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Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation
Proposed Development
936 March Road
Ottawa, Ontario

Prepared For

Minto Communities
2559688 Ontario Inc.

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Report: PG4554-1
Revision 2

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Minto Communities and 2559688 Ontario Inc. to conduct a geotechnical investigation for the proposed development to be constructed at 936 March Road in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objectives of the geotechnical investigation were to:

❑ determine the subsurface soil and groundwater conditions by means of boreholes.

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

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

2.0 Proposed Development

It is understood that the proposed development will consist predominantly of low rise residential buildings including 455 single-family homes and 401 townhouse units located in the central portion of the site. A proposed school will also be located in the north-central portion of the site. Future commercial development lands, for which detailed plans are not presently available, will be located on the western end of the site, fronting onto March Road. The proposed development will also include local roadways and park lands.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation consisted of 38 boreholes (BH 1 through BH 38), in addition to 3 boreholes completed for environmental purposes (BH 40, BH 41, and BH 42), which were drilled to a maximum depth of 7.5 m on June 1, June 26 through 29, and July 3 and 4, 2018. The test hole locations were determined in the field by Paterson personnel and distributed in a manner to provided general coverage of the proposed residential development taking into consideration site features and underground utilities. The test hole locations are presented on Drawing PG4554-1 - Test Hole Location Plan included in Appendix 2.

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

Sampling and In Situ Testing

Soil samples from the boreholes were recovered from the auger flights or a 50 mm diameter split-spoon sampler. All soil samples were classified on site, placed in sealed plastic bags and transported to the laboratory for further review. The depths at which the auger and split spoon samples were recovered from the test holes are presented as AU and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

Standard Penetration Testing (SPT) was conducted and 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 sample 300 mm into the soil after a 150 mm initial penetration with a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted at regular intervals in cohesive soils and completed using a MTO field vane apparatus.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible standpipes were installed in the geotechnical boreholes, with the exception of boreholes BH 9, BH 10, BH 17, BH 19, BH 26, BH 27, BH 28, BH 34, BH 35, and BH 36, and groundwater monitoring wells were installed in the environmental boreholes (BH 40, BH41, and BH 42) during the field investigation to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

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

3.2 Field Survey

The test hole locations were selected by Paterson, and located and surveyed in the field by Stantec. The ground surface elevations at the test hole locations are referenced to a geodetic datum. The test hole locations are presented on Drawing PG4554-1 - Test Hole Location Plan in Appendix 2.

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.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site consists mostly of agricultural lands with some brush covered areas. A farmstead and associated outbuildings are located within the southwest portion of the subject site. The site is trisected in an approximately north-south orientation by an existing rail track on the eastern portion of the site, and by an existing watercourse on the western portion of the site.

An approximately 6 m high slope runs in a north-south direction within the western portion of the subject site, sloping downward to the east. The slope was noted to be stable and shaped to an approximate 8H:1V slope or less. Overall, the ground surface across the subject site slopes downward from southwest to northeast from approximately elevation 80 m to 65 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test holes consists of a thin topsoil layer underlain by silty sand in the central portion of the site, and by a silty clay deposit in the remainder of the site. Where encountered, the silty sand had a thickness of approximately 0.5 to 1.5 m, and was underlain by the silty clay.

The silty clay deposit was observed to generally increase in thickness from west to east across the site, from approximately 0.75 m in the western portion of the site to 7.8 m near the eastern boundary of the site. The silty clay deposit was observed to consist of a hard to firm, brown to grey silty clay.

A glacial till deposit was generally encountered underlying the silty clay, extending to the inferred bedrock surface at approximate depths of 1.5 to 7.8 m. The glacial till was observed to consist of a brown silty clay to silty sand with gravel, cobbles, and boulders.

Practical refusal of the augers was encountered on the inferred bedrock surface at approximate depths ranging from 1.3 m on the western portion of the site to 7.8 m at the eastern boundary of the site.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in the western half of the subject site consists of interbedded sandstone and dolomite of the March formation, while the bedrock in the eastern half of the subject site consists of dolomite of the Oxford formation, with overburden drift thicknesses ranging from 3 to 10 m.

4.3 Groundwater

The measured groundwater levels are summarized below in Table 1 and presented on the Soil Profile and Test Data sheets in Appendix 1. It should be noted that surface water can become perched within a backfilled borehole, which can lead to higher than normal groundwater level readings. The long-term groundwater level can also be estimated based on the recovered soil samples' moisture levels, colouring and consistency. Based on these observations, the long-term groundwater level is anticipated at a 2.5 to 4.5 m depth. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
BH 1	79.44	1.36	78.08	July 12, 2018
BH 2	78.59	0.93	77.66	July 12, 2018
BH 3	78.88	2.31	76.57	July 12, 2018
BH 4	75.89	1.85	74.04	July 12, 2018
BH 5	79.16	1.65	77.51	July 12, 2018
BH 6	77.99	1.04	76.95	July 12, 2018
BH 7	79.20	3.09	76.11	July 12, 2018
BH 8	72.56	0.79	71.77	July 12, 2018
BH 11	69.43	1.51	67.92	July 12, 2018
BH 12	67.58	1.20	66.38	July 12, 2018
BH 13	65.95	1.09	64.86	July 12, 2018
BH 14	78.85	1.27	77.58	July 12, 2018
BH 15	77.56	1.43	76.13	July 12, 2018
BH 16	74.85	2.80	72.05	July 12, 2018
BH 18	69.78	1.11	68.67	July 12, 2018
BH 20	69.37	1.51	67.86	July 12, 2018

Table 1 - Summary of Groundwater Level Readings (Continued)

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
BH 21	66.25	0.85	65.40	July 12, 2018
BH 22	65.61	1.10	64.51	July 12, 2018
BH 23	78.70	1.35	77.35	July 12, 2018
BH 24	77.03	1.06	75.97	July 12, 2018
BH 25	74.86	2.49	72.37	July 12, 2018
BH 29	68.94	1.47	67.47	July 12, 2018
BH 30	66.95	1.07	65.88	July 12, 2018
BH 31	66.06	0.92	65.14	July 12, 2018
BH 32	76.95	Dry	-	July 12, 2018
BH 33	71.39	Dry	-	July 12, 2018
BH 37	68.89	1.26	67.63	July 12, 2018
BH 38	67.01	1.15	65.95	July 12, 2018
BH 40*	79.19	4.44	74.75	July 12, 2018
BH 41*	78.67	4.28	74.39	July 12, 2018
BH 42*	73.50	4.04	69.46	July 12, 2018

Note: - * Denotes borehole instrumented with a 51 mm diameter monitoring well.
-The ground surface at the test hole locations is referenced to an assumed geodetic datum.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the anticipated development. It is expected that low rise, wood framed buildings could be founded on conventional shallow footings placed on an undisturbed, silty sand, silty clay, glacial till or surface-sounded bedrock bearing surface.

