3	100	18	2	
- grey by 3.0m depth		SS	4	12	23	3	
						4	
- dense to very dense by 4.6m depth		SS	5	54	49	5	
	5.74	SS	6	64	64+		
End of Borehole							
(GWL @ 1.31m-May 19/04)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

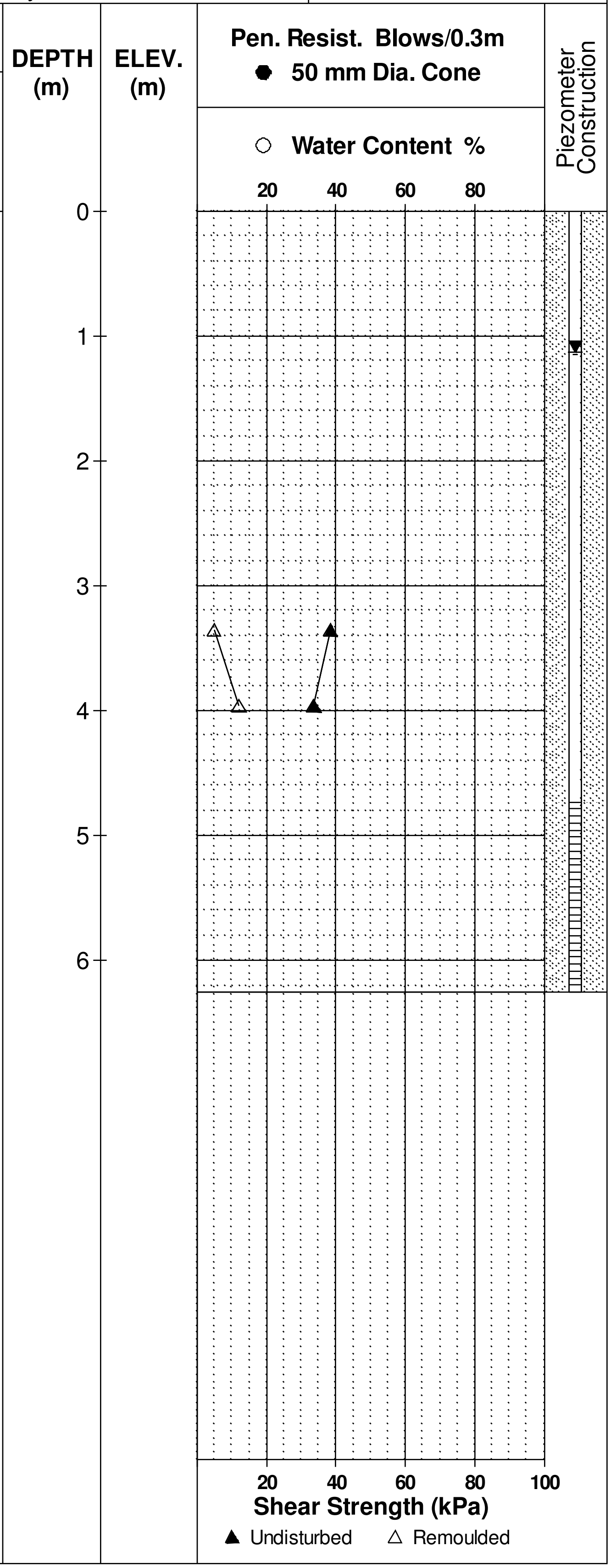
BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. PG0219

HOLE NO. BH 9

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Cultivated silty clay 0.20				
Stiff, brown **SILTY CLAY**	SS	1	100	11
	SS	2	100	4
	SS	3	100	2
- grey by 3.0m depth				
3.96				
GLACIAL TILL: Loose to compact, grey sandy silt with gravel, cobbles and boulders	SS	4	100	5
	SS	5	83	13
6.25				
End of Borehole				
(GWL @ 1.13m-May 19/04)				



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

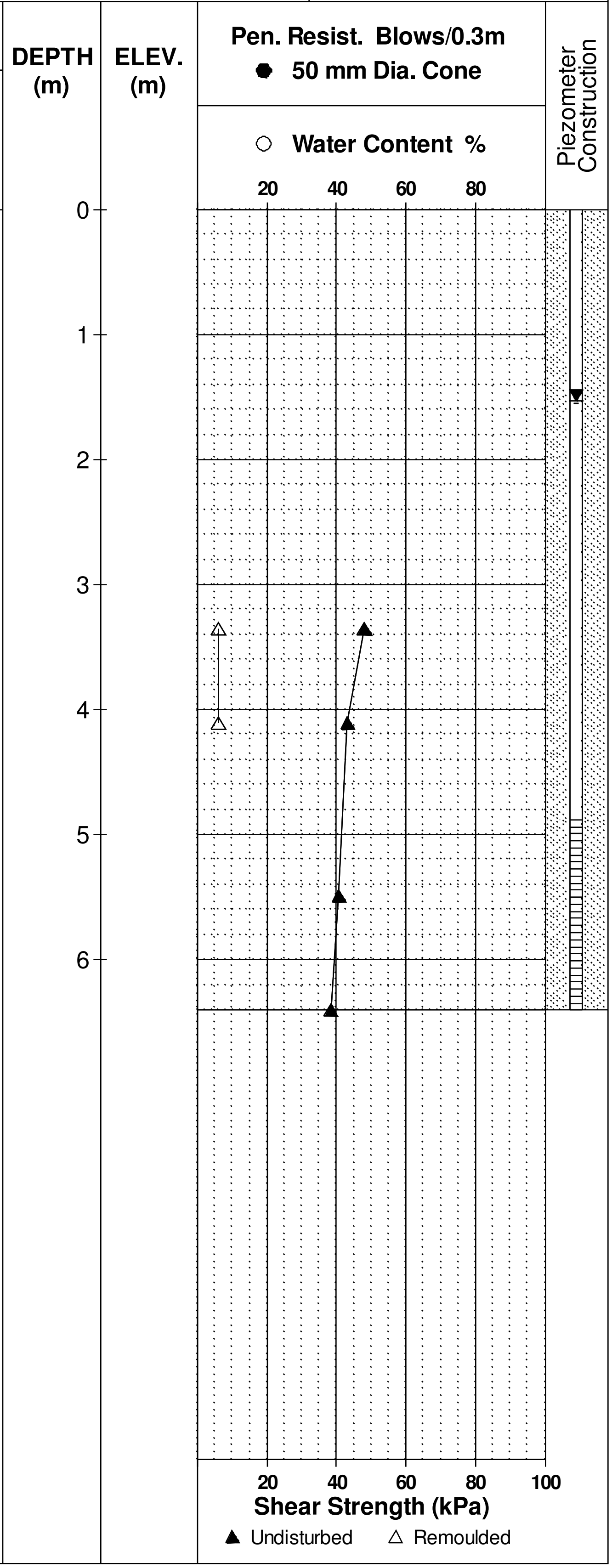
BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. **PG0219**

HOLE NO. **BH10**

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
Cultivated silty clay 0.15				
	AU	1		
Stiff, brown **SILTY CLAY**	SS	2	75	5
	SS	3	100	4
- firm and grey by 2.3m depth	SS	4	100	4
	SS	5	100	1
6.40				
End of Borehole				
(GWL @ 1.53m-May 19/04)				



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

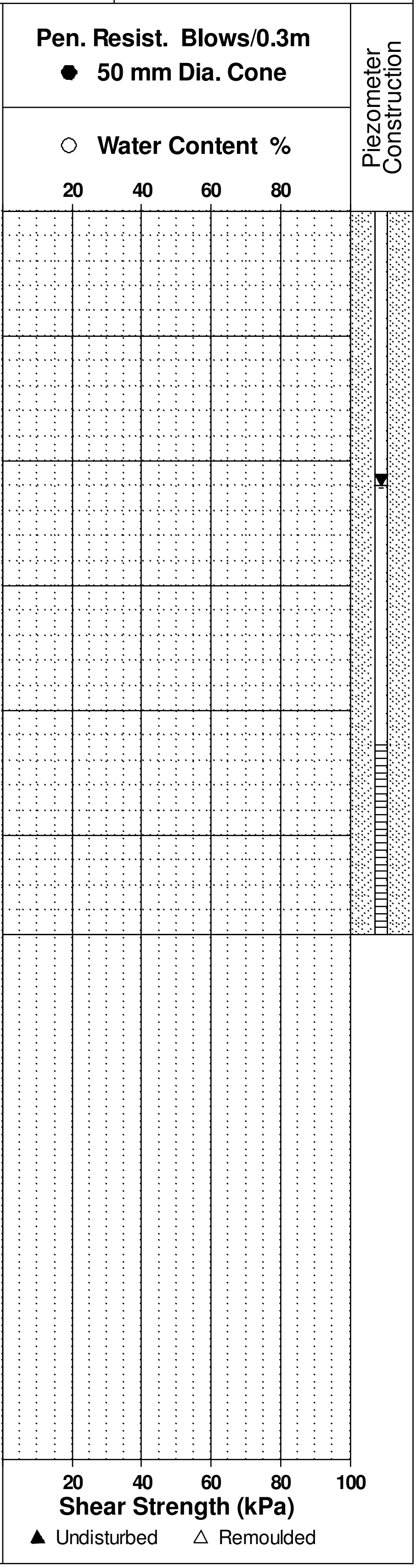
BORINGS BY CME 55 Power Auger

DATE May 10, 04

FILE NO. **PG0219**

HOLE NO. **BH11**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	
Cultivated silty clay 0.20		AU	1				
Very stiff, brown **SILTY CLAY** 1.52		SS	2	100	11	1	
GLACIAL TILL: Compact to very dense, brown sandy silt to silty sand with gravel, cobbles and boulders		SS	3	62	21	2	
		SS	4		15	3	
						4	
		SS	5	83	28	5	
5.79		SS	6	50	76		
End of Borehole							
(GWL @ 2.20m-May 19/04)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Kizzel Property, West of Manotick Main Street
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger

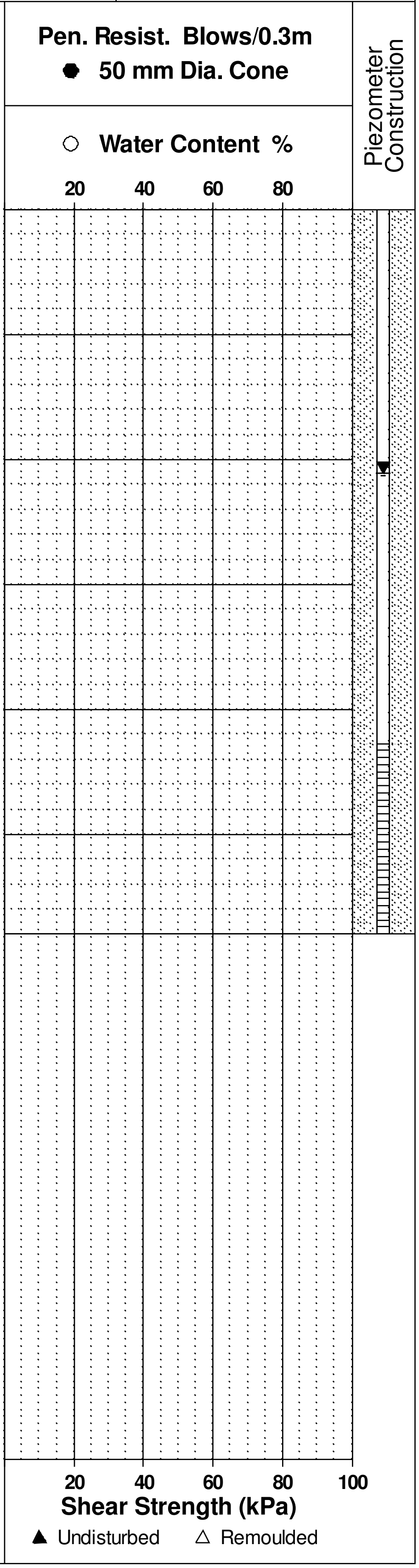
DATE May 10, 04

FILE NO. PG0219

HOLE NO. BH12

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Cultivated silty clay	0.15						
Very stiff, brown **SILTY CLAY**	0.76						
Loose, brown **SILTY SAND**	1.52	SS	1	100	7	1	
Very stiff to stiff **SILTY CLAY** with sand seams	2.29	SS	2	100	2	2	
		SS	3	58	34		
						3	
GLACIAL TILL: Dense to compact, brown to grey sandy silt with gravel, cobbles and boulders						4	
		SS	4	50	14	5	
	5.79	SS	5	67	13		
End of Borehole							

(GWL @ 2.11m-May 19/04)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Parcels 2 and 9, Rideau Valley Drive
Manotick, Ontario

DATUM

REMARKS

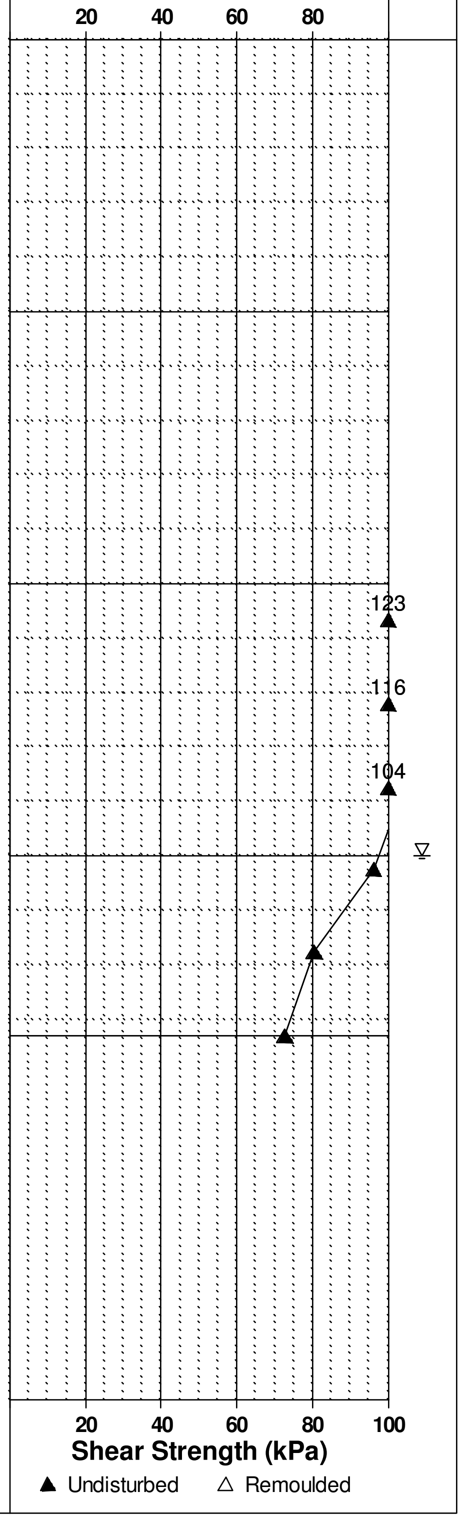
BORINGS BY Backhoe

DATE July 20, 2000

FILE NO. G7840

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
Brown **TOPSOIL** 0.15									
Very stiff, brown **CLAYEY SILT,** some organics 0.91		G	1						
Very stiff to stiff, brown-grey **SILTY CLAY**		G	2			1			
						2			
		G	3			3			⊻
3.66		G	4						
End of Test Pit (GWL @ 3.0m depth)									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Parcels 2 and 9, Rideau Valley Drive
Manotick, Ontario

DATUM

REMARKS

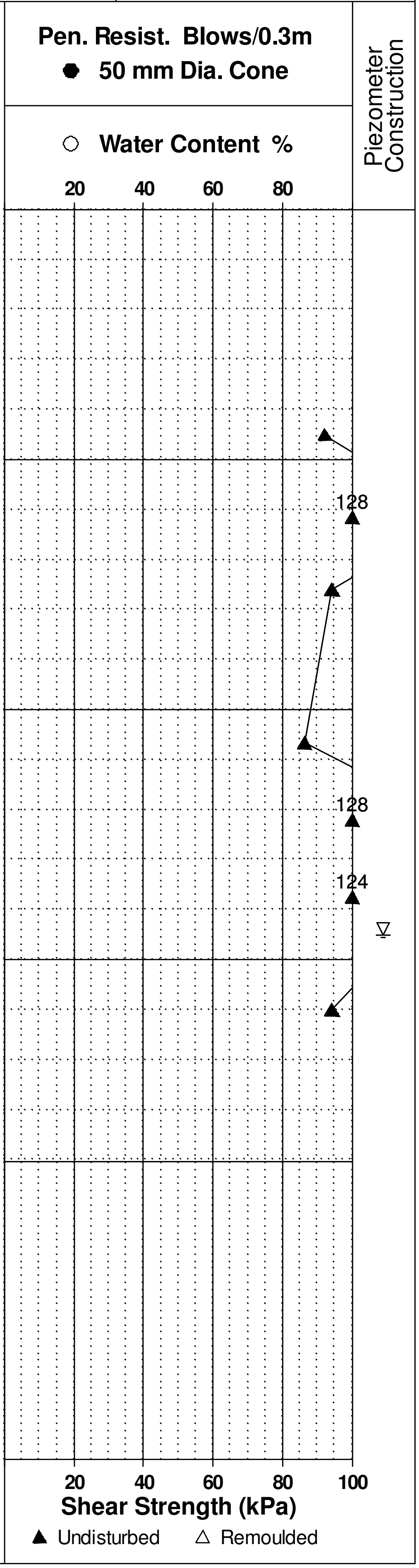
BORINGS BY Backhoe

DATE July 20, 2000

FILE NO. G7840

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Brown **TOPSOIL** 0.20	■						
Very stiff, brown **CLAYEY SILT** 0.76	▨	G	5				
Very stiff to stiff, brown-grey **SILTY CLAY** 3.81	▨	G G G	6 7 8			1 2 3	
End of Test Pit (GWL @ 2.9m depth)							



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FILE NO. G7840

HOLE NO. TP 3

SOIL DESCRIPTION	Depth of base (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE						
Brown **TOPSOIL**	0.20					
Very stiff, brown **CLAYEY SILT**	0.71					
Very stiff to stiff, brown-grey **SILTY CLAY**	3.66		G G G	9 10 11		
Compact, blue grey **SANDY SILT**	3.81		G	12		
End of Test Pit						

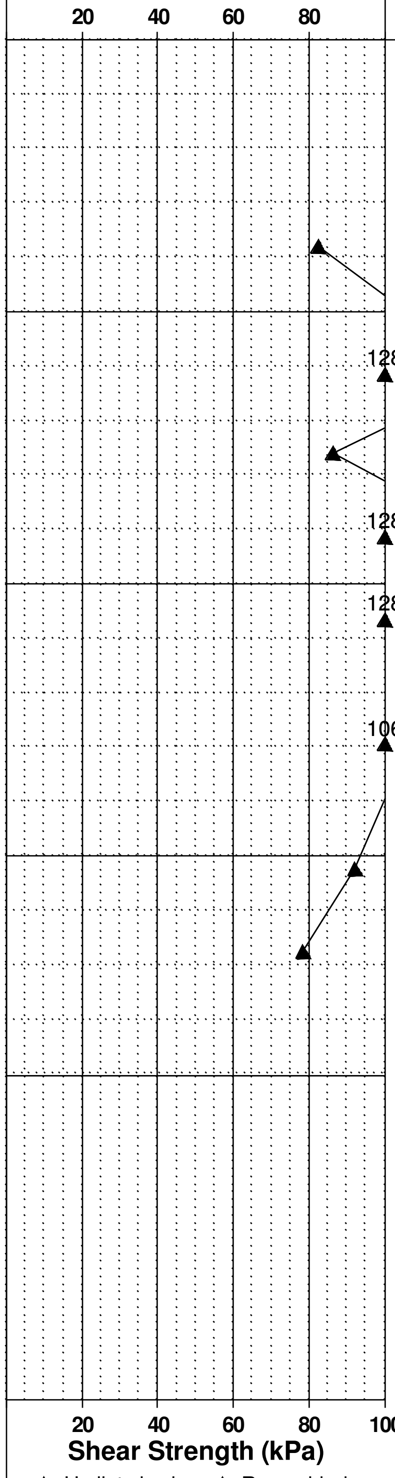
DEPTH (m): 0, 1, 2, 3

ELEV. (m)

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

○ Water Content %

Piezometer Construction



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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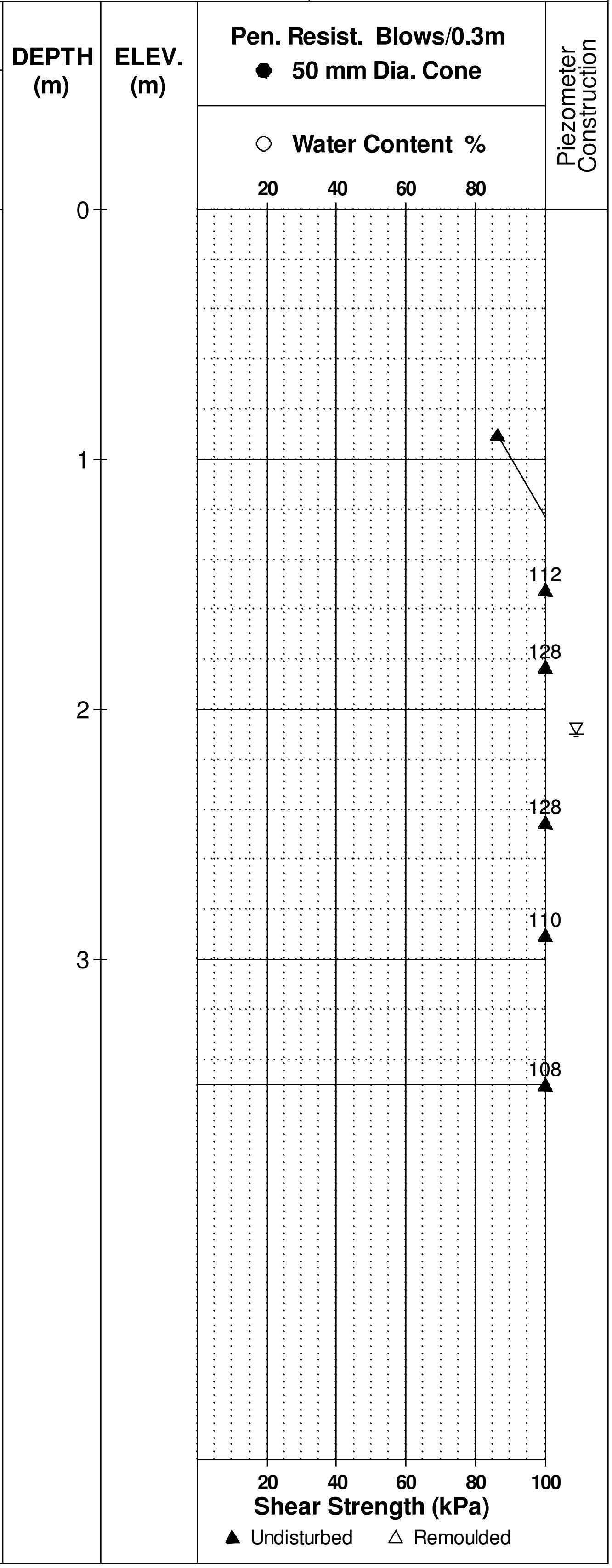
FILE NO. G7840