Should existing grades be raised at the site for the proposed development, it is expected that several options, such as engineered fill or well graded blast rock, would act as suitable subgrade material for the proposed buildings provided the material is adequately placed and approved by the geotechnical consultant at the time of placement.

A permissible grade raise restriction is required for grading around the proposed buildings where the silty clay layer is present.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, and any deleterious fill, such as those containing organic materials, should be stripped from under any buildings and other settlement sensitive structures.

Existing foundation walls and other construction debris should be entirely removed from within the perimeter of the proposed buildings. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 m below final grade.

Fill Placement

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

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts compacted by the tracks of the spreading equipment to minimize voids. If the material is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 2 m wide, and pad footings, up to 4 m wide, placed on an undisturbed, compact silty sand or stiff to firm silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**.

Footings placed on an undisturbed, glacial till bearing surface can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **225 kPa**.

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

Footings placed on a clean, weathered bedrock surface can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **750 kPa**. A clean, weathered bedrock surface consists of one from which all topsoil, soils, deleterious materials and loose rock have been removed prior to concrete placement.

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

Footings designed using the bearing resistance value at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support. Adequate lateral support is provided to a silty sand, silty clay or glacial till bearing medium when a plane extending down and out from the bottom edge of the footing, at a minimum of 1.5H:1V.

Permissible Grade Raise Restrictions

Consideration must also be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For buildings, a minimum value of 50% of the live load is often recommended by Paterson. A post-development groundwater lowering of 0.5 m was assumed.

Based on in-situ undrained shear strength testing results within the silty clay deposit, a permissible grade raise restriction of **3 m** is recommended for areas where building foundations are founded over a silty clay deposit. Footings bearing on the glacial till deposit or bedrock are not subjected to permissible grade raise restrictions.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

The subject site can be taken as seismic site response **Class C** as defined in the Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012 for foundations considered at this site. A site specific shear wave velocity test may be completed to accurately determine the applicable seismic site classification for foundation design of the proposed residential development.

The soils underlying the site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab / Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill from within the footprint of the proposed buildings, the native soil surface or approved engineered fill surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

For any structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

5.6 Pavement Structure

For design purposes, the following pavement structures presented below could be used for the design of car parking areas, bus turning areas and access lanes. It is anticipated that both pavement structures provided would be adequate for use as a fire route.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 3 - Recommended Pavement Structure
Local Roads

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

Table 4 - Recommended Pavement Structure - Bus Routes

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

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. Paving is to be completed in accordance with MTO OPSS 1151 and 310 or applicable City of Ottawa standards.

For residential driveways and car only parking areas, an Ontario Traffic Category A will be used. For local roadways, an Ontario Traffic Category B should be used for design purposes.

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

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable compaction equipment.

Pavement Structure Drainage

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

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

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated and corrugated plastic pipe surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as Miradrain G100N) connected to a drainage system is provided.

Dependent on the basement slab depths of the proposed structures, under-floor drains may be required for the proposed buildings. The under-floor drains should consist of 100 to 150 mm diameter, geotextile-wrapped, perforated and corrugated plastic pipe embedded in the 200 mm thickness of 19 mm clear crushed stone underlying the basement slabs. The spacing of the under-floor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

6.2 Protection Against Frost Action

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

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

6.3 Excavation Side Slopes

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

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

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

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

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

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with City of Ottawa standards and specifications.

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. The bedding material should extend at a minimum to the spring line of the pipe.

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

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

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should consist of 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 SPMDD.

6.5 Groundwater Control

The groundwater infiltration into the excavations should be low to moderate depending on the subsurface soil conditions. The contractor should be prepared to collect and pump groundwater infiltration volumes from the excavation trenches.

A temporary MOECC permit to take water (PTTW) may be required if more than 50,000 L/day are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOECC.

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

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

6.6 Winter Construction

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

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

The trench excavations should be constructed 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 during construction. 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.

6.7 Corrosion Potential and Sulphate

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

6.8 Tree Planting Restrictions

The silty clay deposit encountered at the site was hard to firm and is considered to be low to medium sensitivity clay and should not be considered a sensitive marine clay. Where footings are founded over a silty clay bearing surface, it is recommended that trees placed within 4.5 m of the foundation wall consist of low water demanding trees with shallow roots systems that extend less than 1.5 m below ground surface. Trees placed greater than 4.5 m from the foundation wall may consist of typical street trees, which are typically moderate water demand species with roots extending to a maximum depth of 2 m below ground surface. It should be noted that shrubs and other small plantings are permitted within the 4.5 m setback area.

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.

6.9 Slope Stability Analysis

Slope Conditions

Based on our field observations and available topographic mapping, the subject slopes in the vicinity of the watercourse and in the western portion of the site are stable with no signs of active erosion and are sloped at 8H:1V slope or less. Boreholes in close proximity to the existing slopes were analyzed to determine the subsurface soil conditions for our analysis.

Slope Stability Analysis

The slope stability analysis was modeled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop's method, which is a widely accepted slope analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the slope failure would comprise permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16 g was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

Four (4) slope cross-sections (Sections A, B, C, and D) were studied as the worst case scenarios. The cross section locations are presented on Drawing PG4554-1 - Test Hole Location Plan in Appendix 2. It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 2 through 9 in Appendix 2 from the topographic data identified on Drawing PG4554-1 - Test Hole Location Plan in Appendix 2.

Stable Slope Allowance

The static analysis results for slope sections A, B, C, and D are presented in Figures 2, 4, 6, and 8, respectively, provided in Appendix 2. The factor of safety for the slopes was greater than 1.5 for the slope sections analysed.

The results of the analyses with seismic loading are shown in Figures 3, 5, 7, and 9 presented in Appendix 2. The results indicate that the factor of safety for the sections are greater than 1.1. Based on these results, the slopes are considered to be stable under seismic loading.

As the slopes were determined to be stable under static and seismic conditions for the sections analyzed, a stable slope allowance is not considered to be required.

Toe Erosion and Erosion Access Allowance

The slopes were generally observed to be vegetated with trees and brush. Further, flow from the creek in the watercourse at the base of the slopes was observed to be minimal, with no signs of active erosion observed at the toe of the slopes. In consideration of these observations, a toe erosion allowance is not considered to be required for these slopes.

For the approximately 6 m slope in the western portion of the site (Sections A and B), given that no watercourse is present near the toe of the slope and no signs of active erosion were observed, an erosion access allowance is not considered to be required for this slope.