HOLE NO. TP 4

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Brown **TOPSOIL**	0.15				
Very stiff, brown **CLAYEY SILT**	0.76	G	13		
Very stiff, brown-grey **SILTY CLAY**	3.50	G	14		
		G	15		
End of Test Pit					
(GWL @ 2.1m depth)					



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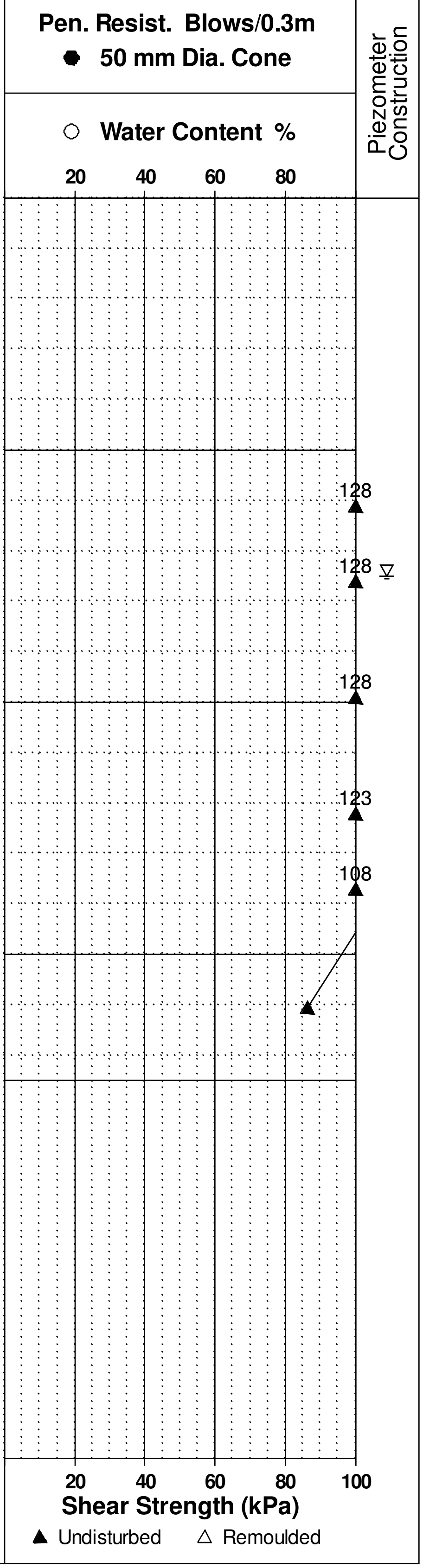
FILE NO. G7840

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
Brown **TOPSOIL** 0.20								
Very stiff, brown **CLAYEY SILT,** some organics 0.76		G	16					
						1		
Very stiff to stiff, brown-grey **SILTY CLAY**						2		
		G	17					
						3		
3.50		G	18					
End of Test Pit (GWL @ 1.5m depth)								



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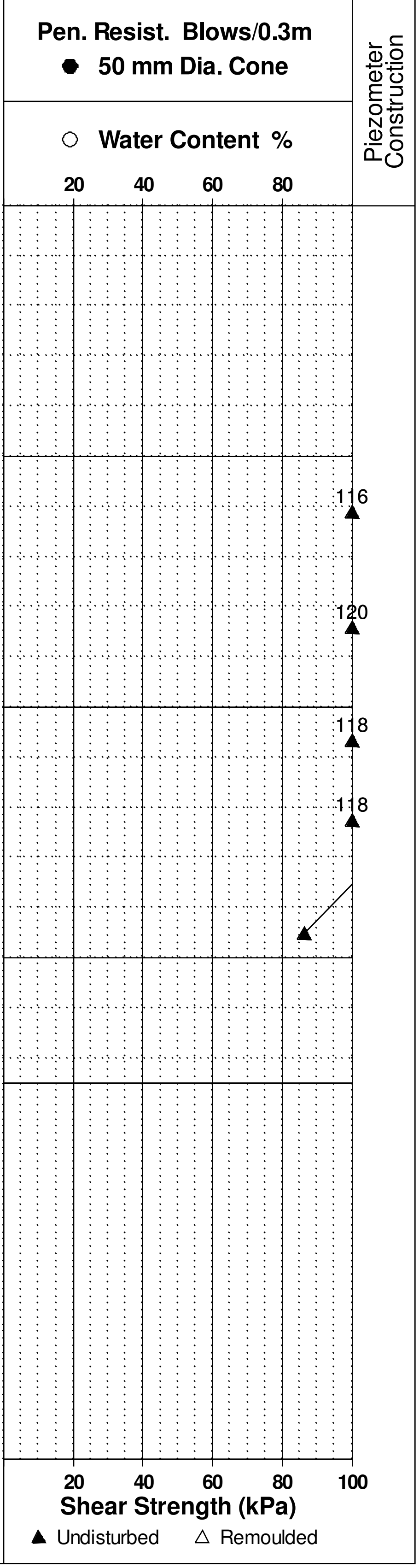
FILE NO. G7840

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
Brown **TOPSOIL** 0.18							
Very stiff, brown **CLAYEY SILT,** some organics 0.60		G	19				
Very stiff, brown to blue grey **SILTY CLAY** 2.74		G	20			1 2	
GLACIAL TILL: Compact silty sand-gravel, some clay, cobbles and boulders 3.50		G	21			3	
End of Test Pit							



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FILE NO. G7840

HOLE NO. TP 7

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			
Brown **TOPSOIL** 0.20									
GLACIAL TILL: Compact, brown silty sand-gravel, some cobbles and boulders		G	22			1			
						2			
2.90		G	23						
End of Test Pit (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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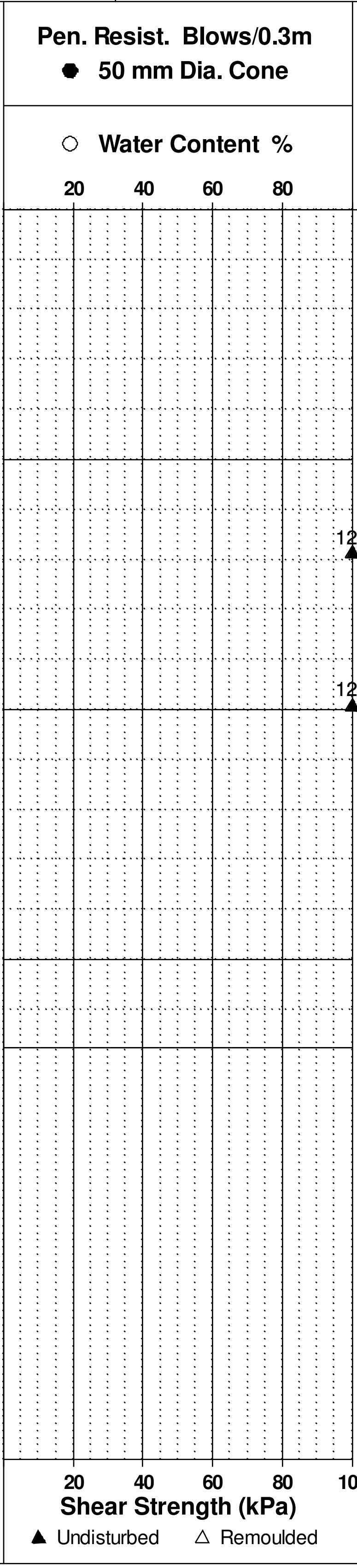
HOLE NO. TP 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
Brown **TOPSOIL** 0.20	■							
Very stiff, brown **CLAYEY SILT,** some organics 0.91	▨	G	1			1		
Very stiff, grey-brown **SILTY CLAY** 2.13	▨	G	2			2		
GLACIALT ILL: Compact, brown silty sand-gravel, some cobbles and boulders 3.35	^^^	G	3			3		
End of Test Pit (TP dry upon completion)								



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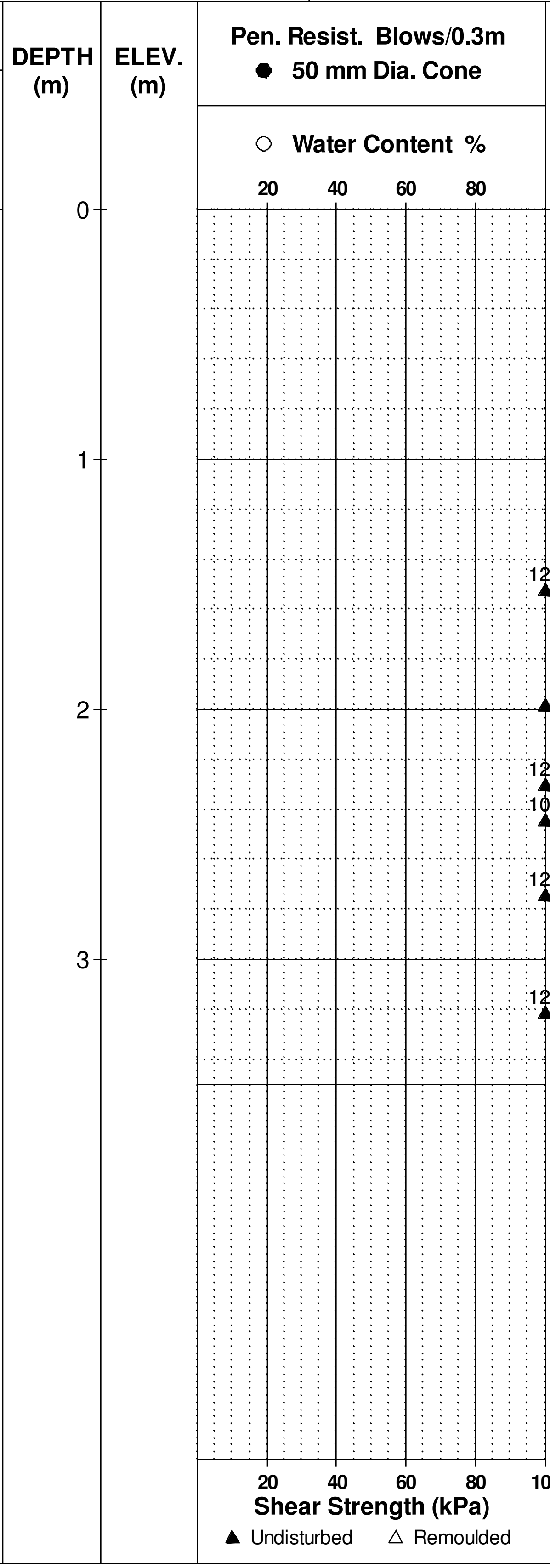
FILE NO. G7840

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
Brown **TOPSOIL** 0.15	■				
Very stiff, brown **CLAYEY SILT,** some organics 0.76	▨	G	27		
Very stiff, brown-grey **SILTY CLAY**	▨	G	28		
3.50	▨	G	29		
End of Test Pit (TP dry upon completion)					



Piezometer Construction

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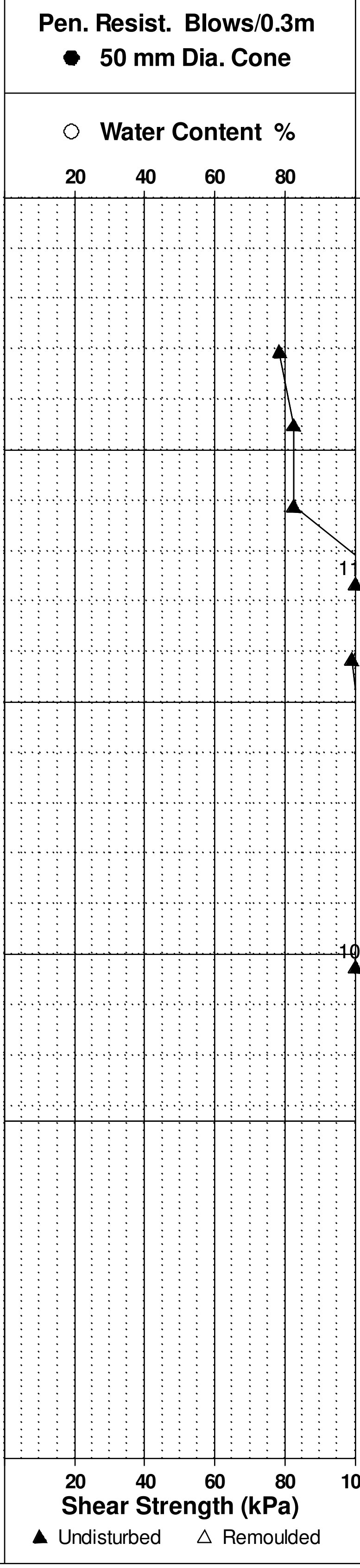
FILE NO. G7840

HOLE NO. TP10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
Brown **TOPSOIL** 0.13								
Compact, light brown **SANDY SILT** 0.60		G	30					
Stiff to very stiff, brown-grey to grey **SILTY CLAY**		G	31			1		
		G	32			2		
						3		
3.66		G	33					∇
End of Test Pit (GWL @ 3.5m depth)								



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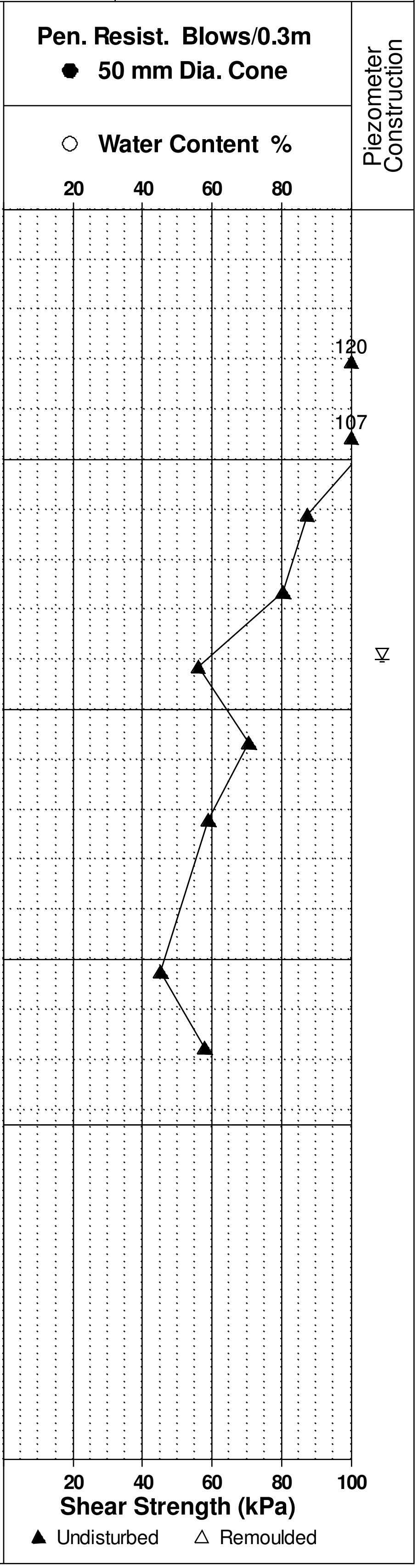
FILE NO. G7840

HOLE NO. TP11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.15							
Compact, brown **SANDY SILT** 0.60		G	34				
Very stiff to stiff, grey-brown to grey **SILTY CLAY**		G	35				
		G	36			1	
		G	37				
						2	
						3	
3.66		G	38				
End of Test Pit (GWL @ 1.8m depth)							



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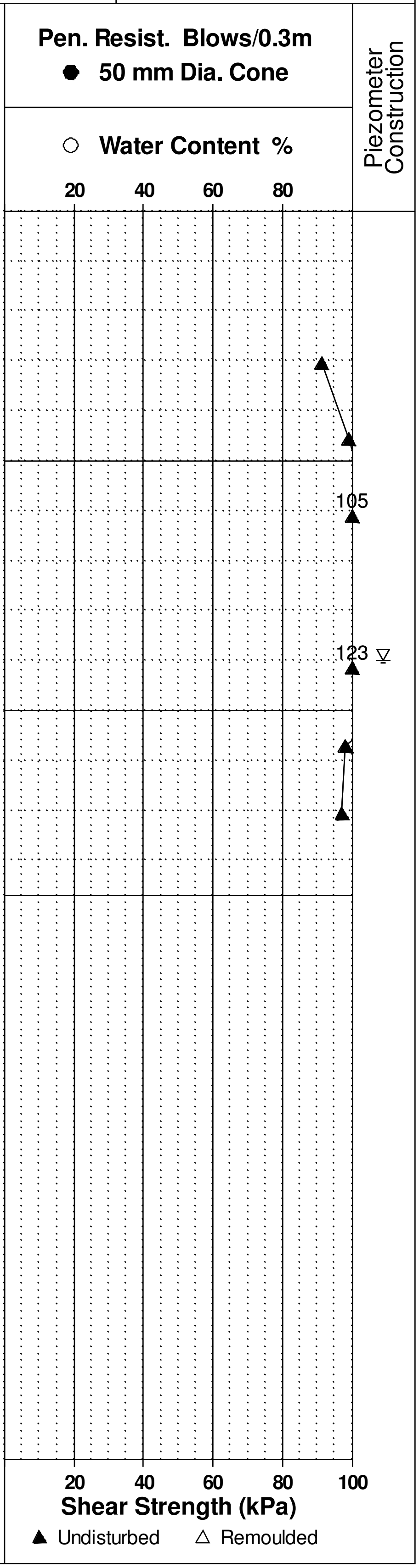
FILE NO. G7840

HOLE NO. TP12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.15							
Very stiff to stiff, grey-brown **SILTY CLAY** 2.13		G G	39 40			1 2	
GLACIAL TILL: Compact, grey silt, some sand, gravel, cobbles and boulders 2.74		G G	41 42				
End of Test Pit TP terminated on inferred bedrock at 2.74m depth (GWL @ 1.8m depth)							



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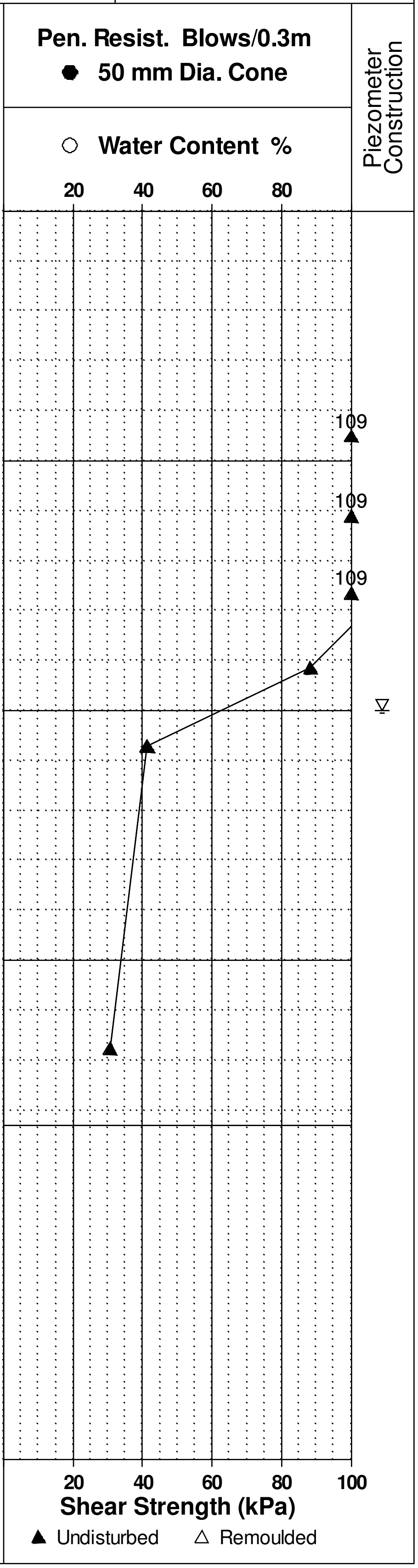
FILE NO. G7840

HOLE NO. TP13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.08							
Very stiff, dark brown **CLAYEY SILT** 1.20		G	43			1	
Brown **SANDY SILT** 1.37		G	44				
Very stiff to firm, brown-grey **CLAYEY SILT,** occasional gravel 3.05		G G	45 46			2	
Firm, grey **SILTY CLAY,** some sand layers and pockets 3.66		G	47			3	
End of Test Pit (GWL @ 2.0m depth)							



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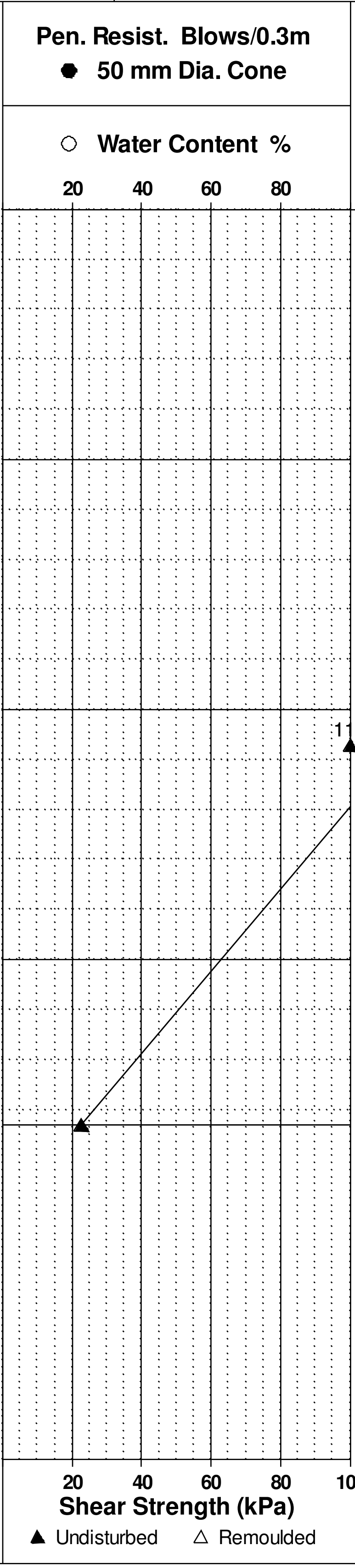
FILE NO. G7840

HOLE NO. TP14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
TOPSOIL 0.05								
Dark grey **CLAYEY SILT** 0.30								
Brown **SILTY SAND** interbedded with sandy silt 1.83		G G	48 49			1		
Very stiff to soft, grey-brown **SILTY CLAY** 3.66		G G G	50 51 52			2 3		
End of Test Pit (TP dry upon completion)								