A 6 m erosion access allowance is recommended to be applied from the top of stable slope for the slopes adjacent to the existing watercourse (Section C and D), to allow for future maintenance of the slopes.

Limit of Hazard Lands

The limit of hazard lands setback lines for the proposed development are presented on Drawing PG4554-2 - Limit of Hazard Lands in Appendix 2. The limit of hazard lands lines consists of a 6 m erosion access allowance taken from the top of stable slopes adjacent to the watercourse. No hazard lands are required for the approximately 6 m slope in the western portion of the site.

It is recommended that the existing vegetation and mature trees not be removed from the slope faces as the presence of the vegetation reduces surficial erosion activities. If the existing vegetation needs to be removed along the slope faces, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed or an erosional control blanket be placed across the exposed slope face.

7.0 Recommendations

The following is recommended to be completed once the site plan and development are determined:

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

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

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to ensure that the specified level of compaction has been achieved.

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

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

A report confirming the construction has been completed in general accordance with the recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test hole locations, we request immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Minto Communities or 2559688 Ontario Inc., or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Scott Dennis

Scott S. Dennis, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Nov. 28-2018
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG4554

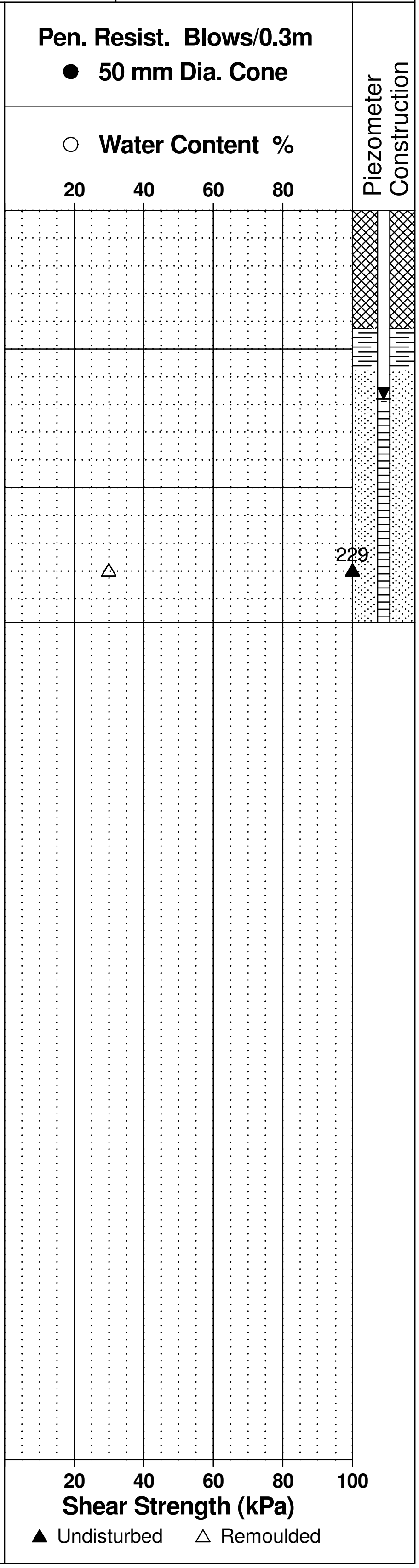
REMARKS

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger

DATE June 26, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE							
TOPSOIL 0.28		AU	1			0	79.44
Hard, grey **SILTY CLAY**		SS	2	100	10	1	78.44
		SS		1003	5	2	77.44
2.97							
End of Borehole Practical refusal to augering at 2.97m depth (GWL @ 1.36m - July 12, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 26, 2018

FILE NO. PG4554

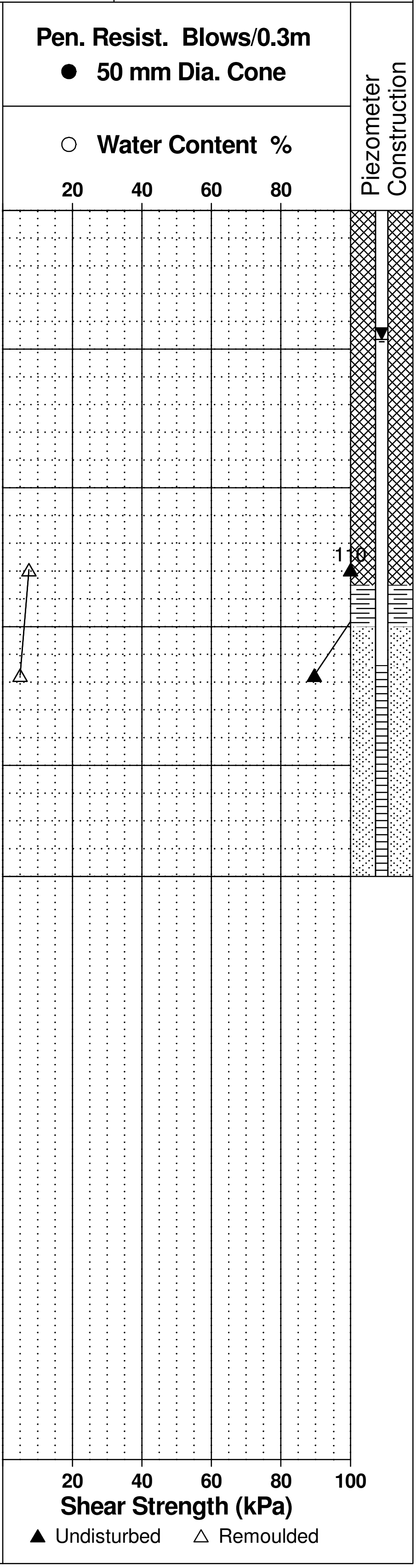
HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.59
TOPSOIL 0.28		AU	1				
Very stiff to stiff, grey **SILTY CLAY**		SS	2	96	7	1	77.59
		SS	3	100	4	2	76.59
3.81						3	75.59
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders		SS	4	79	5	4	74.59
4.80		SS	5	71	50+		

End of Borehole

Practical refusal to augering at 4.80m depth

(GWL @ 0.93m - July 12, 2018)



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Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

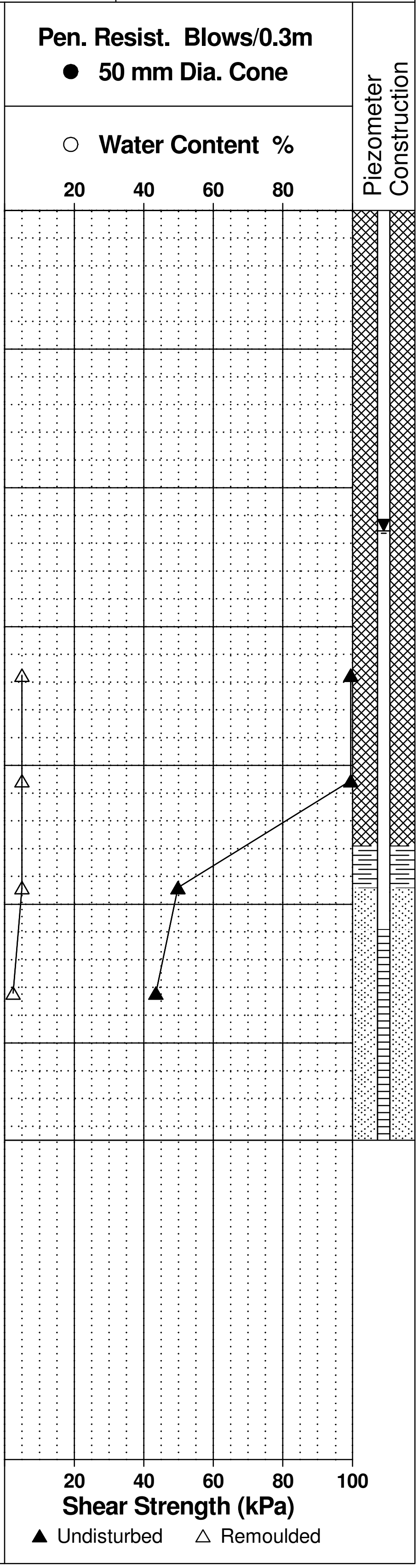
BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

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	78.88
TOPSOIL — 0.25		AU	1				
Loose, brown **SILTY SAND** — 1.07		SS	2	100	8	1	77.88
Stiff to firm, brown **SILTY CLAY** - grey by 2.3m depth		SS	3	100	9	2	76.88
		SS	4	100	4	3	75.88
						4	74.88
— 5.33						5	73.88
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders						6	72.88
— 6.70		SS	5	79	2		
End of Borehole (GWL @ 2.31m - July 12, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 26, 2018

FILE NO. PG4554

HOLE NO. BH 4

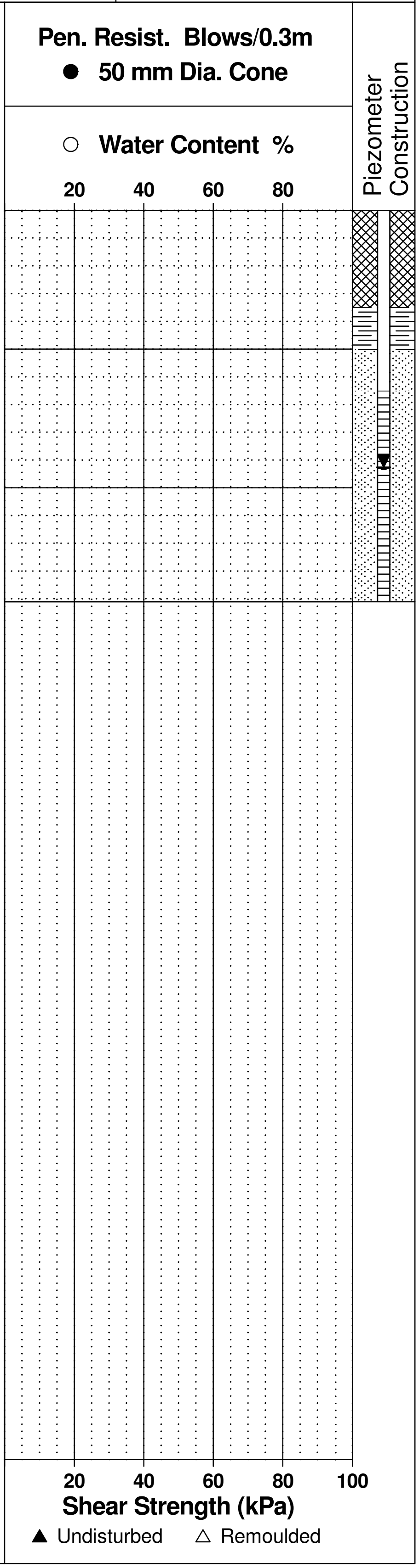
SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.23	AU	1		
Loose, brown **SAND,** trace silt	1.22	SS	2	83	7
Stiff to firm, brown **SILTY CLAY**	2.29	SS	3	100	4
GLACIAL TILL: Brown silty clay, some sand, gravel, cobbles, boulders	2.82	SS	4	80	10

DEPTH (m)	ELEV. (m)
0	75.89
1	74.89
2	73.89

End of Borehole

Practical refusal to augering at 2.82m depth

(GWL @ 1.85m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

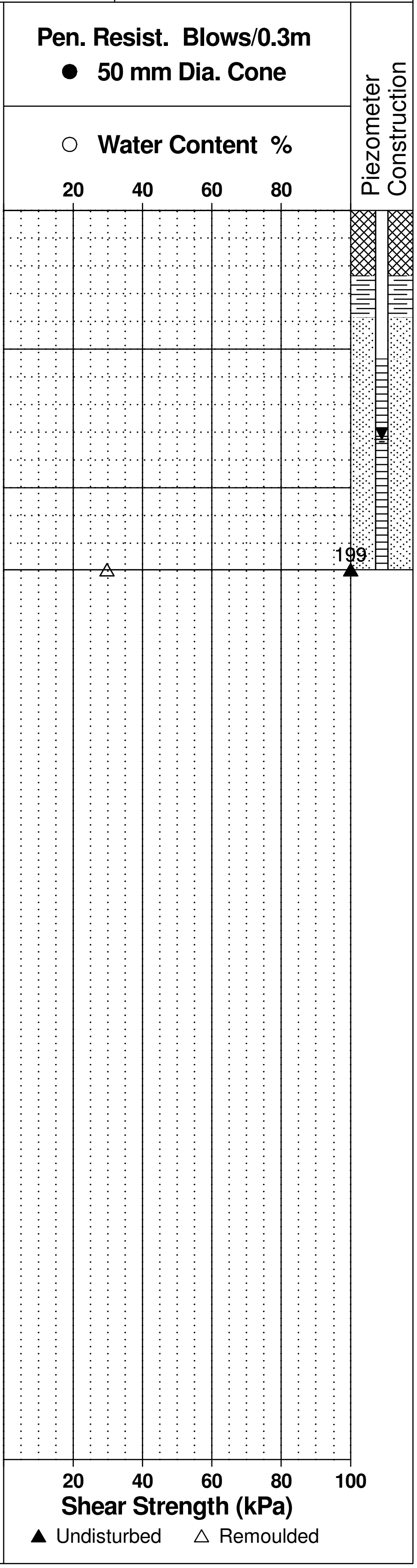
BORINGS BY CME 55 Power Auger

DATE June 26, 2018

FILE NO. PG4554

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	79.16
TOPSOIL 0.25		AU	1				
Very stiff, grey **SILTY CLAY**		SS	2	100	10	1	78.16
		SS	3	100	6	2	77.16
2.59							
End of Borehole Practical refusal to augering at 2.59m depth (GWL @ 1.65m - July 12, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 1, 2018