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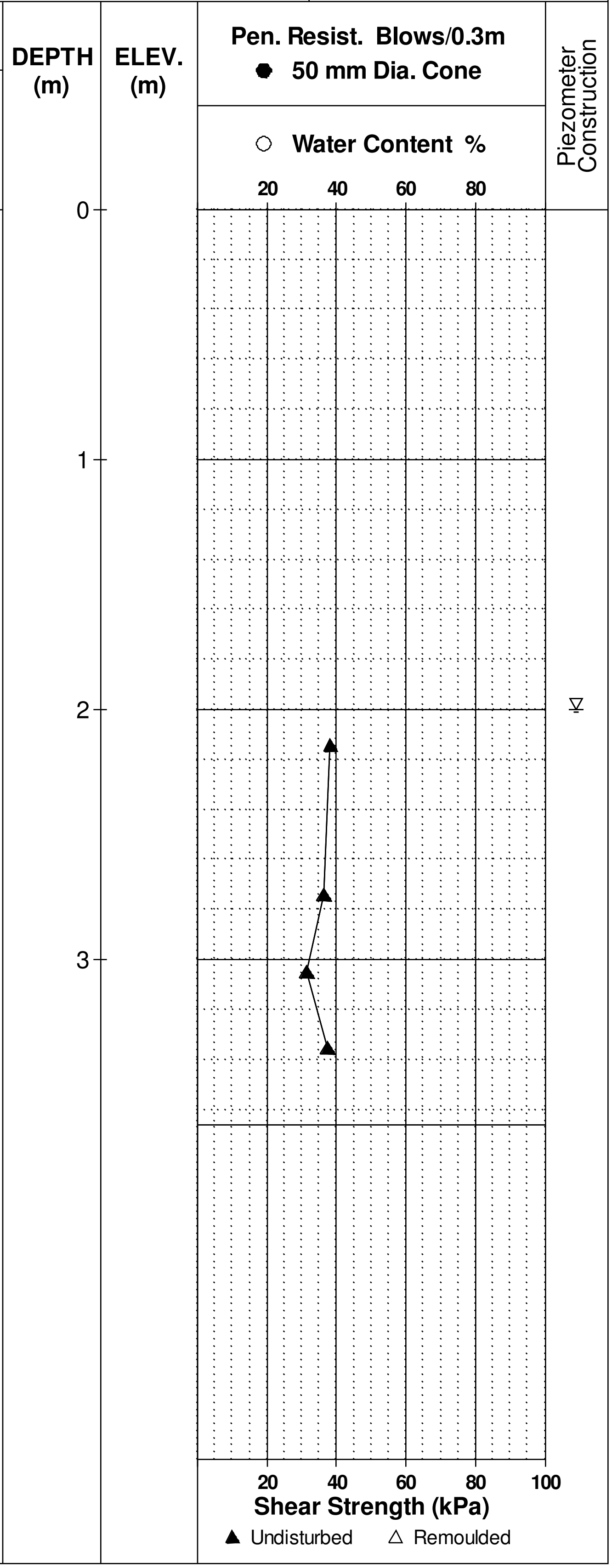
FILE NO. G7840

HOLE NO. TP15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.13					
Compact, brown **SILTY SAND/SANDY SILT** 1.07		G	53		
Firm, grey to brown **CLAYEY SILT** interlayered with sandy silt 2.90		G	54		
		G	55		
		G	56		
Firm, grey **SILTY CLAY** 3.66		G	57		
End of Test Pit (GWL @ 2.0m depth)					



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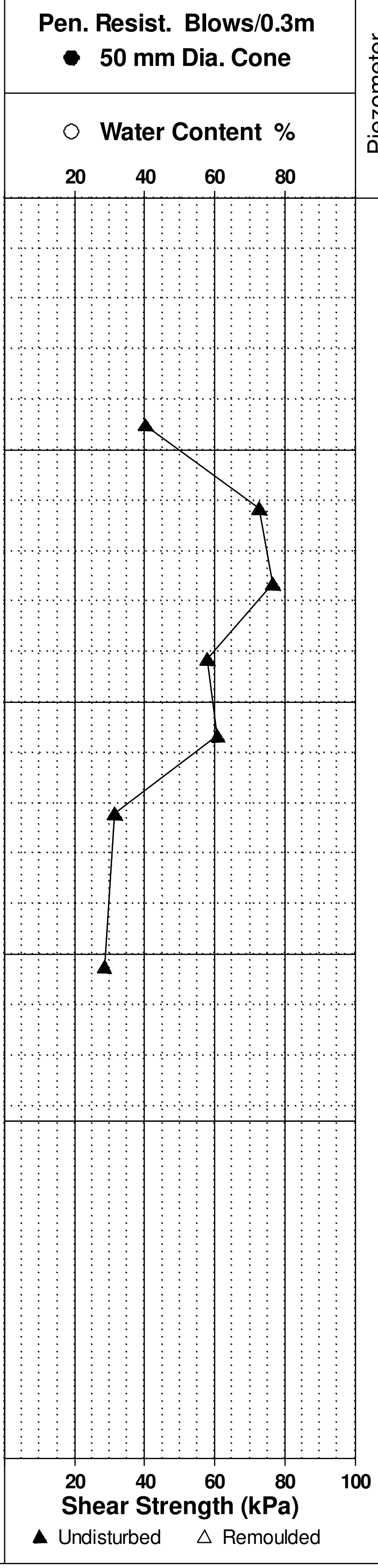
FILE NO. G7840

HOLE NO. TP16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
TOPSOIL 0.15								
Compact, brown **SILTY SAND** 0.91		G	58					
Stiff to firm, grey-brown **CLAYEY SILT,** some sandy silt pockets 2.44		G G	59 60			1 2		
Compact, grey **SILT** 3.66		G	61			3		
End of Test Pit (TP dry upon completion)								



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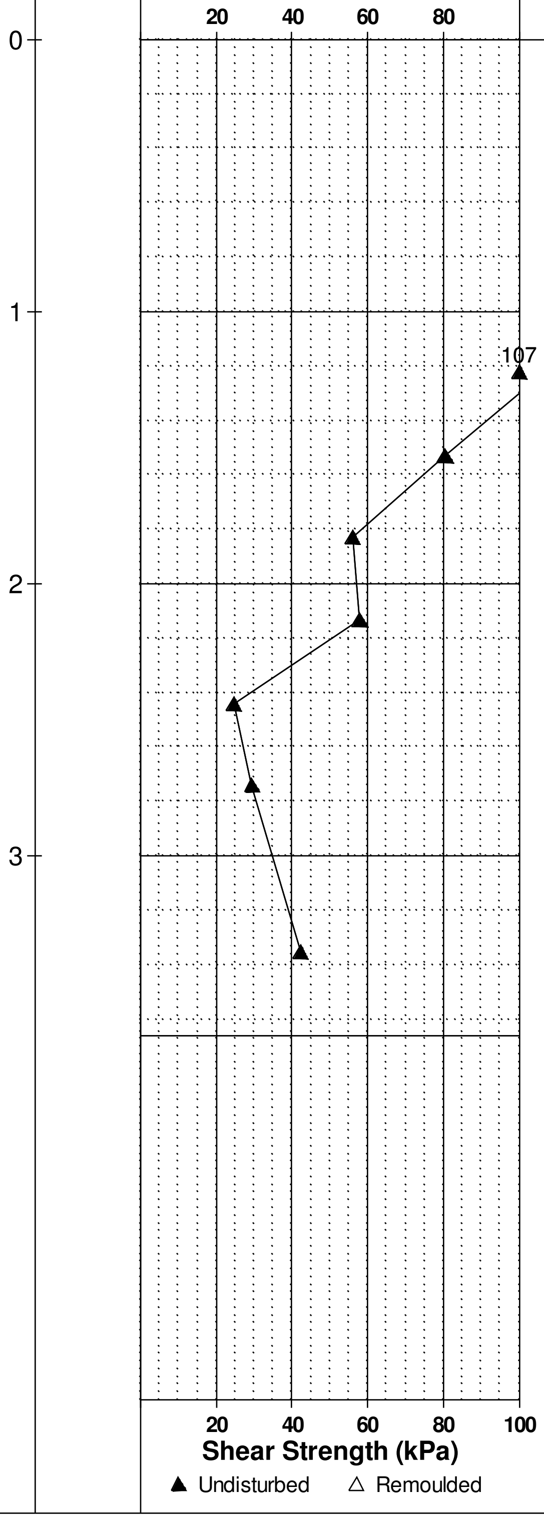
HOLE NO. TP17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.25							
Red-brown **SILTY SAND** 0.91		G	62				
Very stiff to firm, grey-brown **CLAYEY SILT** 3.66		G G	63 64			1 2 3	
End of Test Pit (TP dry upon completion)							

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

○ Water Content %

Piezometer Construction



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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FILE NO. G7840

HOLE NO. TP18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
TOPSOIL 0.20							
Brown **SILTY SAND** 0.40							
Firm, brown **CLAYEY SILT** 1.07		G	65			1	
Compact, brown-grey **SANDY SILT/SILTY SAND**		G	66			2	
2.74		G	67				
End of Test Pit TP terminated on bedrock or large boulder at 2.74m depth (TP dry upon completion)							

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

○ **Water Content %**
20 40 60 80

Piezometer Construction

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

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 relative strength of cohesionless soils is the compactness condition, 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.

Compactness Condition	‘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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity: $S_t < 2$
Medium Sensitivity: $2 < S_t < 4$
Sensitive: $4 < S_t < 8$
Extra Sensitive: $8 < S_t < 16$
Quick Clay: $S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G - "Grab" sample from test pit or surface materials
AU - Auger sample or bulk sample
WS - Wash sample
RC - Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water 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 at 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)

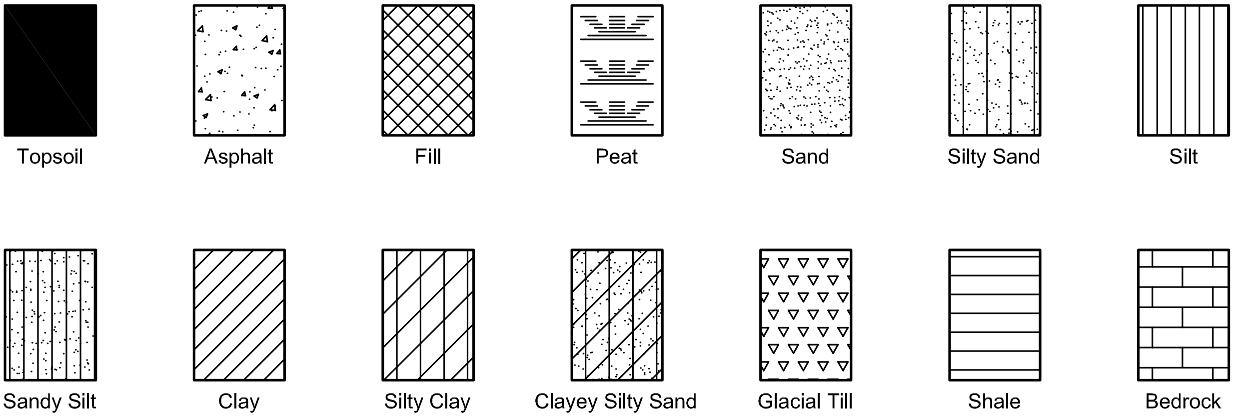
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

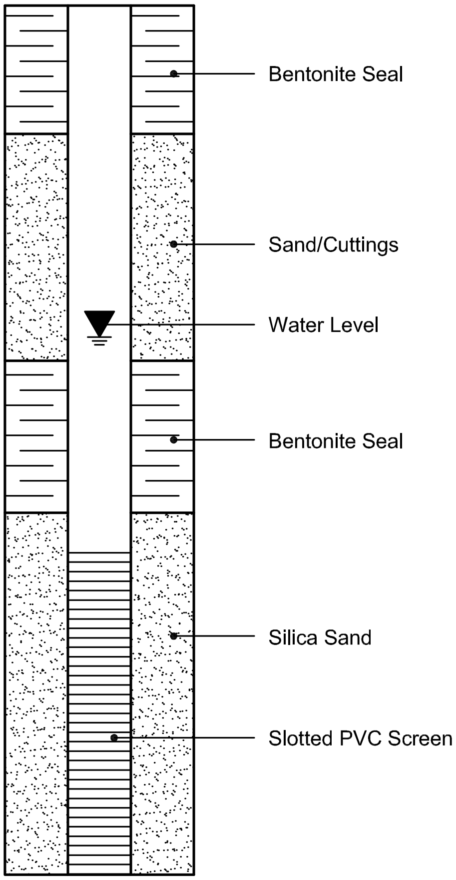
SYMBOLS AND TERMS (continued)

STRATA PLOT

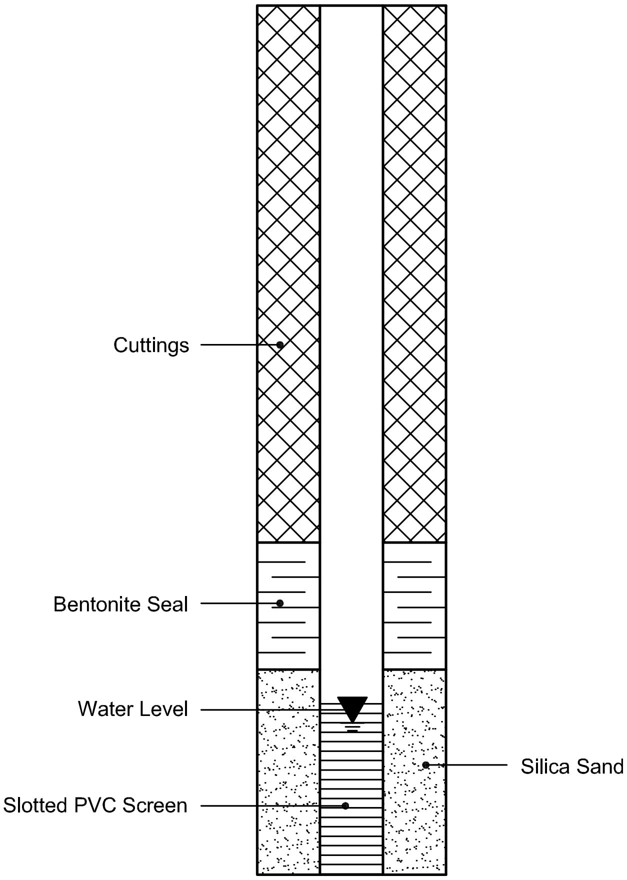


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



APPENDIX 2

TABLE 2 - SUMMARY OF CONSOLIDATION TEST RESULTS

CONSOLIDATION TEST SHEETS

GRAIN SIZE DISTRIBUTION SHEETS

ATTERBERG LIMITS' RESULTS

ANALYTICAL TESTING RESULTS

FIGURES 2 TO 7 - SHEAR STRENGTH PROFILES

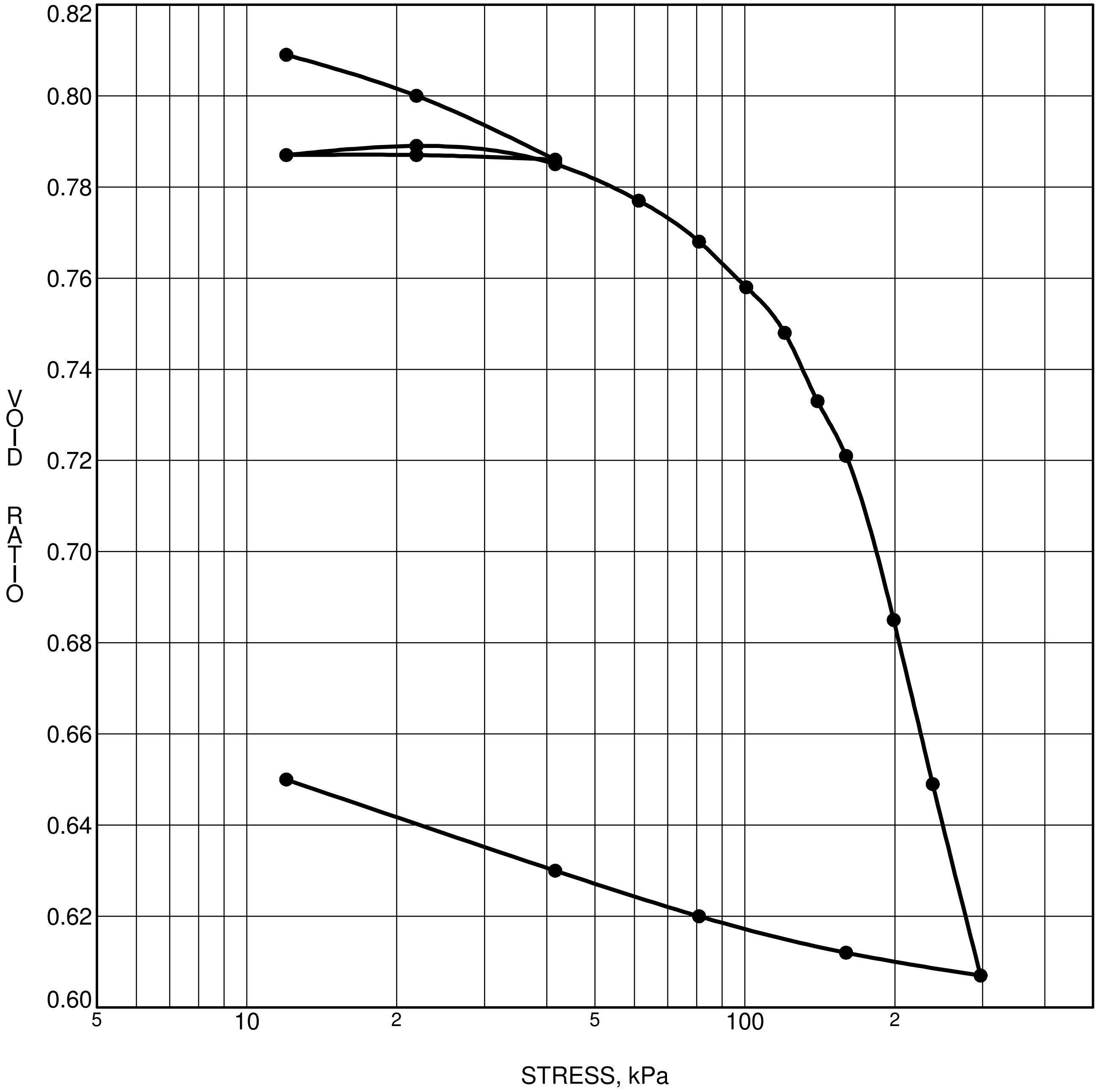
TABLE 4 - SEISMIC SITE CLASS - OBC 2012

TABLE 2:
SUMMARY OF CONSOLIDATION TEST RESULTS FOR MAHOGANY - STAGES 2 TO 5
Century Road, Ottawa (Manotick Village), Ontario

Sample No.	Ground Elev. (m)	Depth (m)	Elevation (m)	p'_c (kPa)	p'_o (kPa)	O.C. (kPa)	Ccr	Cc	W.C. (%)	Disturbance Factor & Limits (%)
Mahogany Community - 2017 Testing Program (PG4008) - Stages 2 to 4 :										
BH 52-17 - TW 3	89.29	4.82	84.47	155	75	80	0.004	0.435	29.8	1.0 < **2.7** < 3.0 = **OK**
BH 54-17 - TW 3	89.19	4.88	84.31	131	75	56	0.025	1.420	74.1	1.5 < **3.1** < 3.5 = **OK**
BH 55-17 - TW 3	89.20	4.27	84.93	103	71	32	0.023	1.705	71.6	2.0 < **2.7** < 4.0 = **OK**
BH 55A-17- TW 1	89.20	5.72	83.48	148	81	67	0.010	0.812	30.8	1.5 < **2.4** < 3.5 = **OK**
BH 56-17 - TW 3	88.84	4.88	83.96	144	75	69	0.031	2.119	71.2	1.5 < **1.7** < 3.5 = **OK**
BH 58-17 - TW 3	89.03	5.56	83.47	208	80	128	0.024	0.776	39.6	1.0 < **2.6** < 3.0 = **OK**
Mahogany Community - 2008 Testing Program (PG0675) - Stage 5:										
BH 42-08 - TW 4	89.10	4.27	84.83	119	51	68	0.020	1.993	73.2	G
BH 44-08 - TW 4	89.43	5.04	84.39	110	56	54	0.020	1.763	68.9	A
BH 45-08 - TW 4	89.35	3.40	85.95	124	45	79	0.017	0.432	40.3	A
Mahogany Community - 2007 Testing Program (PG0675) - Stages 2, 3 and 5:										
BH 10-07 - TW 4	89.21	5.05	84.16	106	56	50	0.024	1.842	66.4	P
BH 17-07 - TW 5	89.07	5.05	84.02	84	76	8	0.036	1.456	73.6	P
BH 39-07 - TW 4	89.59	4.95	84.64	238	75	163	0.009	0.591	39.7	P
Mahogany Community - 2007 Testing Program (PG0328) - Stages 2 and 3:										
BH 4-04 - TW 1	89.30	4.90	84.40	186	75	111	0.019	1.720	67.7	A
BH 5-04 - TW 1	89.20	4.00	85.20	90	69	21	0.019	1.460	77.2	A

Notes:

1. Effective overburden pressure, p'_o, for samples from Stages 2 to 4 is based on a low groundwater depth of 3.5 m below the original ground surface level and an average crust thickness of 4 m. For samples from Stage 5, p'_o is based on a GWL of 1.8 m and average crust thickness of 2.3 m.
2. The last column presents the disturbance ratio of the test sample (Lacasse et. al.) in bold and compares it to the acceptable range (OK samples), or the upper limit of the acceptable range (disturbed or possibly disturbed samples), or the lower limit of the acceptable range (very good samples). The older samples are classified using similar criteria into “G” = Good; “A” = Acceptable or “P” = Poor (likely disturbed) disturbance criteria assessment.



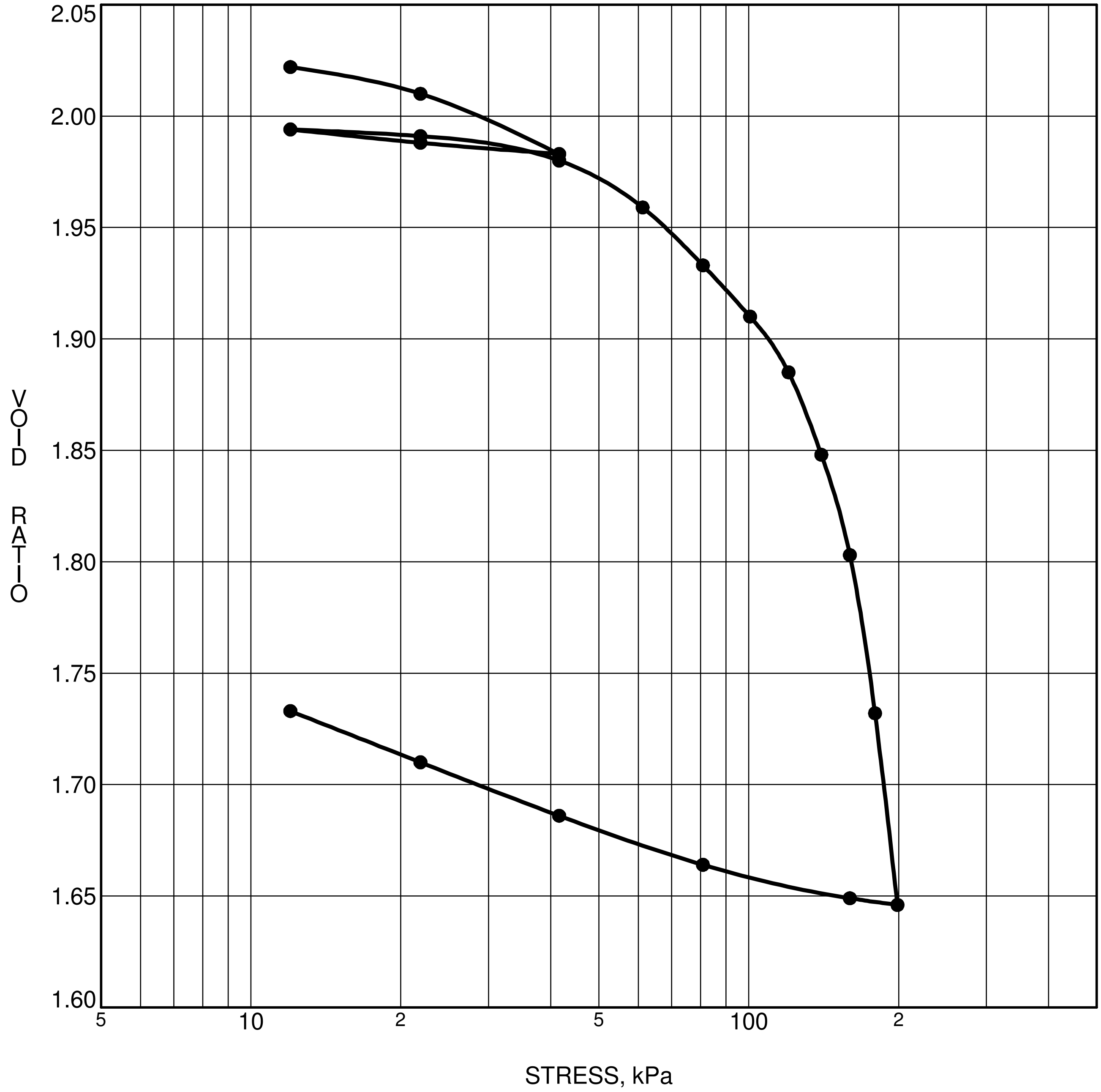
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH52-17**	p'o	**75** kPa	Ccr	**0.004**
Sample No.	**TW 3**	p'c	**155** kPa	Cc	**0.435**
Sample Depth	**4.82** m	OC Ratio	**2.1**	Wo	**29.9** %
Sample Elev.	**84.47** m	Void Ratio	**0.821**	Unit Wt.	**19.2** kN/m ^{3}

CLIENT	**Minto Communities Inc.**	FILE NO.	**PG4008**
PROJECT	**Geotechnical Investigation - Residential Dev. - Mahogany Community Stages 2 to 4**	DATE	**17/04/2017**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH54-17**	p'o	**75** kPa	Ccr	**0.025**
Sample No.	**TW 3**	p'c	**131** kPa	Cc	**1.420**
Sample Depth	**4.88** m	OC Ratio	**1.7**	Wo	**74.1** %
Sample Elev.	**84.31** m	Void Ratio	**2.038**	Unit Wt.	**15.5** kN/m ^{3}

CLIENT **Minto Communities Inc.**

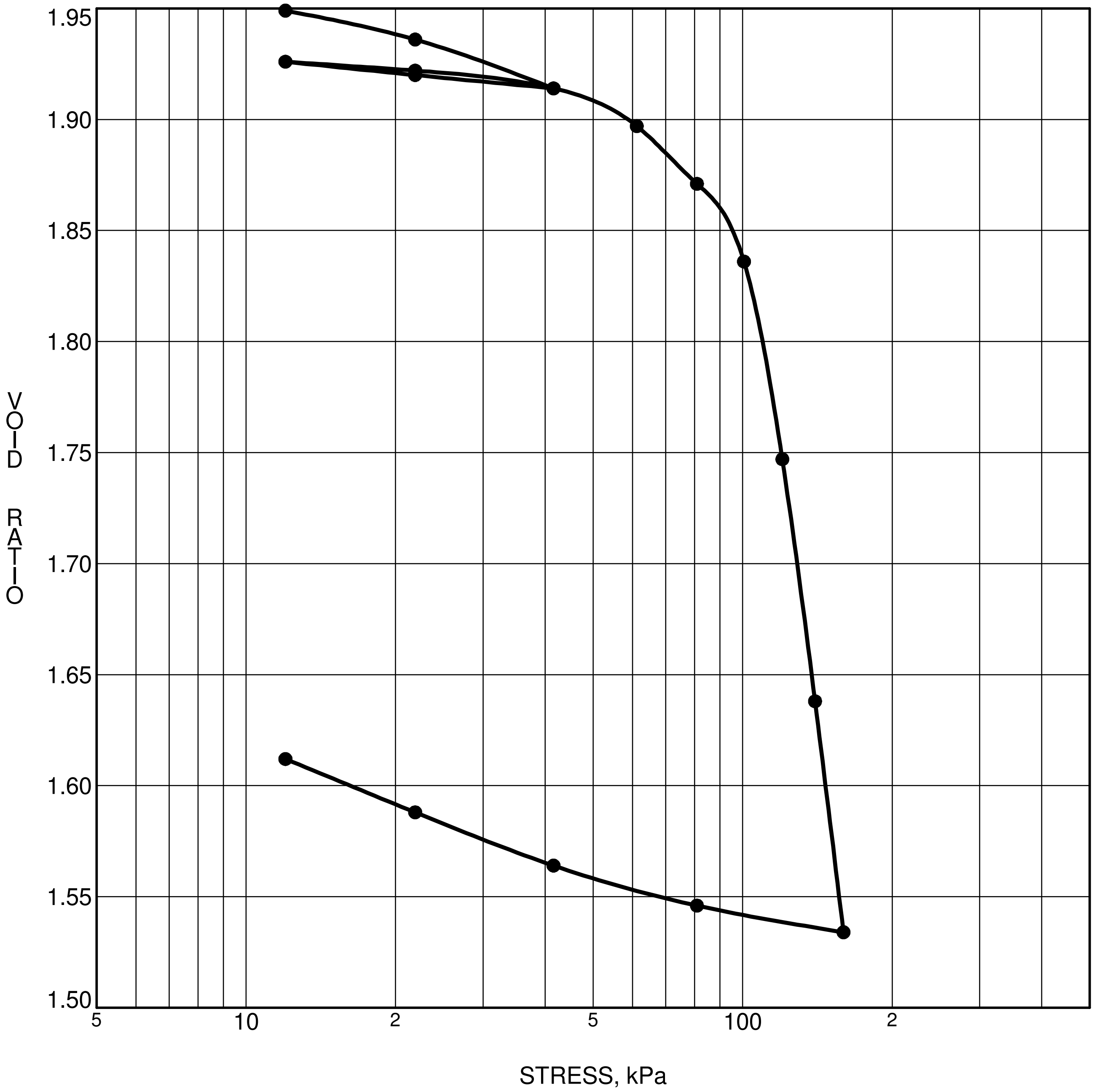
PROJECT **Geotechnical Investigation - Residential Dev. -**
Mahogany Community Stages 2 to 4

FILE NO. **PG4008**

DATE **24/04/2017**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH55-17**	p'_o	**71** kPa	Ccr	**0.023**
Sample No.	**TW 3**	p'_c	**103** kPa	Cc	**1.705**
Sample Depth	**4.27** m	OC Ratio	**1.5**	Wo	**71.6** %
Sample Elev.	**84.93** m	Void Ratio	**1.969**	Unit Wt.	**15.6** kN/m ^{3}

CLIENT **Minto Communities Inc.**

PROJECT **Geotechnical Investigation - Residential Dev. -**
Mahogany Community Stages 2 to 4

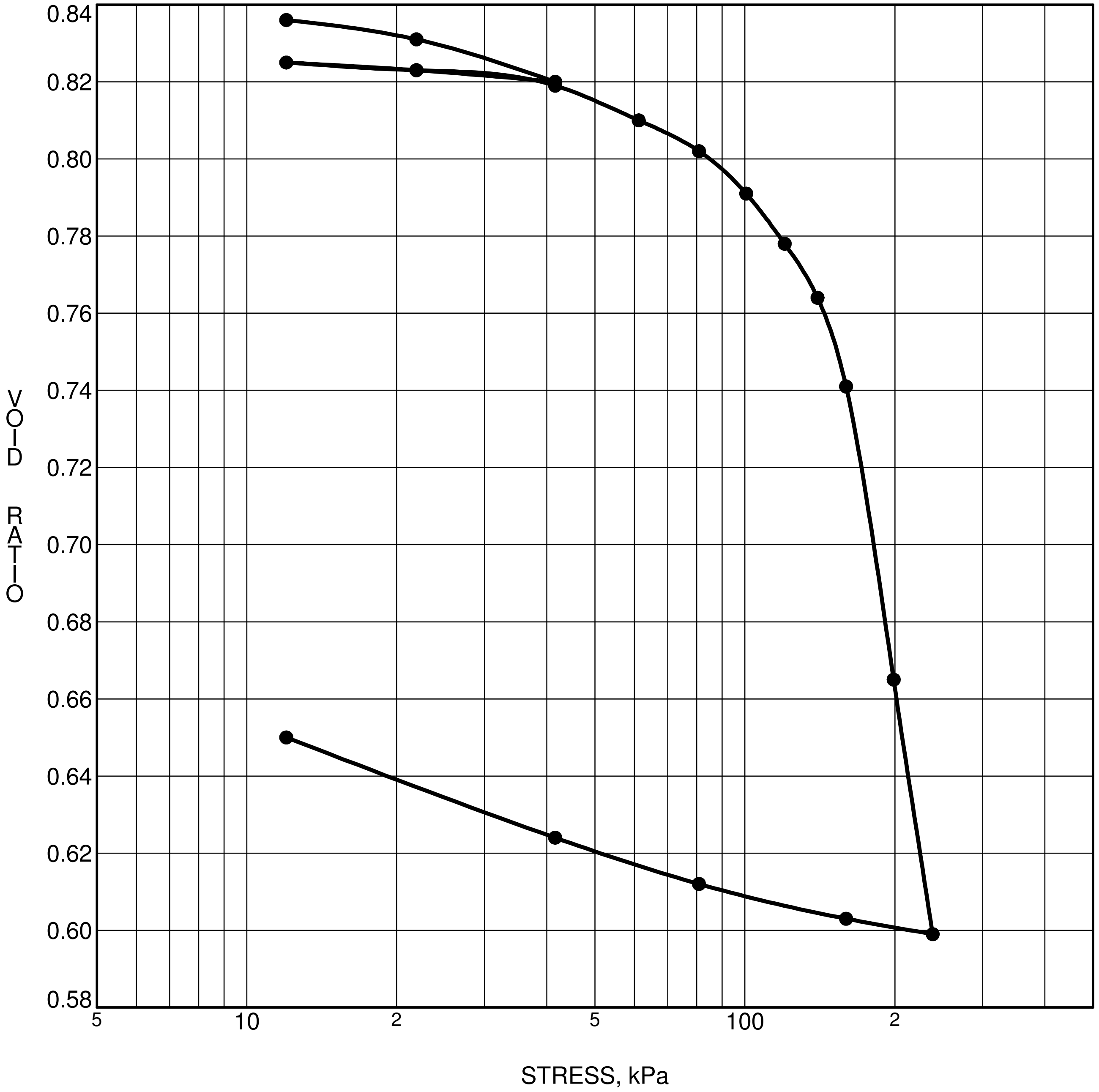
FILE NO. **PG4008**

DATE **24/04/2017**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY

Borehole No.	**BH55A-17**	p'_o	**81** kPa	Ccr	**0.010**
Sample No.	**TW 1**	p'_c	**148** kPa	Cc	**0.812**
Sample Depth	**5.72** m	OC Ratio	**1.8**	Wo	**30.8** %
Sample Elev.	**83.48** m	Void Ratio	**0.847**	Unit Wt.	**19.1** kN/m^3

CLIENT **Minto Communities Inc.**

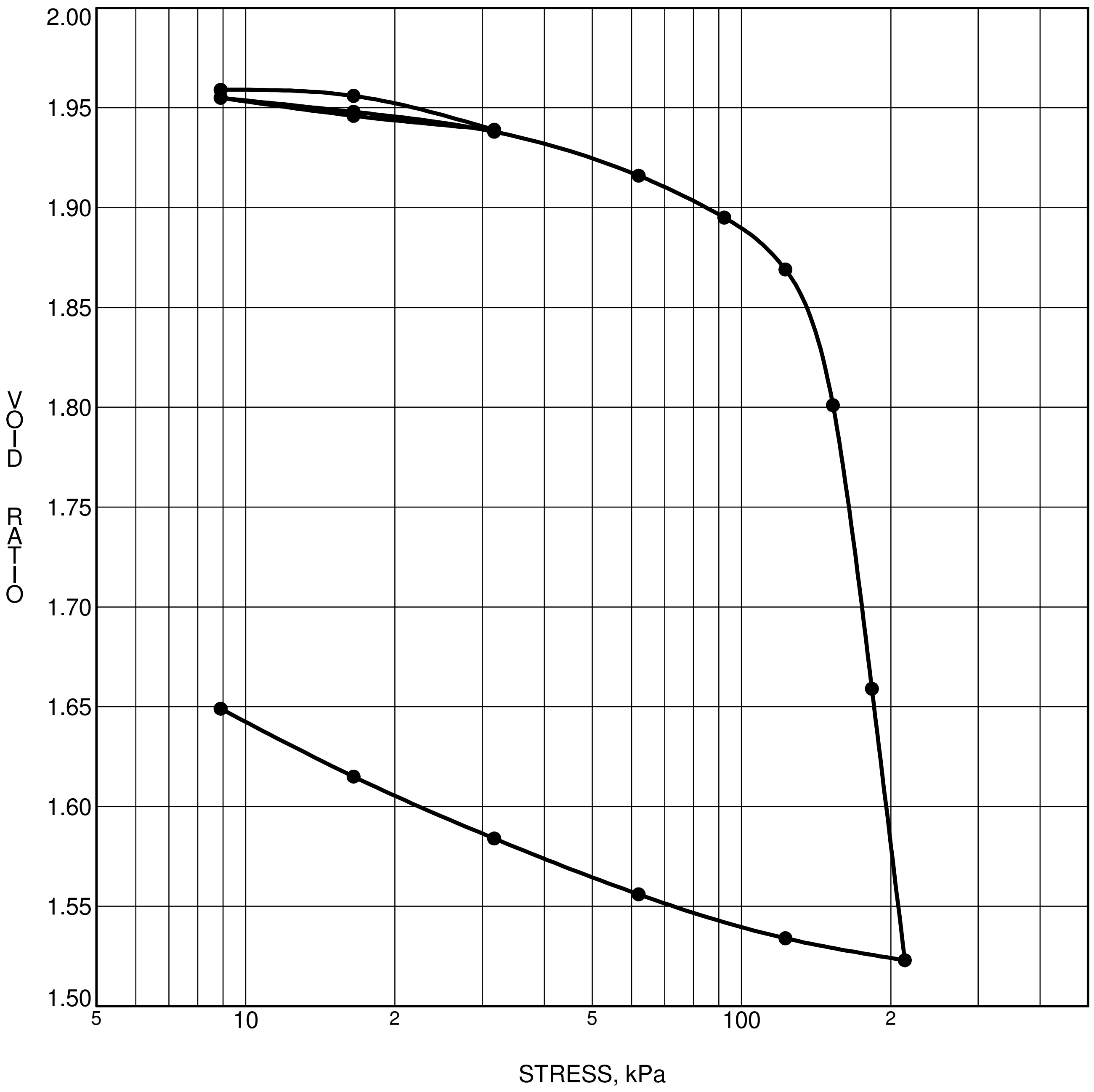
PROJECT **Geotechnical Investigation - Residential Dev. -**
Mahogany Community Stages 2 to 4

FILE NO. **PG4008**

DATE **17/04/2017**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH56-17**	p'o	**75** kPa	Ccr	**0.031**
Sample No.	**TW 3**	p'c	**144** kPa	Cc	**2.119**
Sample Depth	**4.88** m	OC Ratio	**1.9**	Wo	**71.2** %
Sample Elev.	**83.96** m	Void Ratio	**1.959**	Unit Wt.	**15.6** kN/m ^{3}

CLIENT **Minto Communities Inc.**

FILE NO. **PG4008**

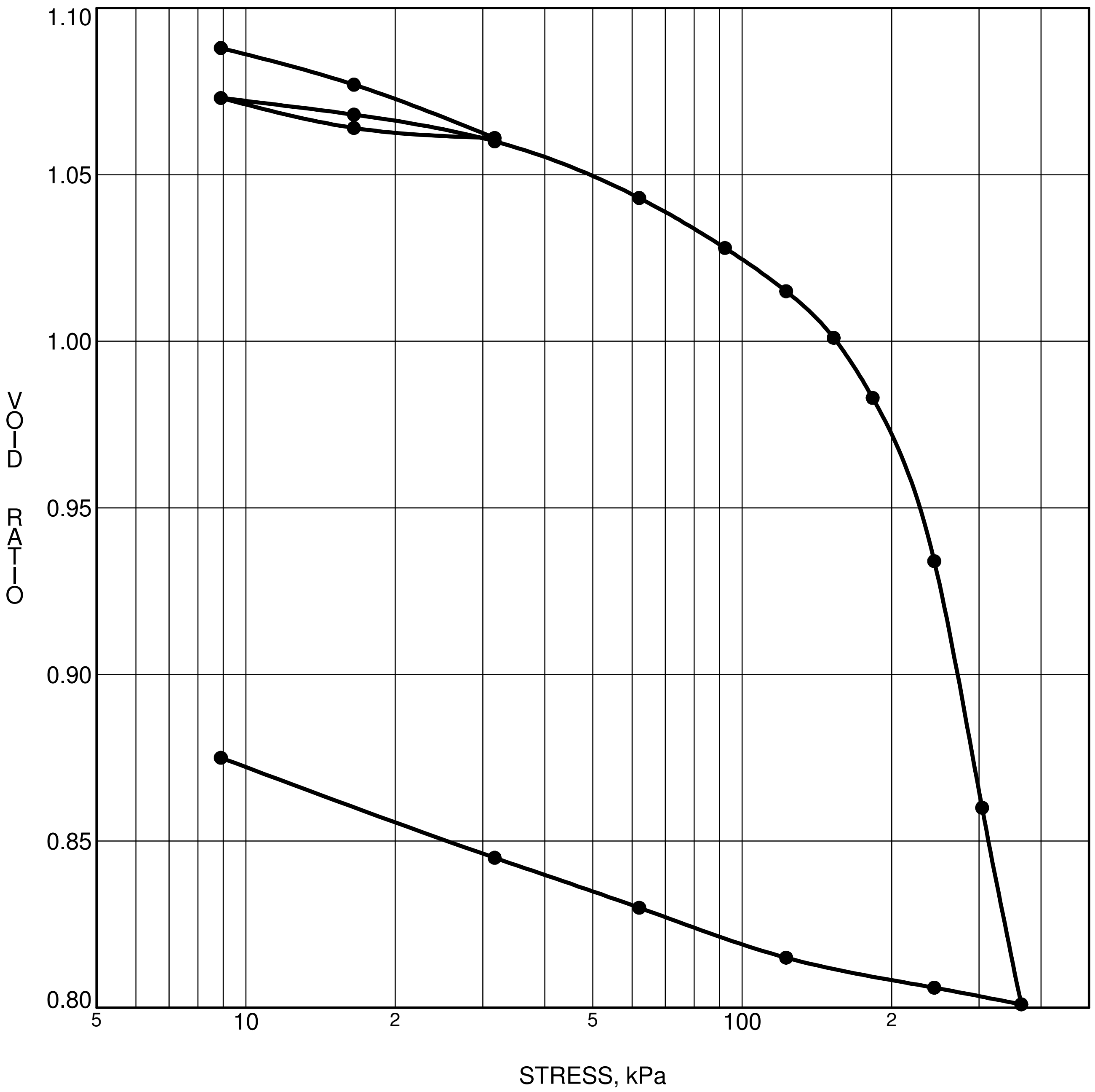
PROJECT **Geotechnical Investigation - Residential Dev. -**
Mahogany Community Stages 2 to 4

DATE **24/04/2017**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH58-17**	p'o	**80** kPa	Ccr	**0.024**
Sample No.	**TW 3**	p'c	**208** kPa	Cc	**0.776**
Sample Depth	**5.56** m	OC Ratio	**2.6**	Wo	**39.6** %
Sample Elev.	**83.47** m	Void Ratio	**1.088**	Unit Wt.	**18.0** kN/m ^{3}

CLIENT **Minto Communities Inc.**

PROJECT **Geotechnical Investigation - Residential Dev. - Mahogany Community Stages 2 to 4**