FILE NO. PG4554

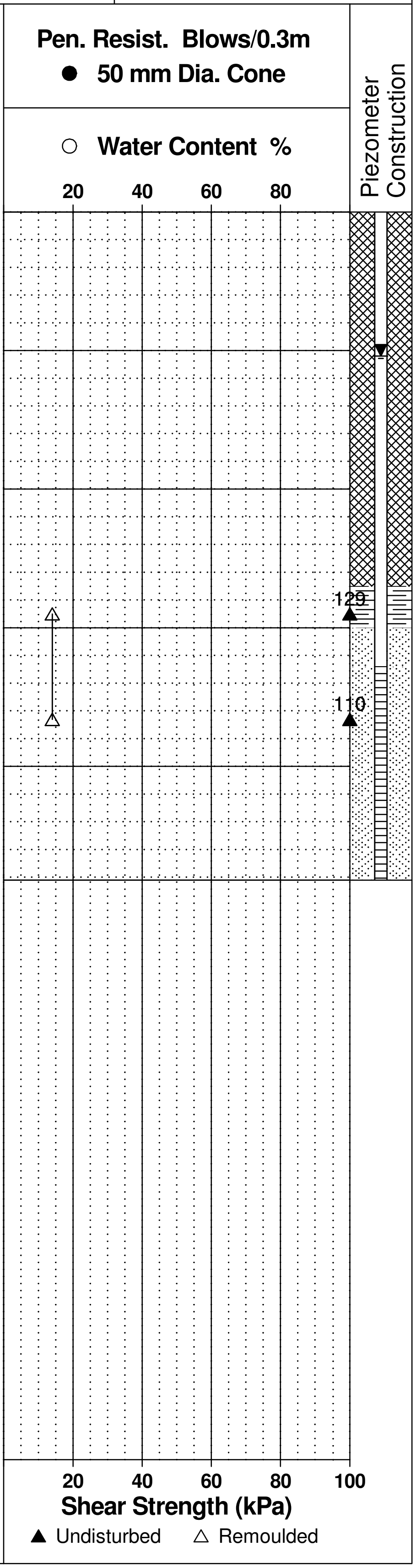
HOLE NO. BH 6

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	77.99
TOPSOIL (0.66)	AU	1				
Very stiff to stiff, grey **SILTY CLAY**	SS	2	92	4	1	76.99
	SS	3	54	6	2	75.99
					3	74.99
					4	73.99
(4.42)	SS	4	42	22		
GLACIAL TILL: Brown silty sand, some gravel, cobbles, boulders (4.82)	SS	5		50+		

End of Borehole

Practical refusal to augering at 4.82m depth

(GWL @ 1.04m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

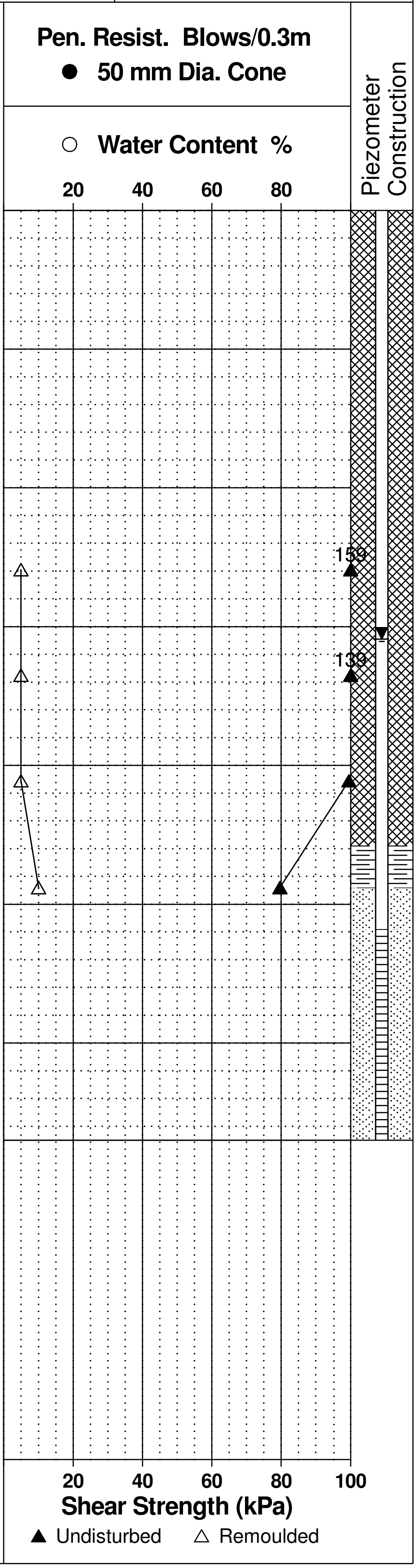
DATE June 26, 2018

FILE NO. PG4554

HOLE NO. BH 7

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25	AU	1		
Loose, brown **SAND,** some silt	1.52	SS	2	100	7
Very stiff to stiff, grey **SILTY CLAY**	5.33	SS	3	100	7
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders	6.70	SS	4	71	8
End of Borehole					
(GWL @ 3.09m - July 12, 2018)					

DEPTH (m)	ELEV. (m)
0	79.20
1	78.20
2	77.20
3	76.20
4	75.20
5	74.20
6	73.20



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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