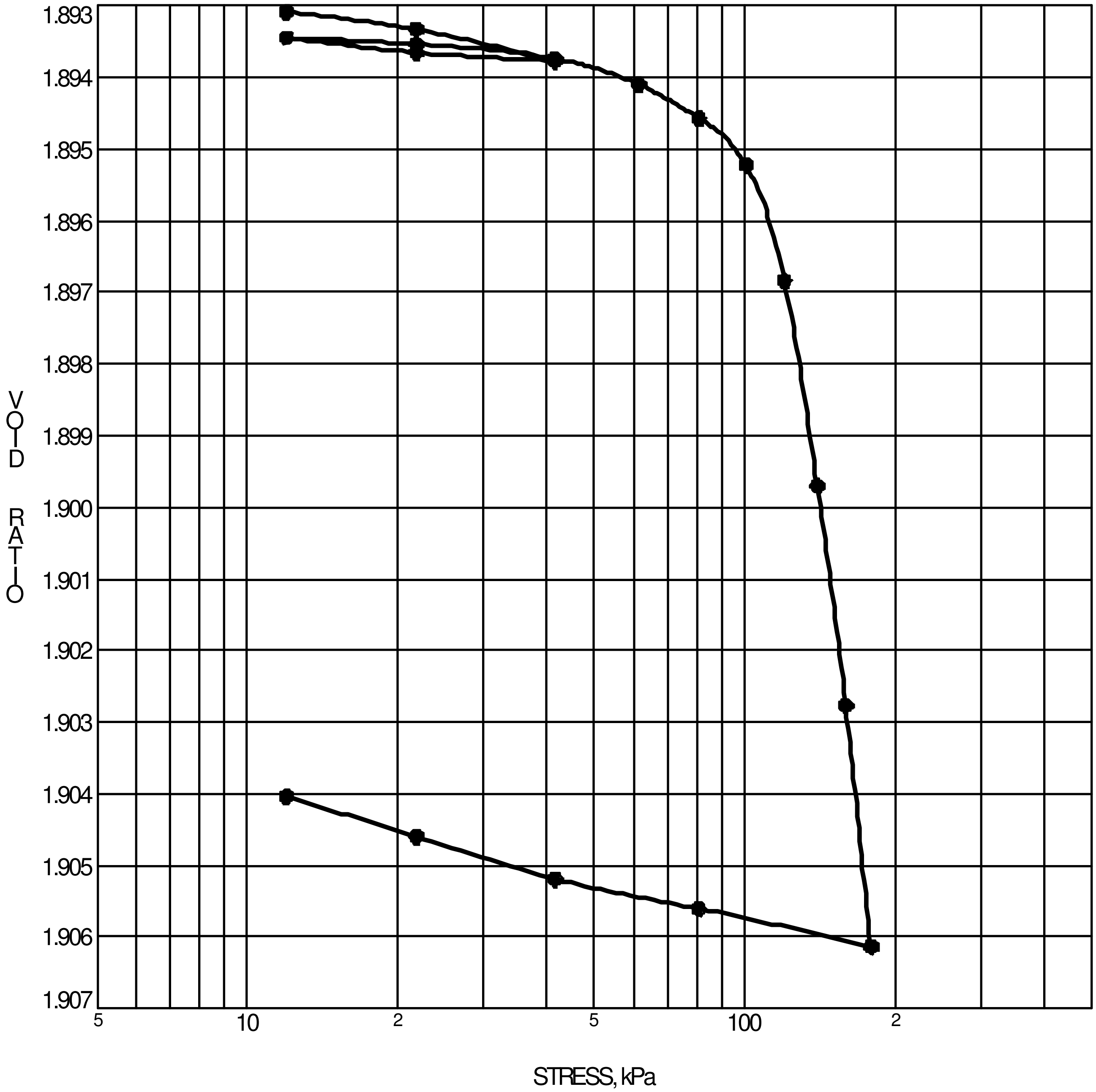
FILE NO. **PG4008**

DATE **15/04/2017**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY

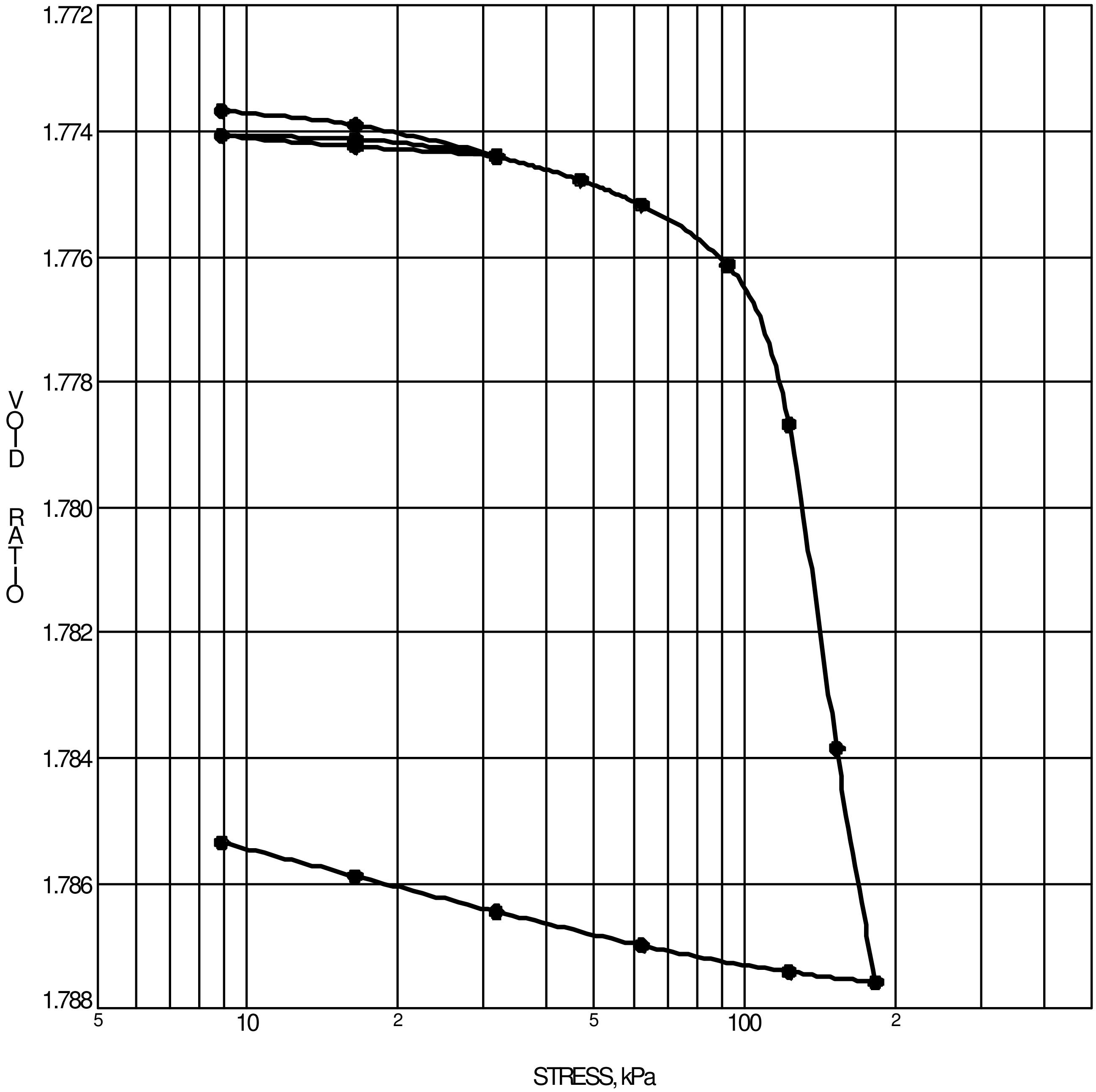
Borehole No.	**BH42**		p'_o	**43**	kPa	Ccr	**0.020**	
Sample No.	**TW 4**		p'_c	**119**	kPa	Cc	**1.993**	
Sample Depth	**4.27**	m	OC Ratio	**2.8**		Wo	**73.2**	%
Sample Elev.	**84.83**	m	Void Ratio	**1.952**		Unit Wt.	**15.5**	kN/m^3

CLIENT	**Minto Developments Inc.**	FILE NO.	**PG0675**
PROJECT	**Geotechnical Investigation - Mahogany Community - First Line Road**	DATE	**23/01/08**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH44**	p'_o	**55** kPa	Ccr	**0.020**
Sample No.	**TW 4**	p'_c	**110** kPa	Cc	**1.763**
Sample Depth	**5.04** m	OC Ratio	**2.0**	Wo	**68.9** %
Sample Elev.	**84.39** m	Void Ratio	**1.827**	Unit Wt.	**15.7** kN/m^3

CLIENT **Minto Developments Inc.**

FILE NO. **PG0675**

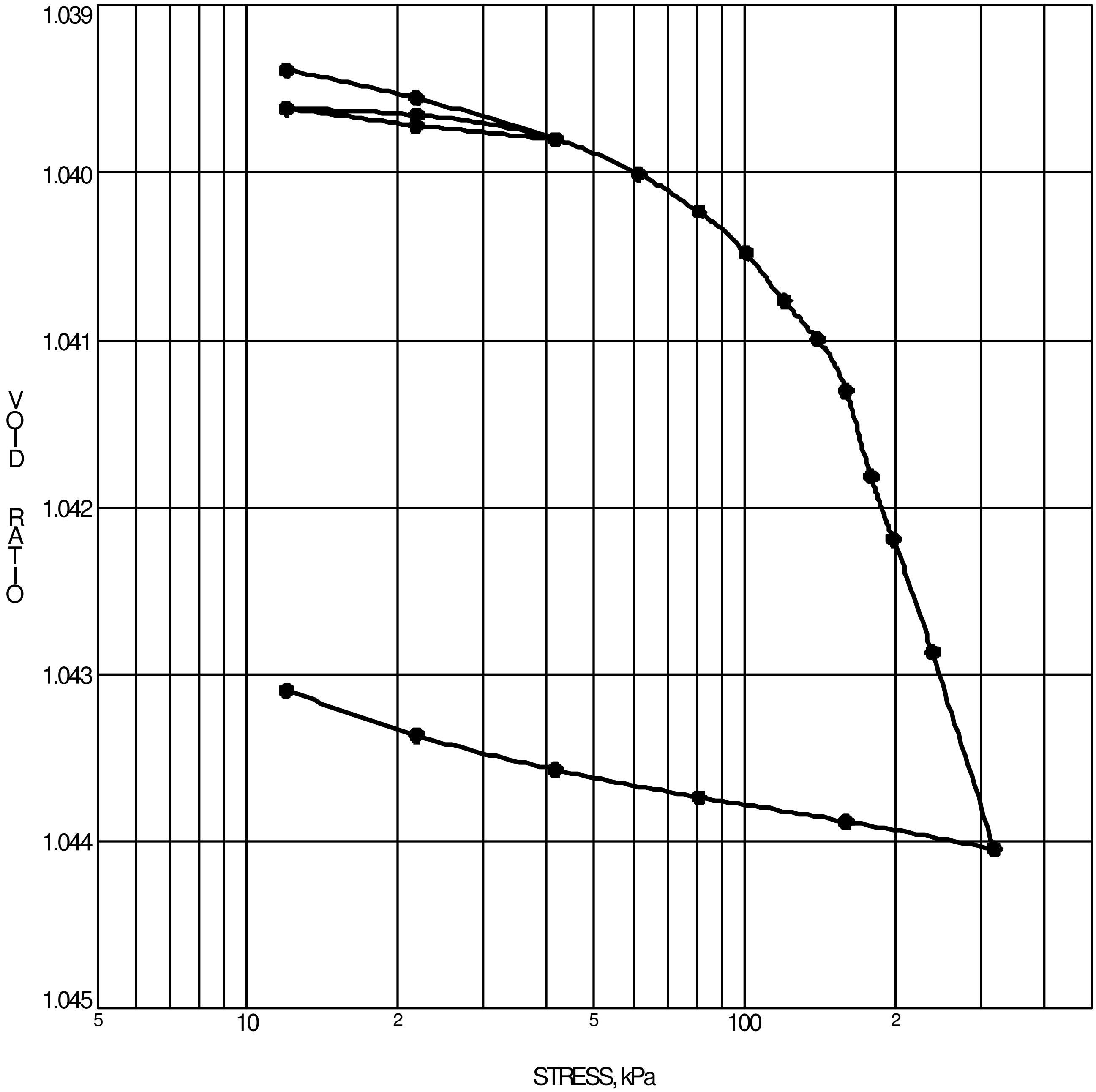
PROJECT **Geotechnical Investigation - Mahogany Community - First Line Road**

DATE **22/01/08**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH45**	p'_o	**42** kPa	Ccr	**0.017**
Sample No.	**TW 4**	p'_c	**124** kPa	Cc	**0.432**
Sample Depth	**3.4** m	OC Ratio	**3.0**	Wo	**40.3** %
Sample Elev.	**85.95** m	Void Ratio	**1.062**	Unit Wt.	**18.0** kN/m^3

CLIENT **Minto Developments Inc.**

FILE NO. **PG0675**

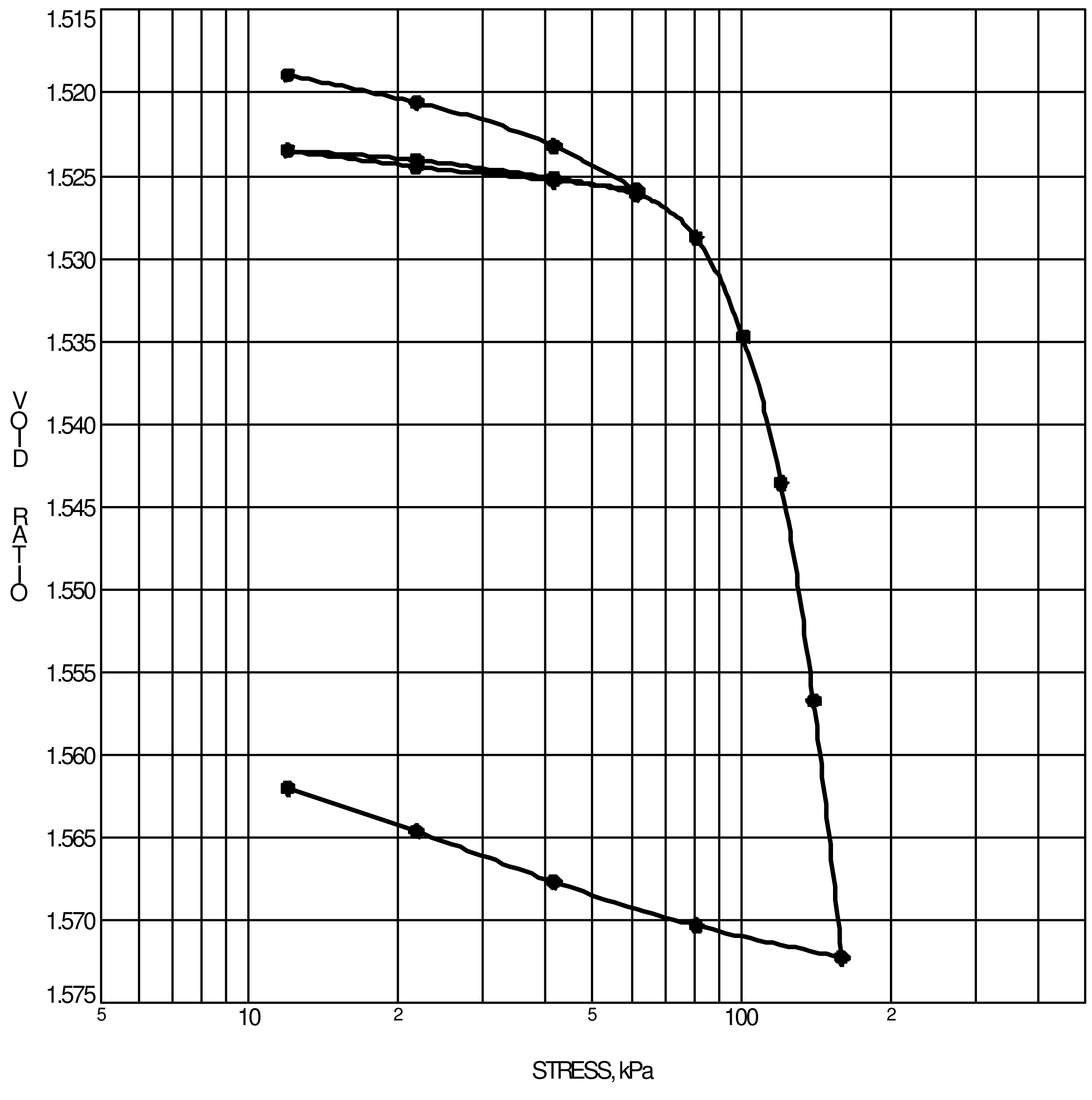
PROJECT **Geotechnical Investigation - Mahogany Community - First Line Road**

DATE **23/01/08**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



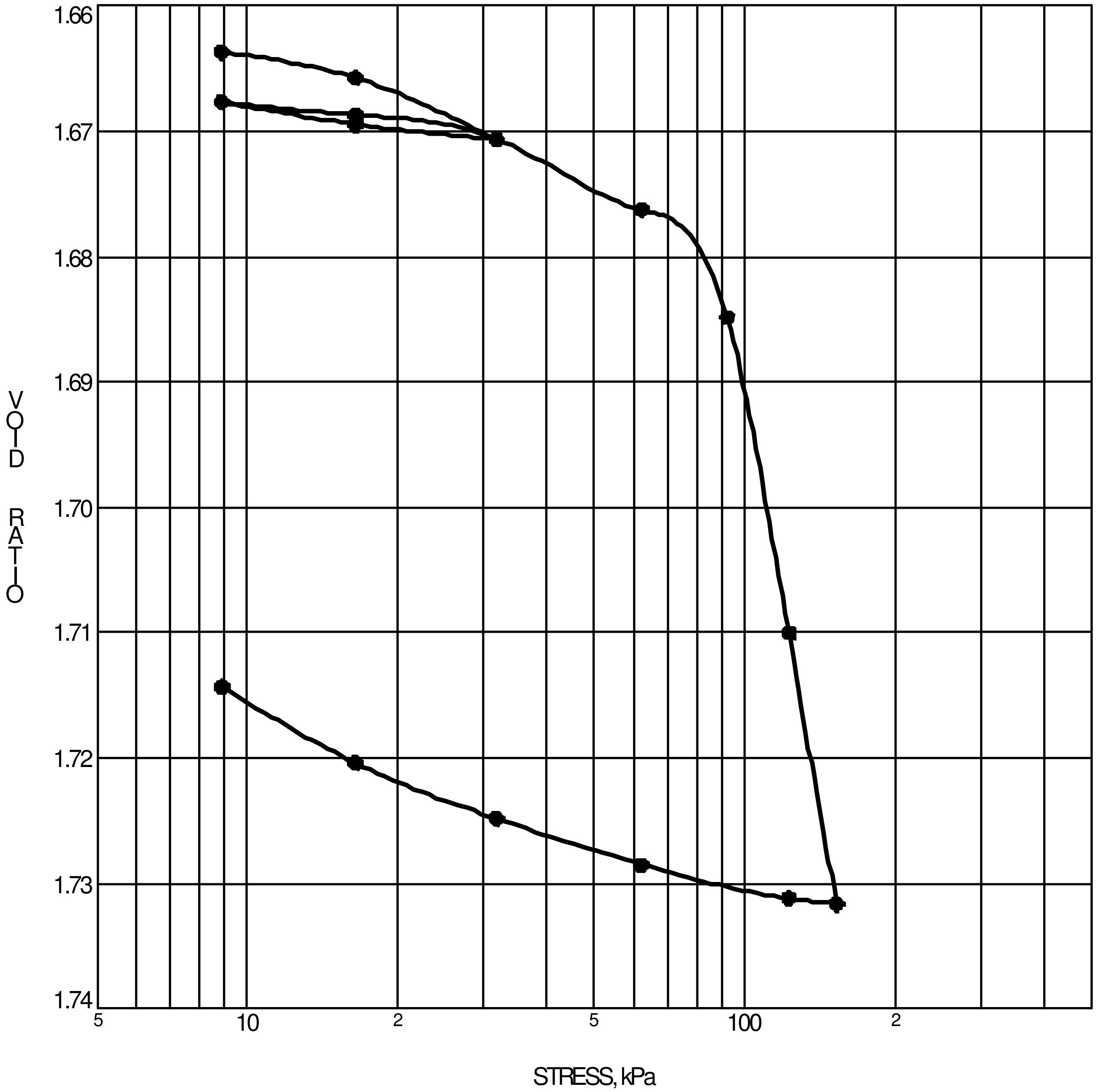
CONSOLIDATION TEST DATA SUMMARY							
Borehole No.	**BH10**	p'$_o$	**73**	kPa	Ccr	**0.024**	
Sample No.	**TW 4**	p'$_c$	**106.4**	kPa	Cc	**1.842**	
Sample Depth	**5.05** m	OC Ratio	**1.5**		Wo	**66.4**	%
Sample Elev.	**84.16** m	Void Ratio	**1.770**		Unit Wt.	**15.9**	kN/m^3

CLIENT	**Minto Developments Inc.**	FILE NO.	**PG0675**
PROJECT	**Geotechnical Investigation - Mahogany Community - First Line Road**	DATE	**30/07/07**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY								
Borehole No.	BH17		p'_o	61	kPa	Ccr	0.036	
Sample No.	TW 5		p'_c	84.2	kPa	Cc	1.456	
Sample Depth	5.05	m	OC Ratio	1.4		Wo	73.6	%
Sample Elev.	84.02	m	Void Ratio	1.963		Unit Wt.	15.5	kN/m^3

CLIENT **Minto Developments Inc.**

FILE NO. **PG0675**

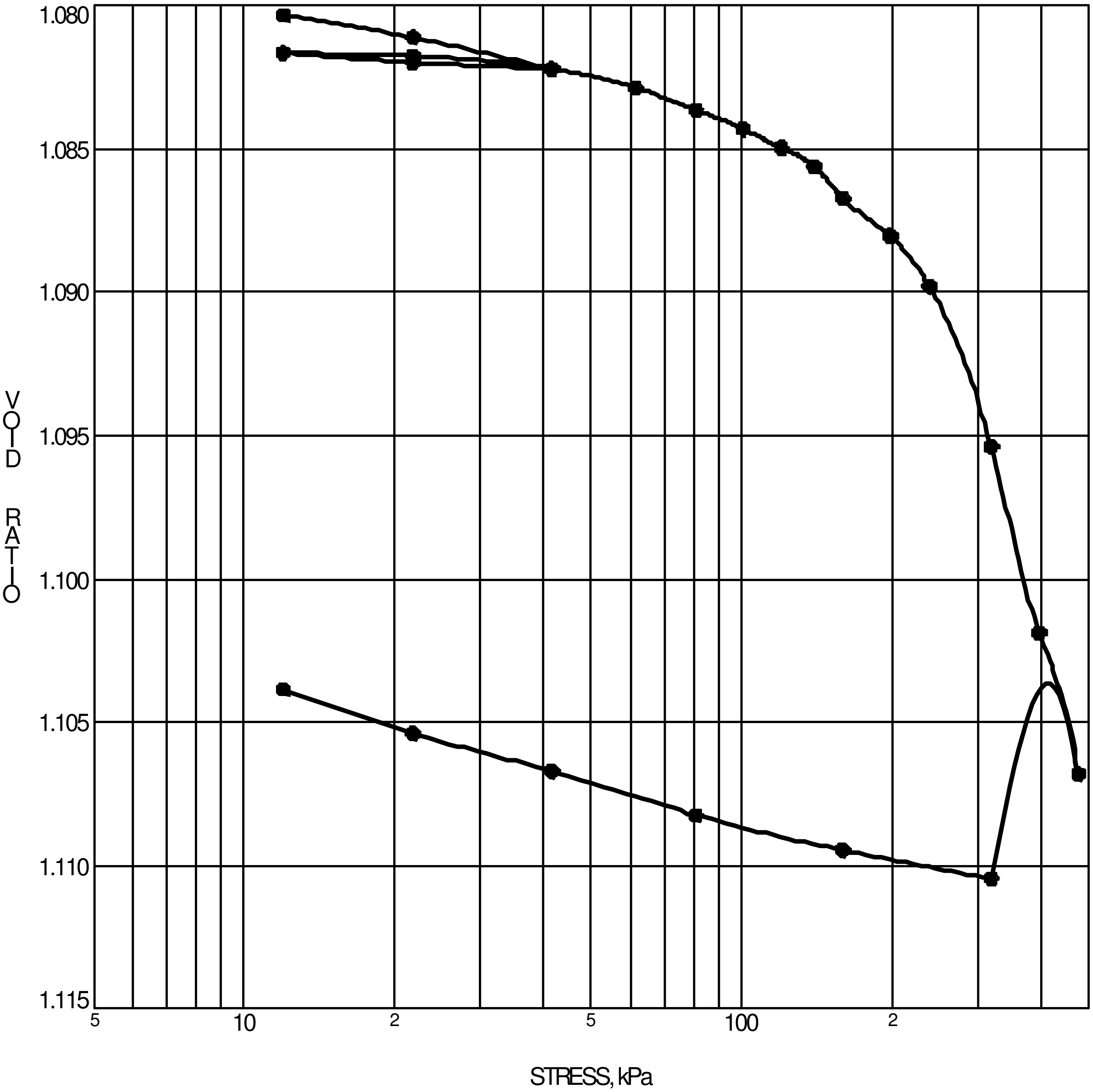
PROJECT **Geotechnical Investigation - Mahogany Community - First Line Road**

DATE **26/07/07**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



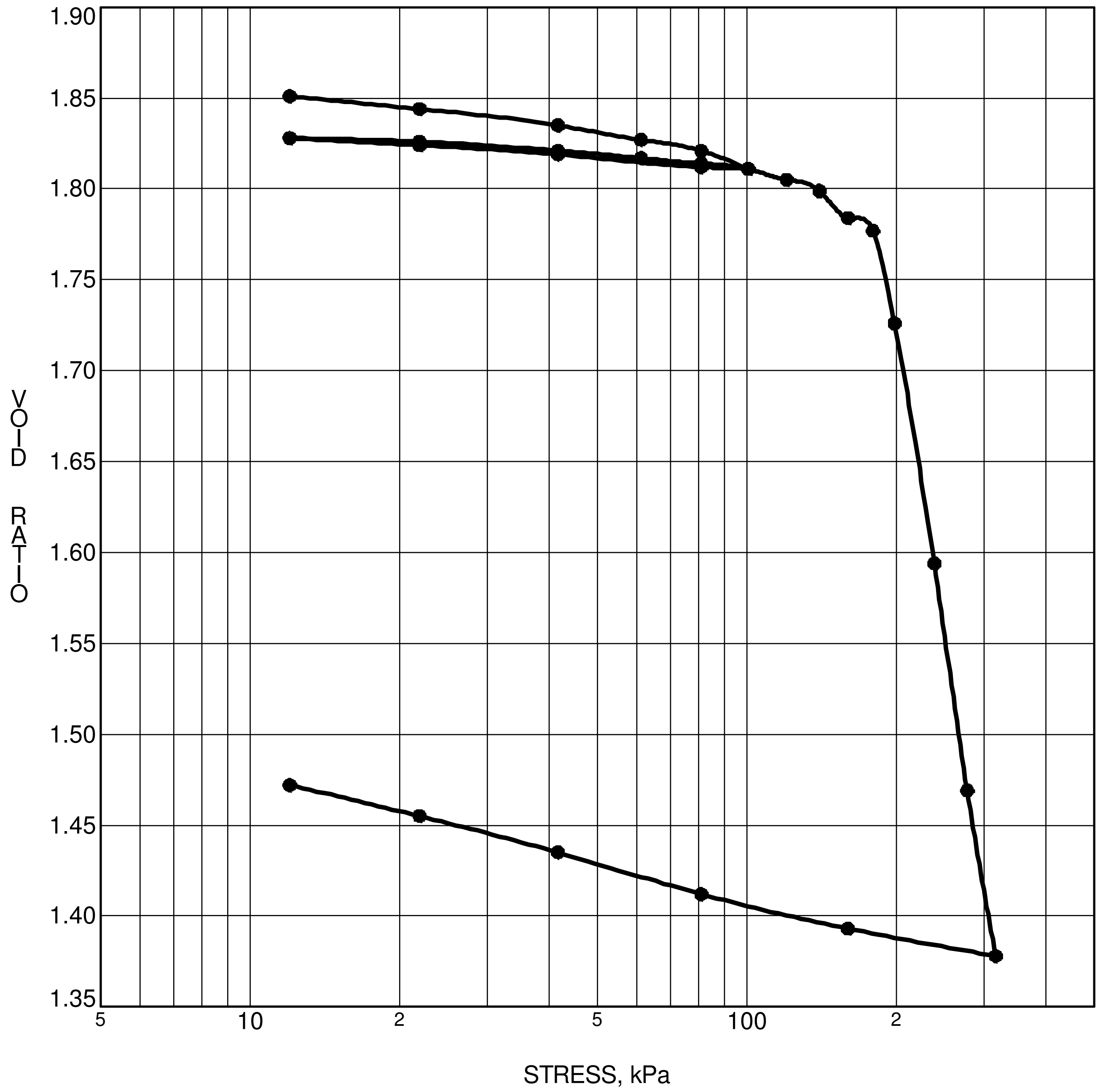
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH39	p'$_o$	68.9 kPa	Ccr	0.009
Sample No.	TW 4	p'$_c$	237.6 kPa	Cc	0.591
Sample Depth	4.95 m	OC Ratio	3.4	Wo	39.7 %
Sample Elev.	84.64 m	Void Ratio	1.200	Unit Wt.	18.0 kN/m^3

CLIENT	**Minto Developments Inc.**	FILE NO.	**PG0675**
PROJECT	**Geotechnical Investigation - Mahogany Community - First Line Road**	DATE	**30/07/07**

patersongroup **Consulting Engineers**

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

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 4**	p'$_o$	**58** kPa	Ccr	**0.019**
Sample No.	**TW 1**	p'$_c$	**186** kPa	Cc	**1.720**
Sample Depth	**4.90** m	OC Ratio	**3.2**	Wo	**67.7** %
Sample Elev.	m	Void Ratio	**1.86**	Unit Wt.	**15.8** kN/m^3

CLIENT **Minto Developments Inc.**

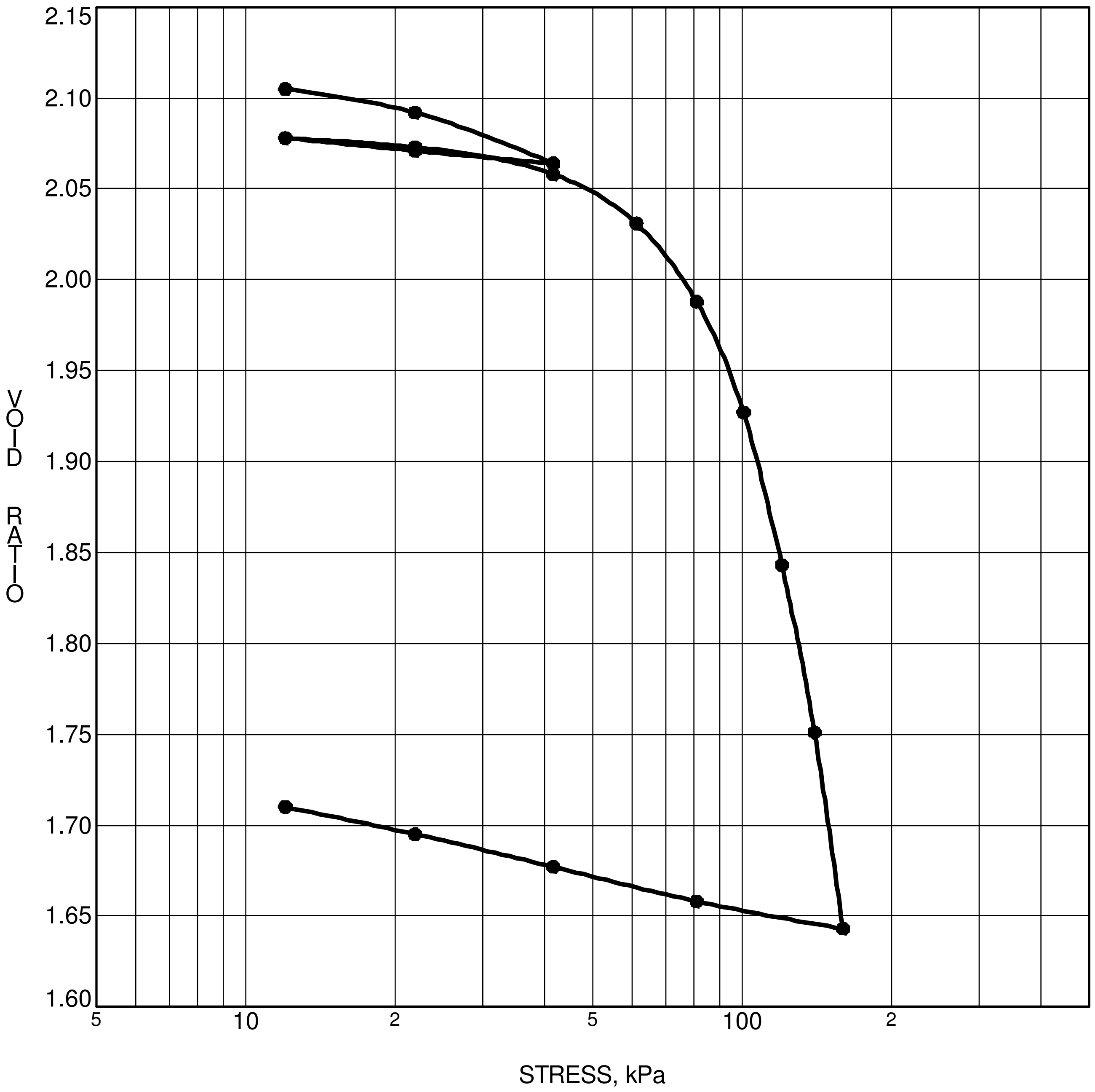
FILE NO. **PG0328**

PROJECT **Geotechnical Investigation - Percival Property,**
Main Street at Century Road

DATE **18/08/2004**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



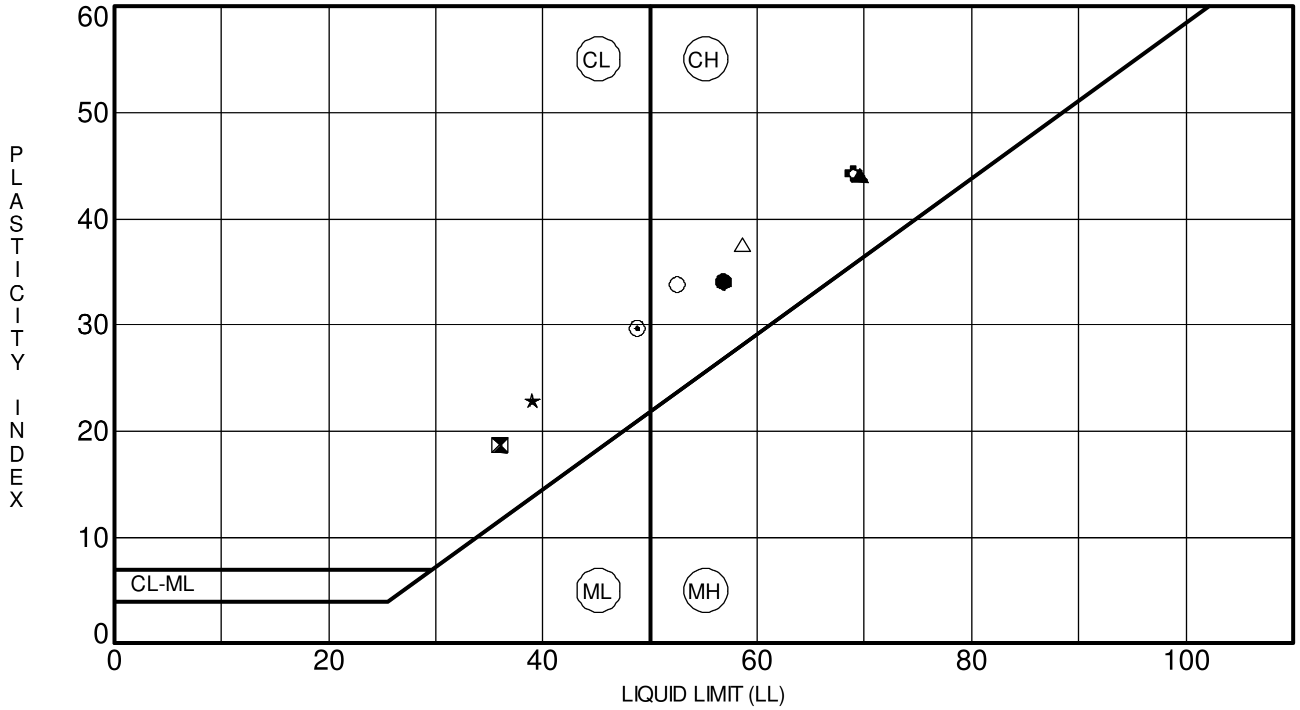
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 5**	p'$_o$	**51** kPa	Ccr	**0.019**
Sample No.	**TW 1**	p'$_c$	**90** kPa	Cc	**1.460**
Sample Depth	**4.00** m	OC Ratio	**1.8**	Wo	**77.2** %
Sample Elev.	m	Void Ratio	**2.12**	Unit Wt.	**15.3** kN/m^3

CLIENT	**Minto Developments Inc.**	FILE NO.	**PG0328**
PROJECT	**Geotechnical Investigation - Percival Property,** **Main Street at Century Road**	DATE	**17/08/2004**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



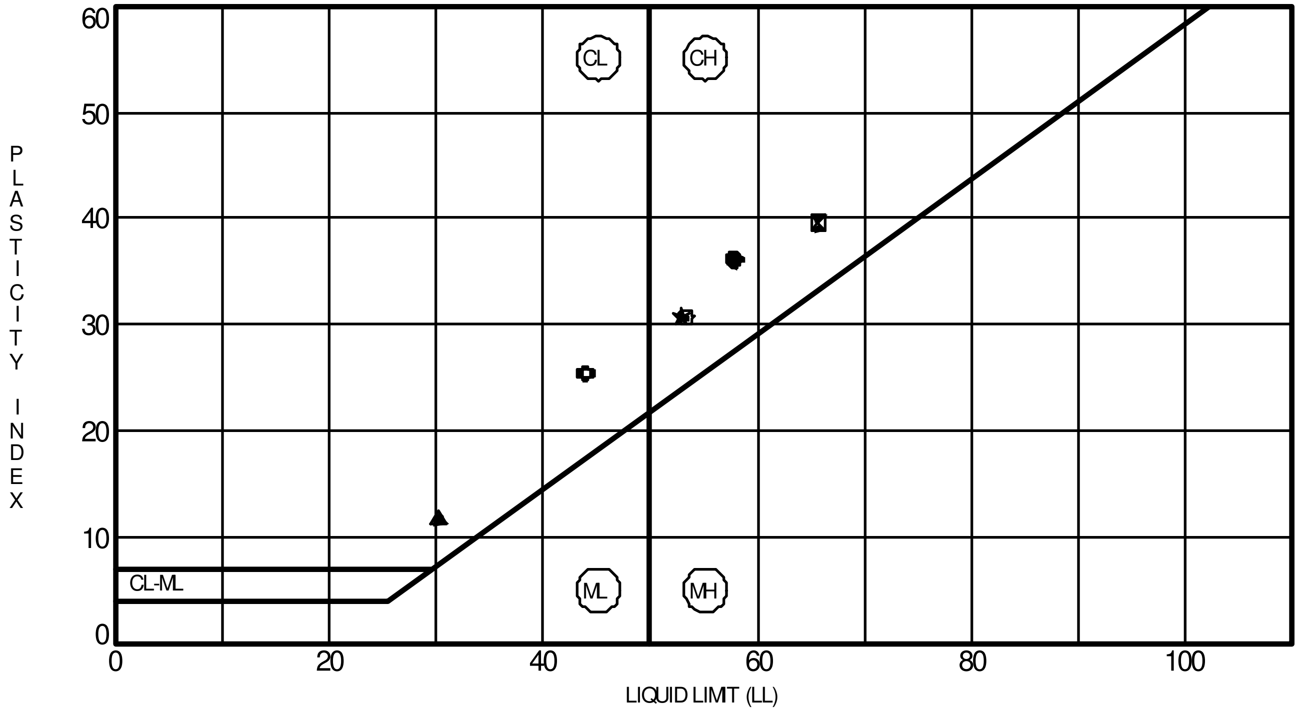
Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH50-17 SS3**	**57**	**23**	**34**		**CH - Inorganic clays of high plasticity**
⧗	**BH52-17 TW3**	**36**	**17**	**19**		**CL - Inorganic clays of low plasticity**
▲	**BH53-17 SS2**	**70**	**25**	**44**		**CH - Inorganic clays of high plasticity**
★	**BH54-17 SS2**	**39**	**16**	**23**		**CL - Inorganic clays of low plasticity**
⊙	**BH56-17 SS2**	**49**	**19**	**30**		**CL - Inorganic clays of low plasticity**
✚	**BH56-17 TW3**	**69**	**25**	**44**		**CH - Inorganic clays of high plasticity**
○	**BH58-17 SS2**	**53**	**19**	**34**		**CH - Inorganic clays of high plasticity**
△	**BH59-17 G3**	**59**	**21**	**38**		**CH - Inorganic clays of high plasticity**

CLIENT **Minto Communities Inc.**
PROJECT **Geotechnical Investigation - Residential Dev. -**
Mahogany Community Stages 2 to 4

FILE NO. **PG4008**
DATE **30 Mar 17**

patersongroup **Consulting Engineers**
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**BH10**	**58**	**22**	**36**		**Inorganic Clays of High Plasticity**
☒	**BH17**	**66**	**26**	**40**		**Inorganic Clays of High Plasticity**
▲	**BH39**	**30**	**18**	**12**		**Inorganic Clays of Low Plasticity**
★	**BH42**	**53**	**22**	**31**		**CH - Clay with high plasticity (TW 4)**
⊕	**BH44**	**53**	**23**	**31**		**CH - Clay with high plasticity (TW 4)**
✚	**BH45**	**44**	**19**	**25**		**CL - Clay with low plasticity (TW 4)**

CLIENT **Minto Developments Inc.**

FILE NO. **PG0675**

PROJECT **Geotechnical Investigation - Mahogany Community - First Line Road**

DATE **Jan 14, 08**

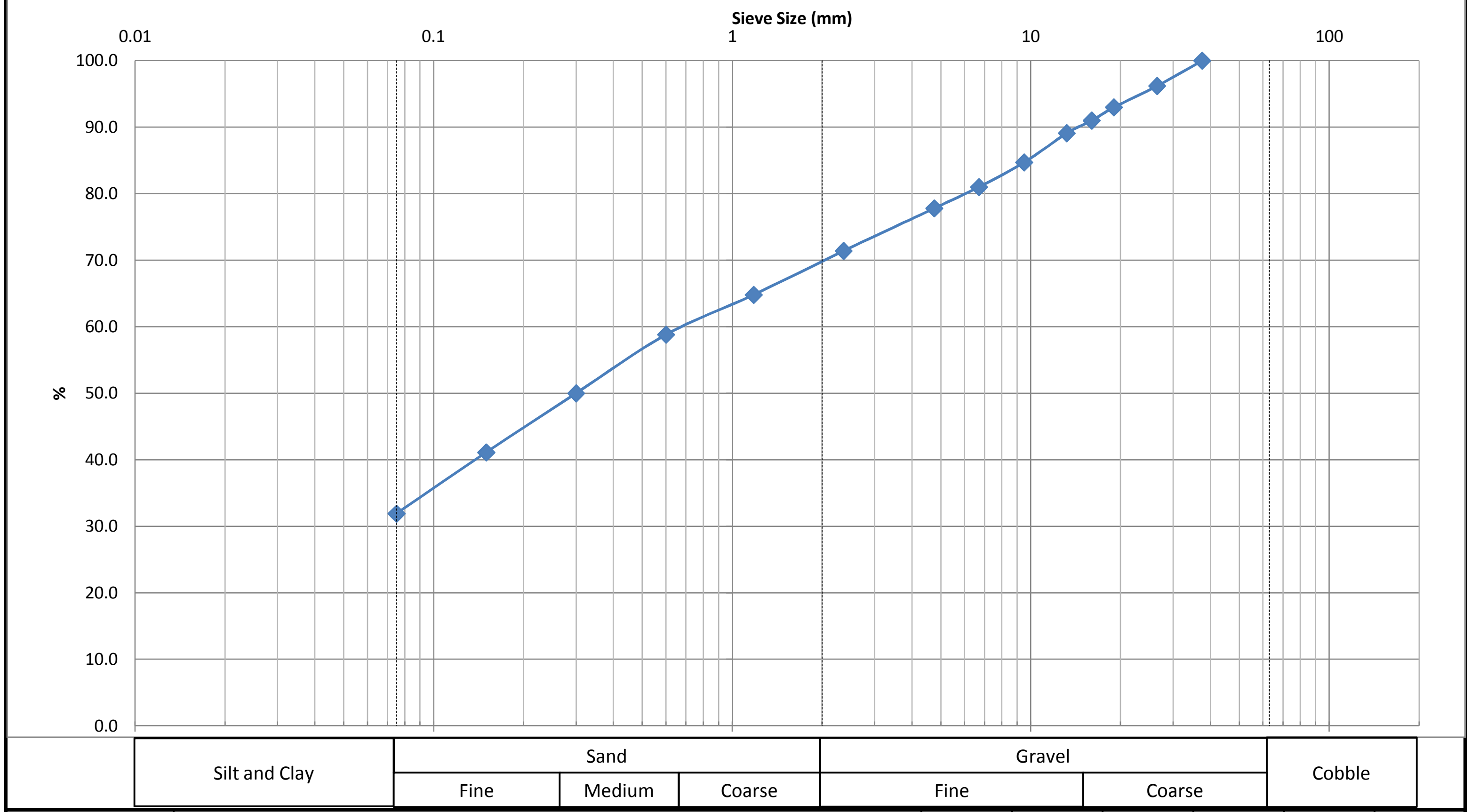
patersongroup **Consulting Engineers**

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

ATTERBERG LIMITS' RESULTS

SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO:	91323
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE RECEIVED:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	3-Apr-17	SOURCE LOCATION:	BH 50	DATE REPORTED:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS6 17'6"-19'6"	TESTED BY:	DB



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						0.51	57.5

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	38.5	0.69	0.065	0.012	22.2	45.9	31.9	

Comments	

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consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO.:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO.:	91323
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE REC'D:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	03-Apr-17	SOURCE LOCATION:	BH 50	DATE REP'D:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS6 17'6"-19'6"	TESTED BY:	DB

WEIGHT BEFORE WASH			A+B	776.7
WEIGHT AFTER WASH	A	B	A+B	553.1

SIEVE SIZE (mm)	**WEIGHT RETAINED**	**PERCENT RETAINED**	**PERCENT PASSING**	**LOWER SPEC**	**UPPER SPEC**	**REMARK**
150						
106						
75						
63						
53						
37.5	0.0	0.0	**100.0**			
26.5	**29.5**	3.8	**96.2**			
19	**54.1**	7.0	**93.0**			
16	**69.9**	9.0	**91.0**			
13.2	**84.6**	10.9	**89.1**			
9.5	**118.8**	15.3	**84.7**			
6.7	**147.4**	19.0	**81.0**			
4.75	**172.2**	22.2	**77.8**			
2.36	**222.2**	28.6	**71.4**			
1.18	**273.4**	35.2	**64.8**			
0.6	**320.1**	41.2	**58.8**			
0.3	**388.4**	50.0	**50.0**			
0.15	**457.2**	58.9	**41.1**			
0.075	**529.0**	68.1	**31.9**			
PAN	**553.1**					
SIEVE CHECK FINE		0.00	0.3% max.			