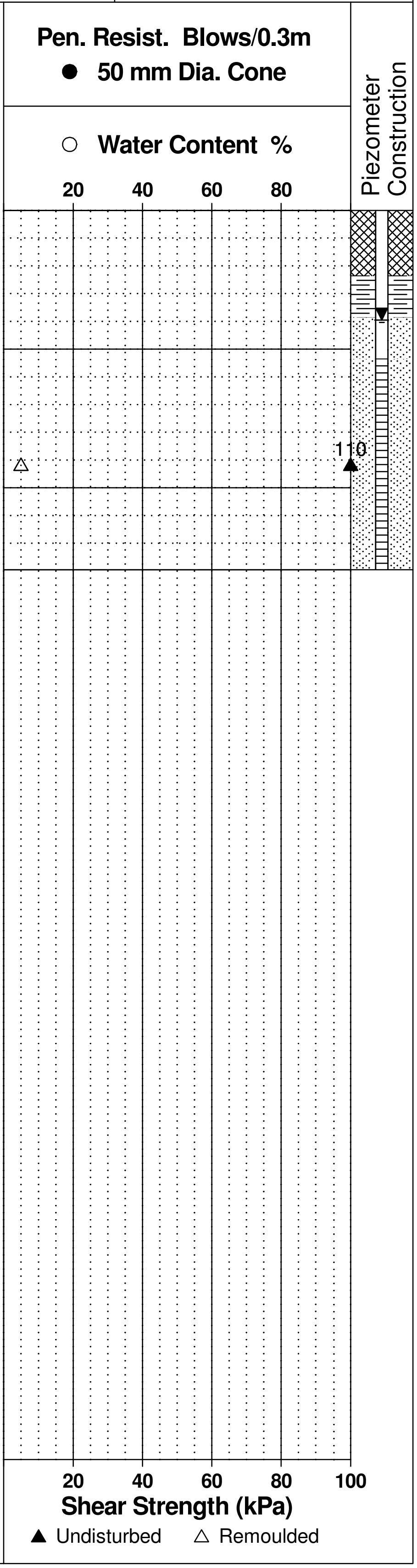
HOLE NO. BH 8

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	72.56
TOPSOIL 0.30	AU	1				
Very stiff, grey **SILTY CLAY**	SS	2	83	5	1	71.56
2.29					2	70.56
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders 2.59	SS	3	85	50+		

End of Borehole

Practical refusal to augering at 2.59m depth

(GWL @ 0.79m - July 12, 2018)



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FILE NO. PG4554

REMARKS

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger

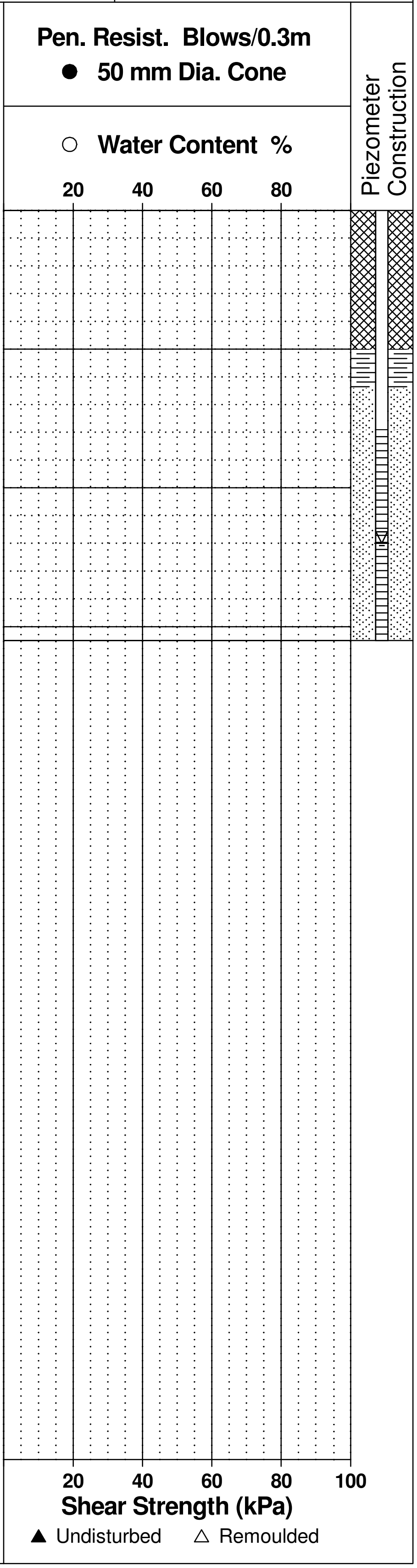
DATE June 28, 2018

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	69.71
TOPSOIL 0.15	AU	1				
Loose, brown **SILTY SAND,** trace clay 0.76	AU	2				
					1	68.71
Firm, grey **SILTY CLAY** 1.68	SS	3	100	3		
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders	SS	4	58	3		
					2	67.71
	SS	5	62	14		
					3	66.71
3.10	SS	6	100	50+		

End of Borehole

Practical refusal to augering at 3.10m depth

(GWL @ 2.4m depth based on field observations)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

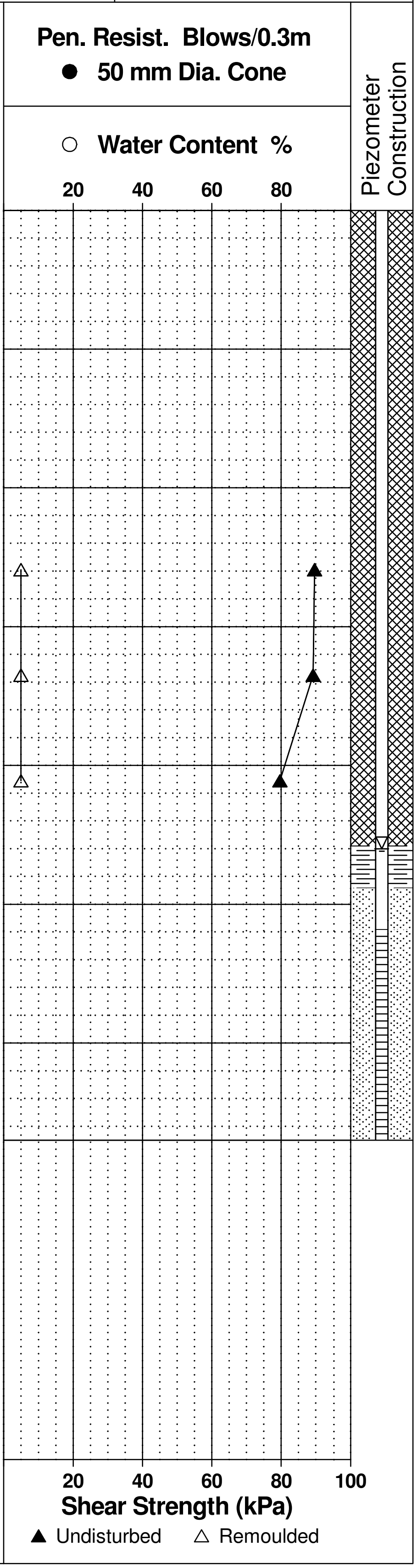
BORINGS BY CME 55 Power Auger

DATE June 28, 2018

FILE NO. PG4554

HOLE NO. BH10

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	69.60
TOPSOIL	0.15	AU	1				
Brown **SILTY SAND,** trace clay	0.71	AU	2				
Stiff, grey **SILTY CLAY**		SS	3	100	6	1	68.60
		SS	4	100	2		
						2	67.60
						3	66.60
						4	65.60
	4.57						
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders		SS	5	75	11	5	64.60
		SS	6	79	20		
						6	63.60
	6.70	SS	7	71	68		
End of Borehole (GWL @ 4.6m depth based on field observations)							