OTHER TESTS	**RESULT**	**REFERENCE MATERIAL** **LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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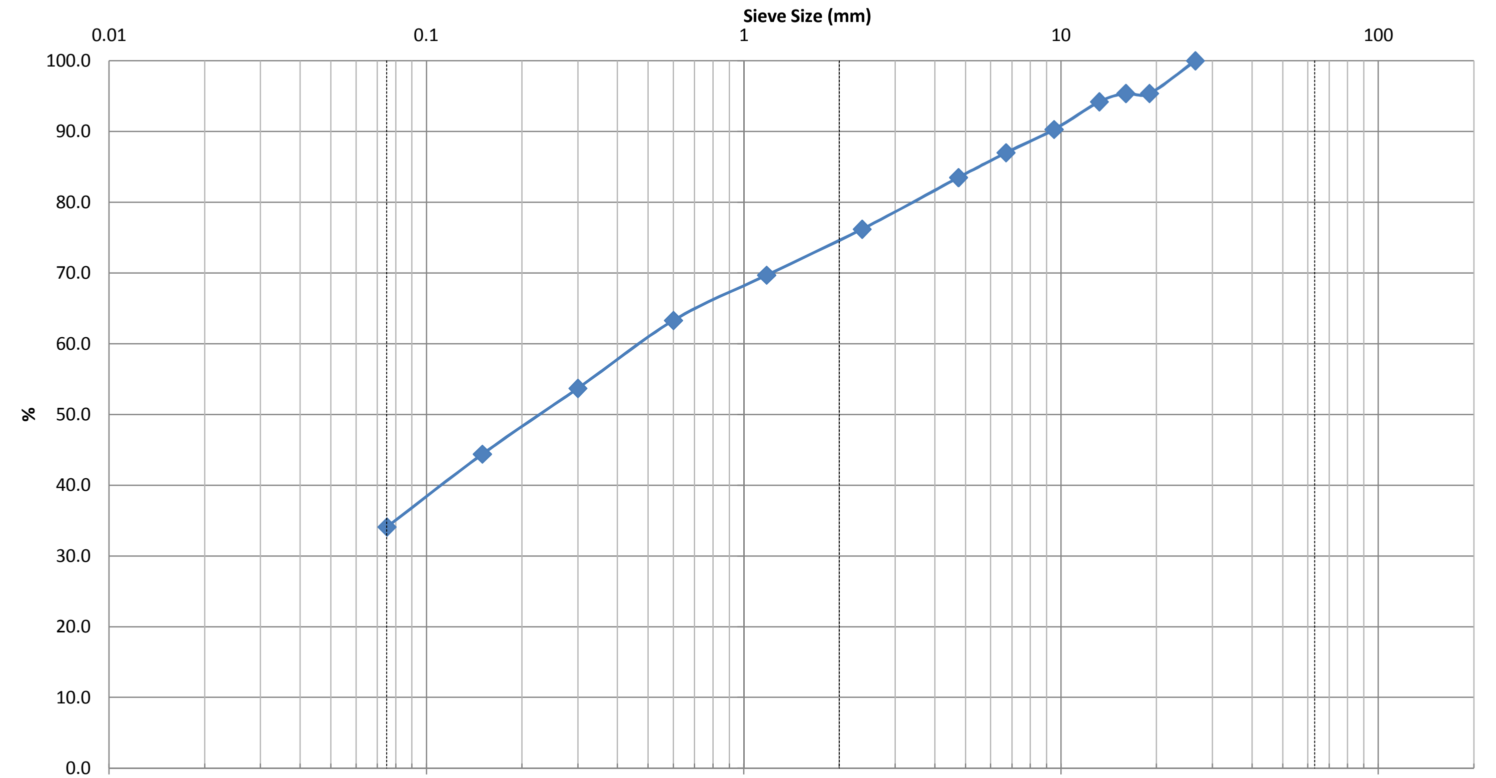
SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO:	91324
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE RECEIVED:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	3-Apr-17	SOURCE LOCATION:	BH 51	DATE REPORTED:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS4 15'-17'	TESTED BY:	DB



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						0.35	40.0

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
27.5	0.48	0.045	0.012	16.5	49.4	34.1	

Comments

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO.:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO.:	91324
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE REC'D:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	03-Apr-17	SOURCE LOCATION:	BH 51	DATE REP'D:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS4 15'-17'	TESTED BY:	DB

WEIGHT BEFORE WASH			A+B	585.2
WEIGHT AFTER WASH	A	B	A+B	407.0

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5	**0.0**	0.0	**100.0**			
19	**26.7**	4.6	**95.4**			
16	**26.7**	4.6	**95.4**			
13.2	**34.1**	5.8	**94.2**			
9.5	**57.0**	9.7	**90.3**			
6.7	**75.8**	13.0	**87.0**			
4.75	**96.6**	16.5	**83.5**			
2.36	**139.2**	23.8	**76.2**			
1.18	**177.4**	30.3	**69.7**			
0.6	**214.8**	36.7	**63.3**			
0.3	**270.8**	46.3	**53.7**			
0.15	**325.4**	55.6	**44.4**			
0.075	**385.9**	65.9	**34.1**			
PAN	**407.0**					

SIEVE CHECK FINE	0.00	0.3% max.	**REFERENCE MATERIAL**

OTHER TESTS	**RESULT**	**LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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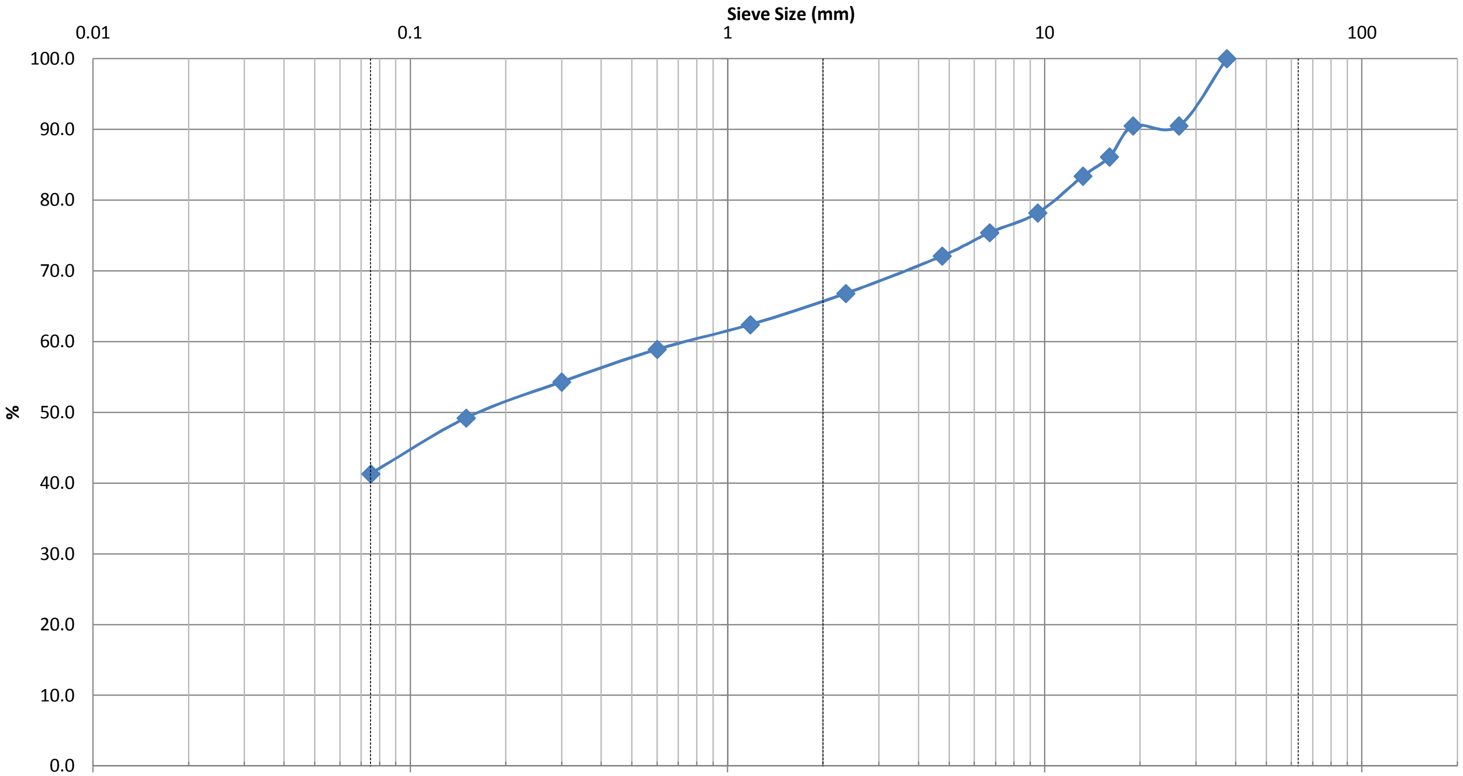
SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO:	91325
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE RECEIVED:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	3-Apr-17	SOURCE LOCATION:	BH 58	DATE REPORTED:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS4 22'6"-24'6"	TESTED BY:	DB



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
									0.06	75.0
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)		Clay (%)	
	38	0.75	0.022	0.01	27.9	30.8	41.3			

Comments

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Minto Communities	DESCRIPTION:	Silty Sand with Gravel	FILE NO.:	PG4008
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO.:	91325
PROJECT:	Mahogany Phase 2	INTENDED USE:	-	DATE REC'D:	13-Apr-17
		PIT OR QUARRY:	In Situ	DATE TESTED:	17-Apr-17
DATE SAMPLED:	03-Apr-17	SOURCE LOCATION:	BH 58	DATE REP'D:	18-Apr-17
SAMPLED BY:	M. Killam	SAMPLE LOCATION:	SS4 22'6"-24'6"	TESTED BY:	DB

WEIGHT BEFORE WASH			A+B	518.3
WEIGHT AFTER WASH	A	B	A+B	320.5

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5	0.0	0.0	**100.0**			
26.5	**49.0**	9.5	**90.5**			
19	**49.0**	9.5	**90.5**			
16	**72.1**	13.9	**86.1**			
13.2	**86.1**	16.6	**83.4**			
9.5	**112.8**	21.8	**78.2**			
6.7	**127.5**	24.6	**75.4**			
4.75	**144.6**	27.9	**72.1**			
2.36	**172.1**	33.2	**66.8**			
1.18	**194.7**	37.6	**62.4**			
0.6	**212.9**	41.1	**58.9**			
0.3	**236.7**	45.7	**54.3**			
0.15	**263.4**	50.8	**49.2**			
0.075	**304.3**	58.7	**41.3**			
PAN	**320.1**					
SIEVE CHECK FINE		0.12	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	RESULT	LAB NO.	RESULT

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 21804

Report Date: 11-Apr-2017

Order Date: 5-Apr-2017

Project Description: PG4008

	Client ID:	BH53-17-SS2	BH55-17-SS2	BH58-17-SS2	-
	Sample Date:	31-Mar-17	31-Mar-17	30-Mar-17	-
	Sample ID:	1714326-01	1714326-02	1714326-03	-
	MDL/Units	Soil	Soil	Soil	-
Physical Characteristics					
% Solids	0.1 % by Wt.	68.2	77.7	76.9	-
General Inorganics					
pH	0.05 pH Units	6.83	7.05	6.89	-
Resistivity	0.10 Ohm.m	72.1	121	120	-
Anions					
Chloride	5 ug/g dry	7	12	8	-
Sulphate	5 ug/g dry	40	14	26	-

Certificate of Analysis

Report Date: 22-Jul-2004
Order Date: 19-Jul-2004

Client: **Paterson Group Inc.**
Client PO: 1568

Project: PG0328

Matrix: Soil
Sample Date: 15/07/2004

Parameter	MDL/Units	BH1 SS2 J2746.1	BH5 SS2 J2746.2
Chloride	5 ug/g	25	10
Sulphate	5 ug/g	20	15
pH	0.05 pH units	8.56	8.05
Resistivity	0.1 ohm.m	87	74

Certificate of Analysis

Client: **Paterson Group Inc.**
Client PO: **1158**

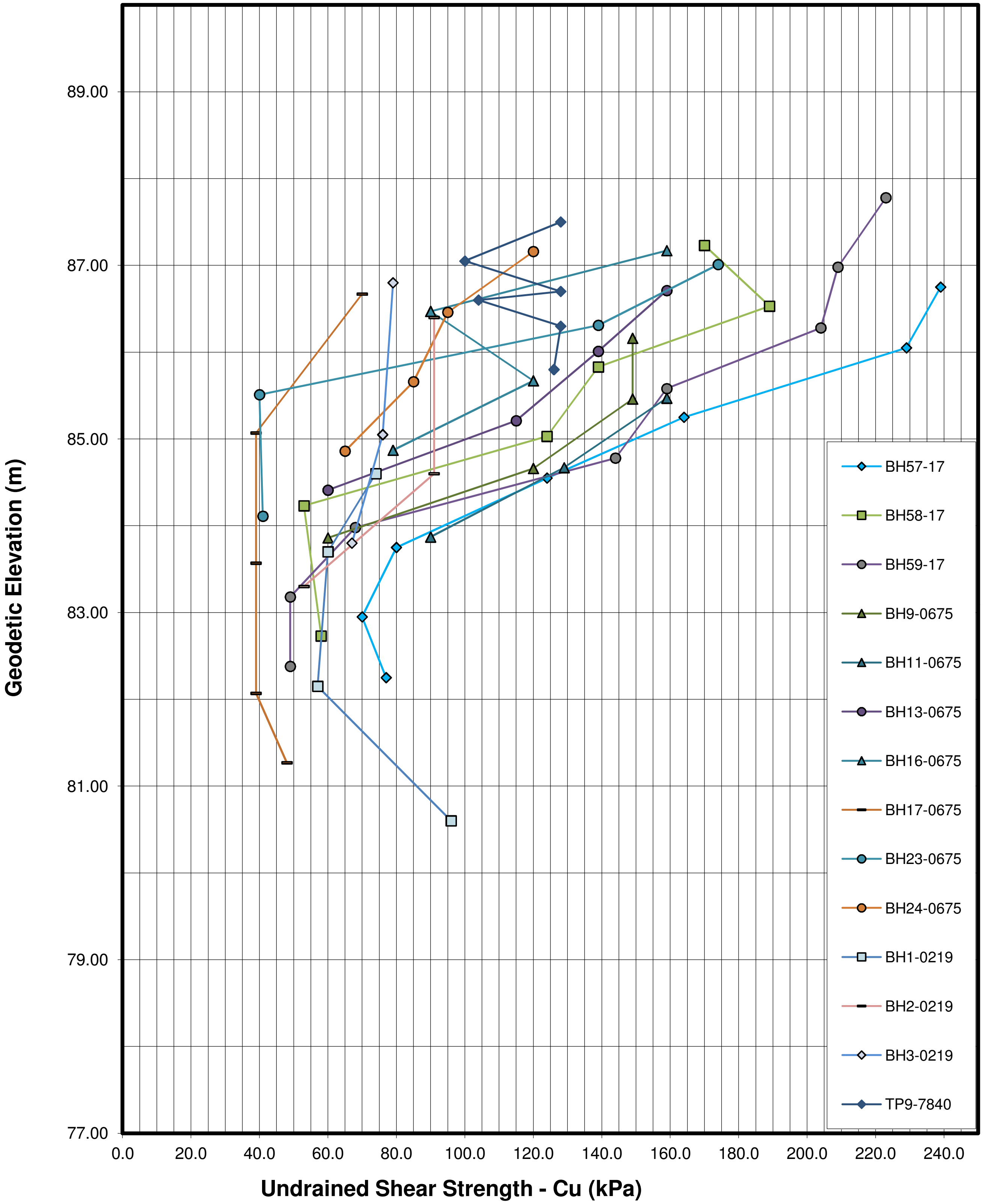
Report Date: 19-May-2004
Order Date: 14-May-2004

Project: **PG0219**

Matrix: Soil
Sample Date: 10/05/2004

Parameter	MDL/Units	BH10 SS3 J1559.1
Chloride	5 ug/g	10
Sulphate	5 ug/g	35
pH	0.05 pH units	7.41
Resistivity	0.1 ohm.m	47

Figure 2 - Shear Strength Profile - Mahogany - Stage 2 - North



Report No. PG4008-1
June 21, 2017

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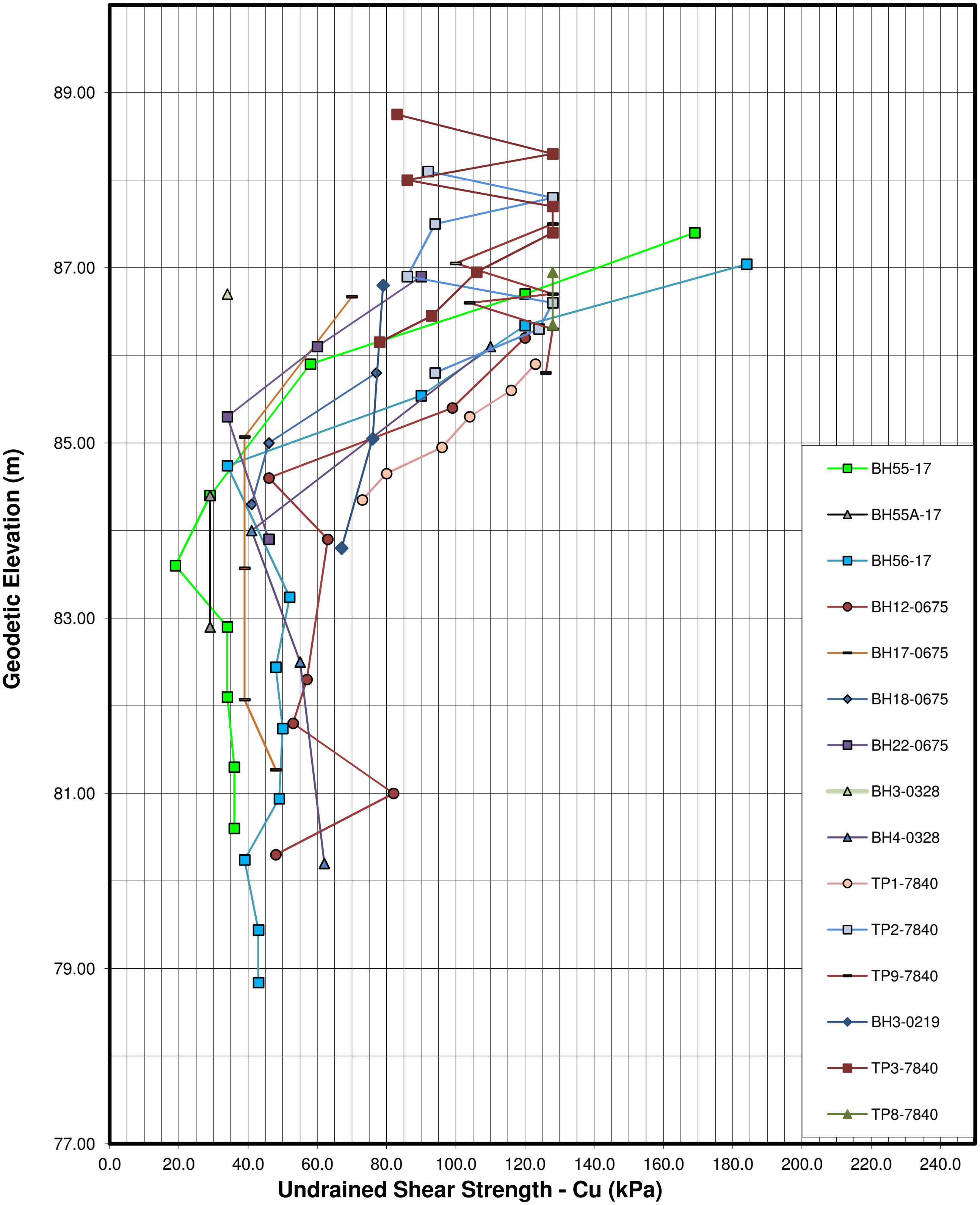
Figure 3 - Shear Strength Profile - Mahogany - Stage 2 - South



Report No. PG4008-1
June 21, 2017

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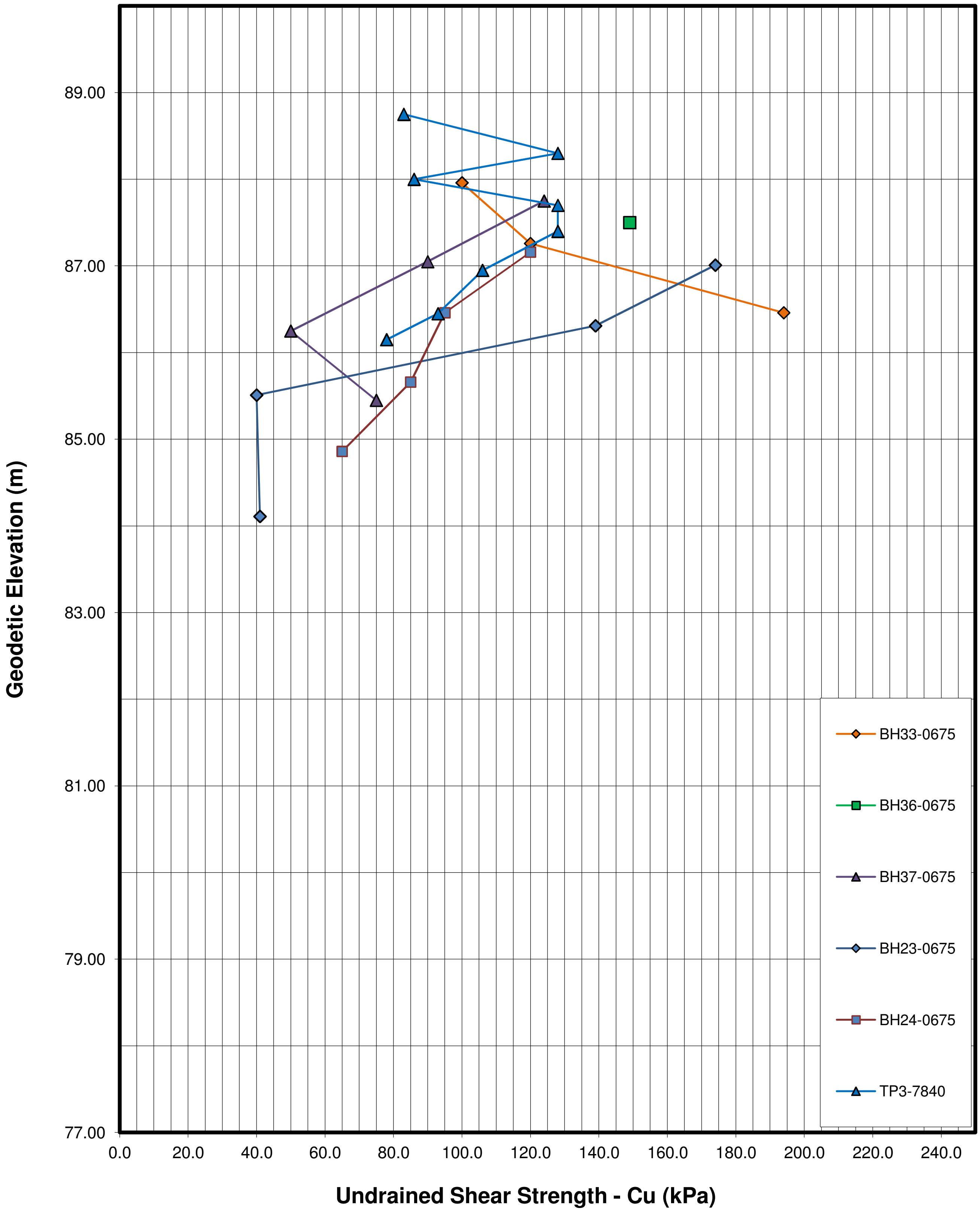
Figure 4 - Shear Strength Profile - Mahogany - Stage 3 - North