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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE July 3, 2018

FILE NO. PG4554

HOLE NO. BH11

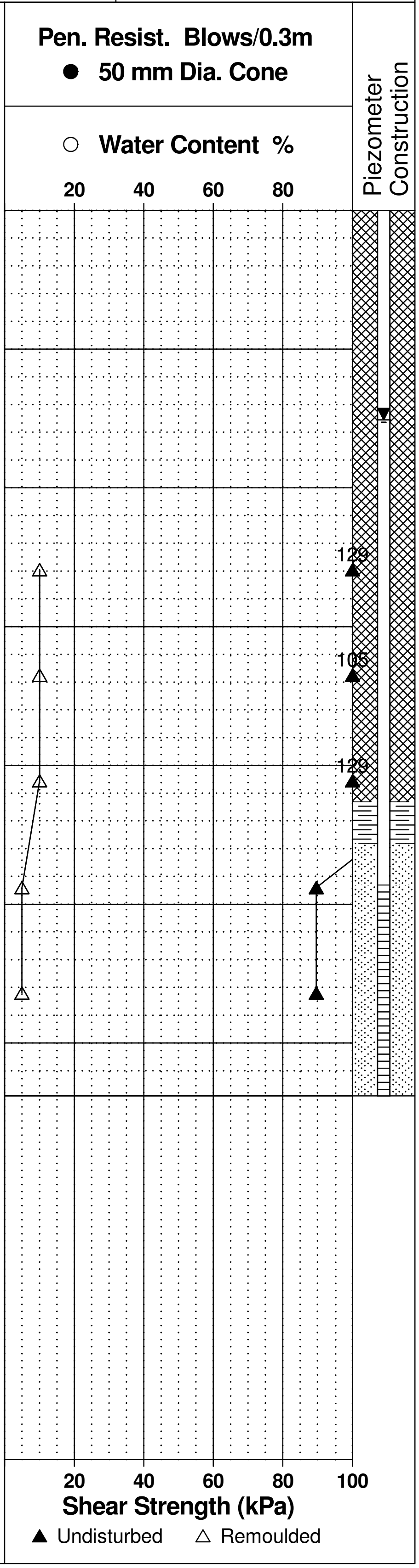
SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.60	AU	1		
	SS	2	96	7
	SS	3	92	2
Very stiff to stiff, brown **SILTY CLAY**				
- grey by 3.8m depth 6.10				
GLACIAL TILL: Grey silty sand, some gravel, cobbles, boulders, trace clay 6.38	SS	4	73	50+

End of Borehole

Practical refusal to augering at 6.38m depth

(GWL @ 1.51m - July 12, 2018)

DEPTH (m)	ELEV. (m)
0	69.43
1	68.43
2	67.43
3	66.43
4	65.43
5	64.43
6	63.43



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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE July 3, 2018

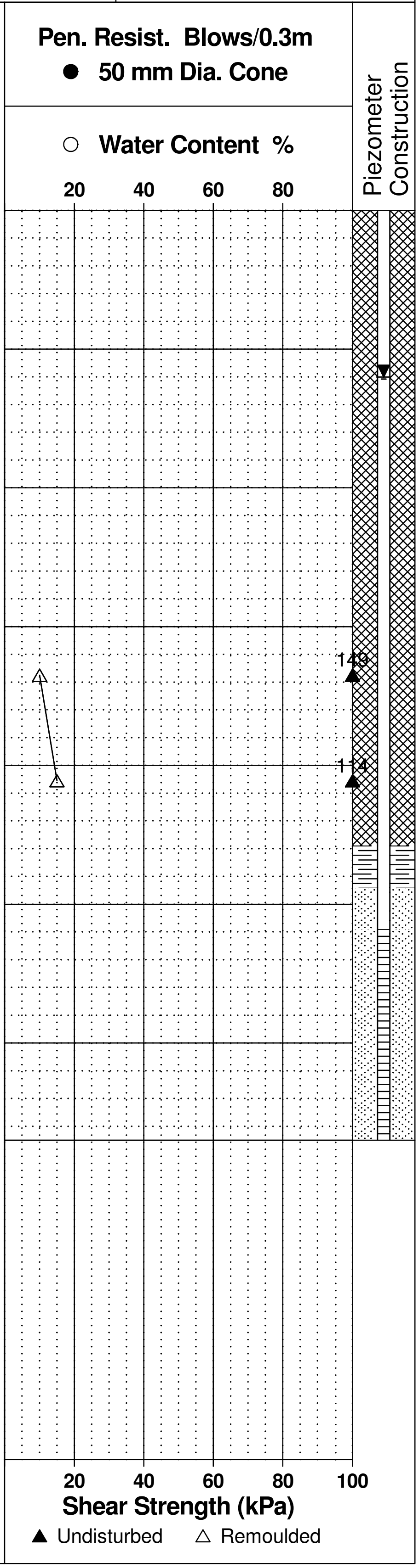
FILE NO. PG4554

HOLE NO. BH12

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.28
Loose, brown **SILTY SAND**	0.76
Very stiff, brown **SILTY CLAY** - grey by 2.3m depth	4.57
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	6.70
End of Borehole (GWL @ 1.20m - July 12, 2018)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	96	7
SS	3	96	7
SS	4		6
SS	5	12	10
SS	6	75	25