Report No. PG4008-1
June 21, 2017

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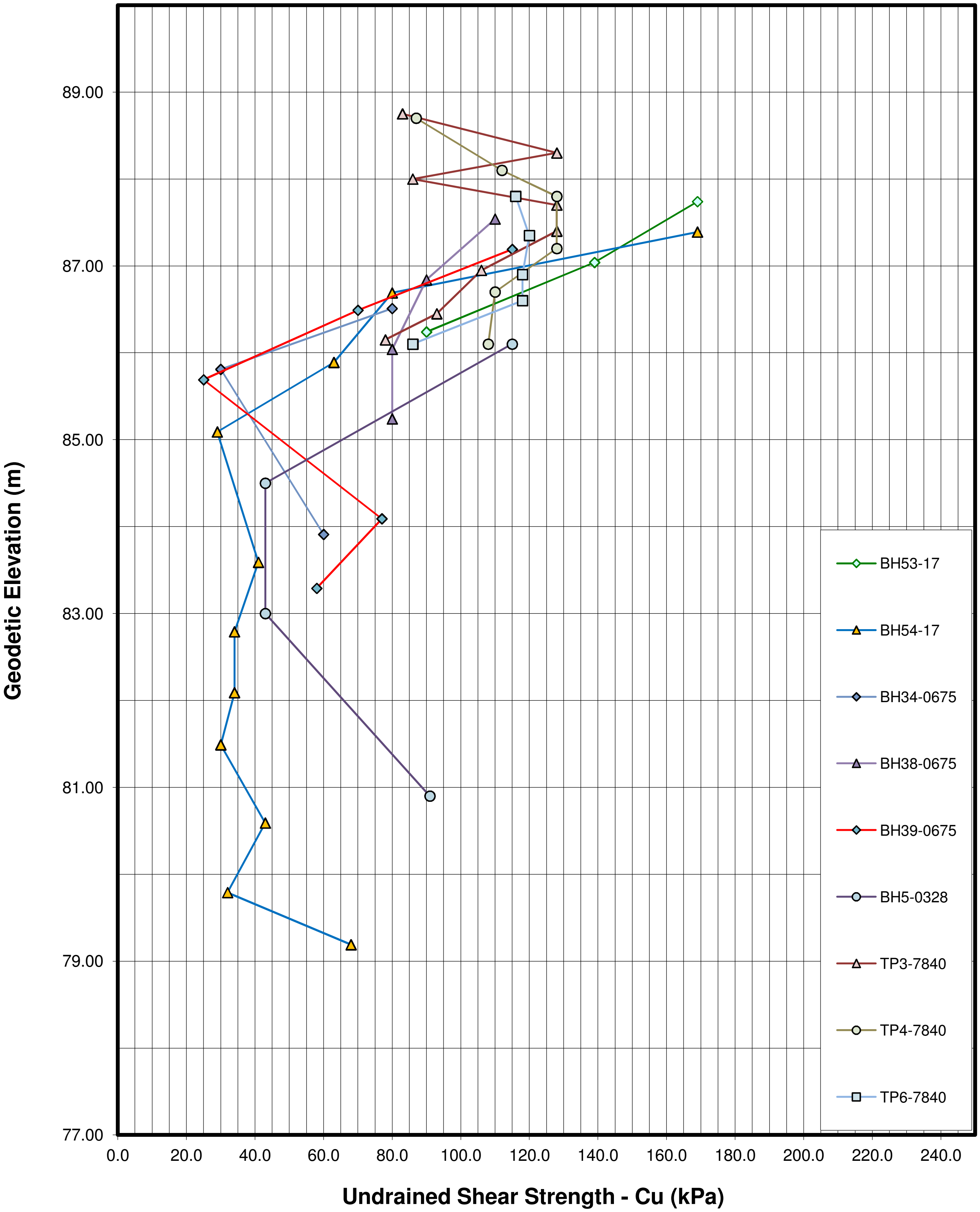
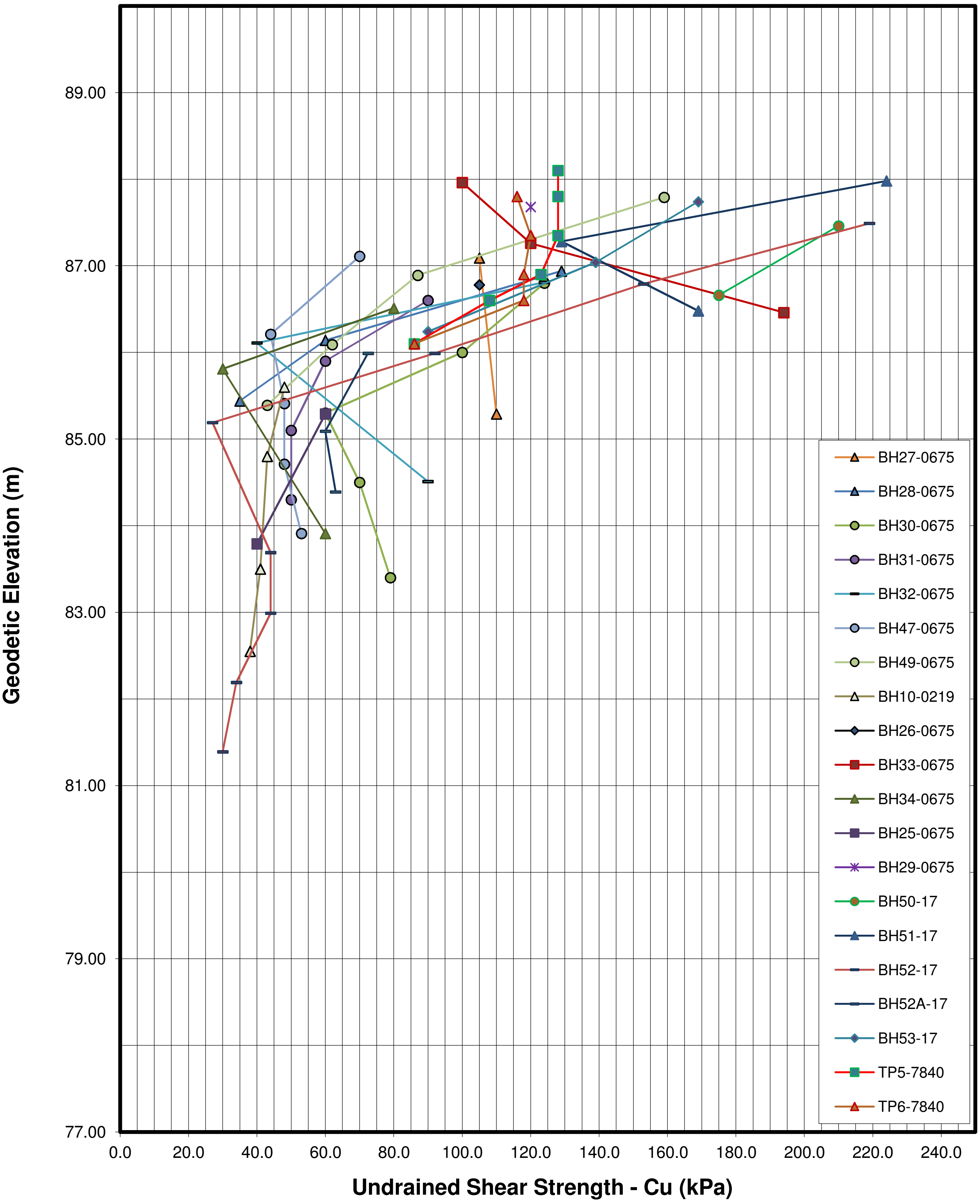
Figure 5 - Shear Strength Profile - Mahogany - Stage 3 - South



Report No. PG4008-1
June 21, 2017

Figure 6 - Shear Strength Profile - Mahogany - Stage 4



Report No. PG4008-1
June 21, 2017

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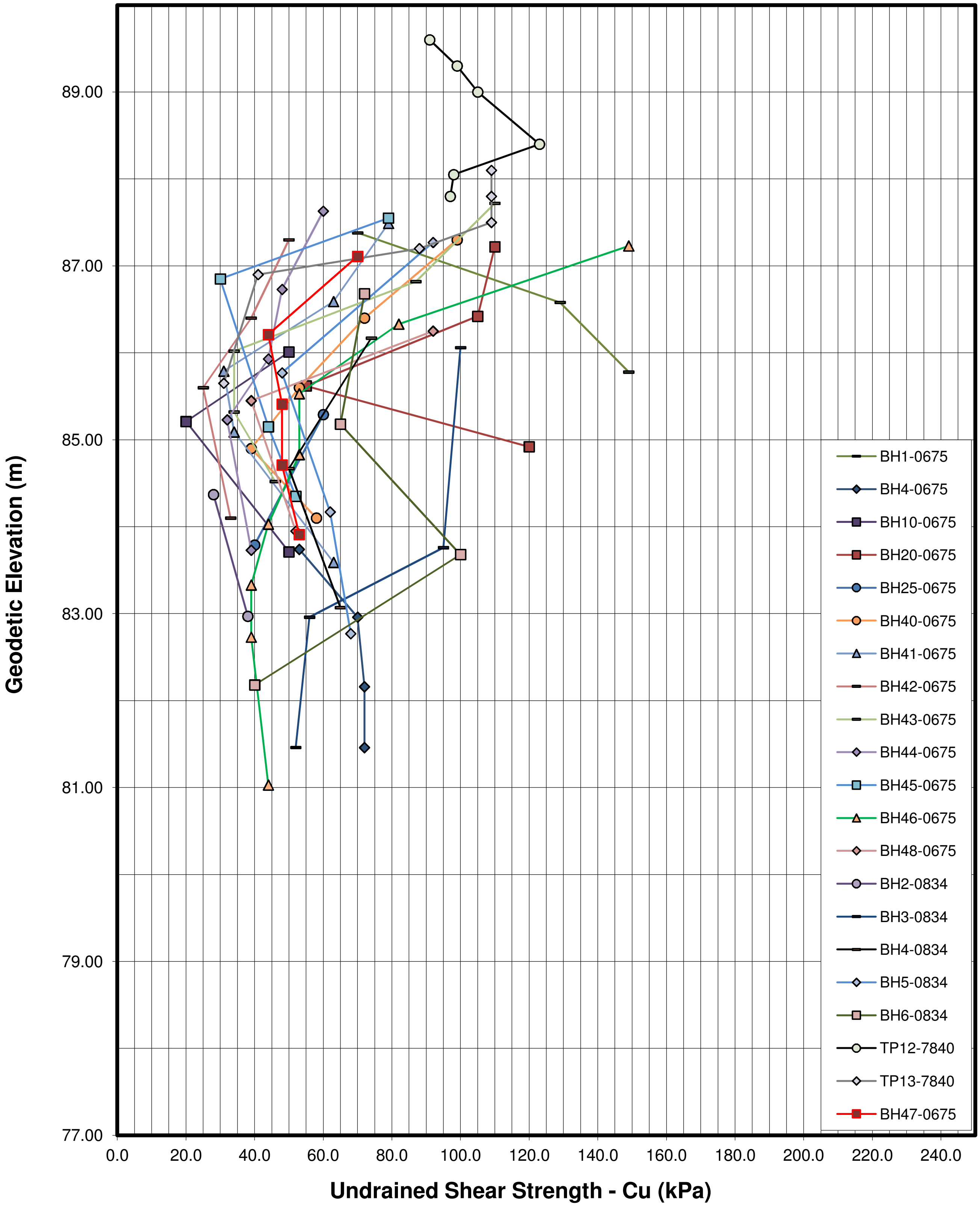
Figure 7 - Shear Strength Profile - Mahogany - Stage 5



Report No. PG4008-1
June 21, 2017

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Table 4: BH Summary of Seismic Site Class - OBC 2012 - Using Typical Vs Values

Project: Mahogany Community Stages 2 to 4 - Manotick - Ottawa
File No: PG4008-REP.01 **Date:** June 23, 2017
PGA 0.32 **Region:** Ottawa (Manotick)

Note: Analyses Assume USF Levels at Ground Surface.
Analyses based on borehole descriptions only.

Layer Description	Layer Vs	Depths (m) of Various Layers at Specified Borehole									
		BH 51-17	**BH 52-17**	**BH 53-17**	**BH 54-17**	**BH 55-17**	**BH 56-17**	**BH 58-17**	**BH 21-07**	**BH 4-04B**	**BH 3-06**
stiff silty clay	200	3.5	3.2	2.9	3.2	3.3	3.6	4.4	1.5	3.8	3.7
grey silty clay (input)	130	0.0	5.0	0.8	7.0	5.5	7.0	2.3	0.0	8.2	2.4
Vs by Equation (= 125 + 1.1667*Z)		127.0	129.8	127.2	131.0	130.1	131.2	128.9	125.9	132.0	128.6
compact glacial till	200	3.2	0.0	0.8	2.5	0.0	1.4	2.0	2.2	0.6	4.9
dense sand and/or silt	250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
dense glacial till	350	1.0	0.6	2.0	0.5	1.0	0.6	2.9	0.0	0.0	1.2
weathered bedrock	1500	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
sound bedrock	2200	20.3	19.2	21.5	14.8	18.2	15.4	16.4	24.3	15.4	15.8
Total of Thicknesses:	**N/A**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
More than 3 m Soft Soil? (Y/N)		N	N	N	N	N	N	N	N	N	N
Average Vs and Site Class by Each Method:											
Vs Input for Grey Clay:	**Avg. Vs**	639.4	452.9	723.3	326.7	420.9	337.5	449.3	971.5	321.2	408.7
	Class	**C**	**C**	**C**	**D**	**C**	**D**	**C**	**B**	**D**	**C**
Vs Eqn. for Grey Clay:	**Avg. Vs**	639.4	452.5	721.0	328.1	421.2	339.3	448.3	971.5	324.5	407.5
	Class	**C**	**C**	**C**	**D**	**C**	**D**	**C**	**B**	**D**	**C**

Note:
1. Vs values are representative values based on texture and state of compaction or consistency.
2. Equation Vs = 125 + 1.1667*Z for sensitive silty clay from Hunter, Burns, et. al. - Figure 16 (conservative interpretation without high Lemieux BH)
3. Where Site Class is indicated as B and the thickness of soil is greater than 3.0 m, **Site Class C** is applicable.

APPENDIX 3

FIGURE 1 - KEY PLAN

DRAWING PG4008-1 - TEST HOLE LOCATION PLAN

DRAWING PG4008-2 - PERMISSIBLE GRADE RAISE PLAN

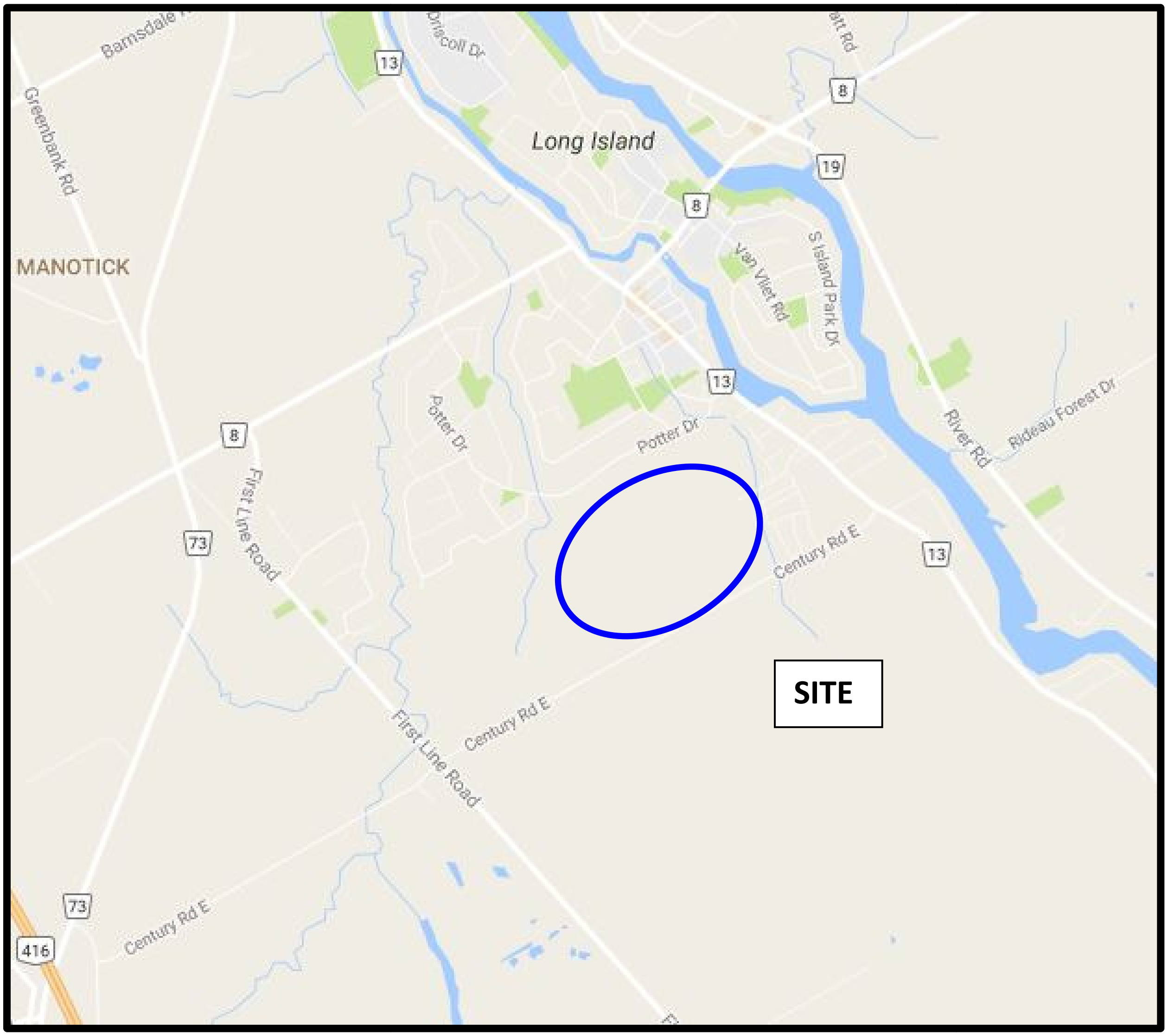

FIGURE 1

KEY PLAN

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LEGEND:

⊕	BOREHOLE LOCATION, CURRENT 2017 INVESTIGATION
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0675-6) 2007-2008
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0834-1) 2006
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0328-1) 2004
◎	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0219-1) 2004
▣	TEST PIT LOCATION, PREVIOUS INVESTIGATION (JDPA REPORT G7840-1) 2000
88.56	GROUND SURFACE ELEVATION (m)
90.0	APPROX. GROUND SURFACE ELEVATION (m)
(76.39)	PRACTICAL REFUSAL TO AUGERING/DCPT ELEVATION (m)

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. APPROXIMATE GROUND ELELEVATIONS AT OLDER TEST HOLES INTERPOLATED FROM TOPOGRAPHY.

SCALE: 1:4000

0 50 100 150 200 300m

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NO.	REVISIONS	DATE	INITIAL
0			

MINTO COMMUNITIES INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - MAHOGANY COMMUNITY
OTTAWA (MANOTICK), ONTARIO

Title:

TEST HOLE LOCATION PLAN

Stamp:

Scale: 1:4000
Drawn by: RCG
Checked by: AJT
Approved by: AJT
Date: 06/2017

Report No.: PG4008-REP.01
Drawing No.: PG4008-1
Revision No.: 0

p:\autocad drawings\geotechnical\pg40xx\pg4008-1 june 2017.dwg

PERMISSIBLE GRADE RAISE LEGEND:

▭	AREAS OF SPECIFIC GRADE RAISE RESTRICTIONS
87.15	INTERPRETED ORIGINAL GROUND ELEVATION (m)
0.70	PERMISSIBLE GRADE RAISE (m)
87.85	PERMISSIBLE FINISHED GRADE (m)
88.25	MAX. FINISHED GRADE LIGHTWEIGHT FILL (LWF)

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ACCOMPANYING FILE PG4008-REP.01
2. WHERE PERMISSIBLE GRADE RAISE IS NOT SPECIFIED, IT IS AT LEAST 3.0m. HIGHER GRADE RAISES COULD BE PERMISSIBLE TO BE CONFIRMED BY GEOTECHNICAL ENGINEER ON A CASE-BY-CASE BASIS.
3. PHASE/STAGE 5 IS NOT INCLUDED IN THE GRADE RAISE ANALYSIS AND RECOMMENDATIONS.

LEGEND:

⊕	BOREHOLE LOCATION, CURRENT 2017 INVESTIGATION
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0675-6) 2007-2008
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0834-1) 2006
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0328-1) 2004
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0219-1) 2004
▦	TEST PIT LOCATION, PREVIOUS INVESTIGATION (JDPA REPORT G7840-1) 2000
88.56	GROUND SURFACE ELEVATION (m)
90.0	APPROX. GROUND SURFACE ELEVATION (m)
(76.39)	PRACTICAL REFUSAL TO AUGERING/DCPT ELEVATION (m)

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. APPROXIMATE GROUND ELELEVATIONS AT OLDER TEST HOLES INTERPOLATED FROM TOPOGRAPHY.

SCALE: 1:4000

0 50 100 150 200 300m

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NO.	REVISIONS	DATE	INITIAL
0			

MINTO COMMUNITIES INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - MAHOGANY COMMUNITY
OTTAWA (MANOTICK), ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Stamp:

Scale:	1:4000
Drawn by:	RCG
Checked by:	AJT
Approved by:	AJT
Date:	06/2017

Report No.: PG4008-REP.01

Drawing No.: PG4008-2

Revision No.: 0