DEPTH (m)	ELEV. (m)
0	67.58
1	66.58
2	65.58
3	64.58
4	63.58
5	62.58
6	61.58



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REMARKS

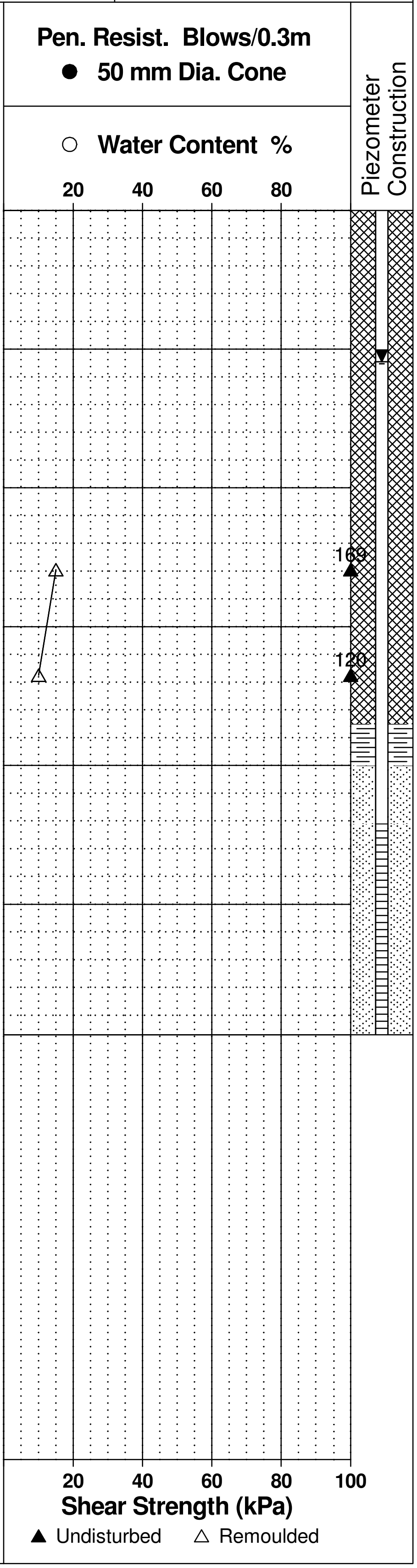
BORINGS BY CME 55 Power Auger

DATE July 2, 2018

FILE NO. PG4554

HOLE NO. BH13

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	65.95
TOPSOIL 0.15	AU	1				
Very stiff, brown **SILTY CLAY** - grey by 1.8m depth	SS	2	88	8	1	64.95
	SS	3	96	4	2	63.95
					3	62.95
3.81						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders	SS	4	69	9	4	61.95
	SS	5	88	12	5	60.95
	SS	6	62	18		
5.94						
End of Borehole (GWL @ 1.09m - July 12, 2018)						



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Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG4554

REMARKS

HOLE NO. BH14

BORINGS BY CME 55 Power Auger

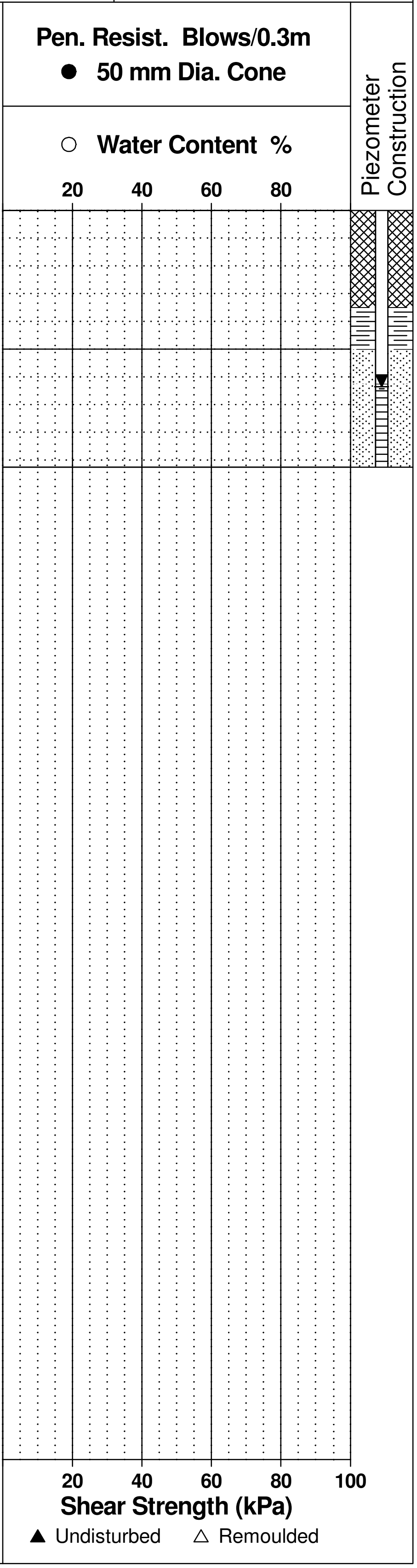
DATE June 26, 2018

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	78.85
TOPSOIL 0.28	AU	1				
Very stiff, grey **SILTY CLAY**	SS	2	100	10	1	77.85
1.85	SS	3	100	50+		

End of Borehole

Practical refusal to augering at 1.85m depth

(GWL @ 1.27m - July 12, 2018)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 26, 2018

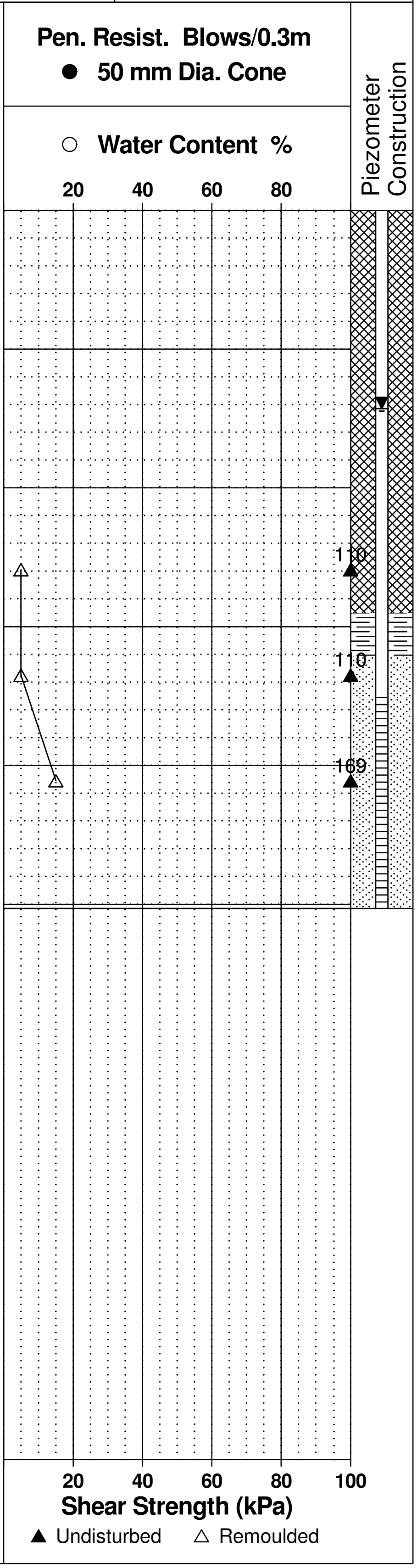
FILE NO. PG4554

HOLE NO. BH15

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	77.56
TOPSOIL 0.15	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	100	11	1	76.56
- grey by 1.5m depth	SS	3	100	4		
					2	75.56
					3	74.56
					4	73.56
4.57						
GLACIAL TILL: Grey sandy silt, some gravel, trace clay, cobbles, boulders 5.03	SS	4	85	50+	5	72.56
End of Borehole						

Practical refusal to augering at 5.03m depth

(GWL @ 1.43m - July 12, 2018)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

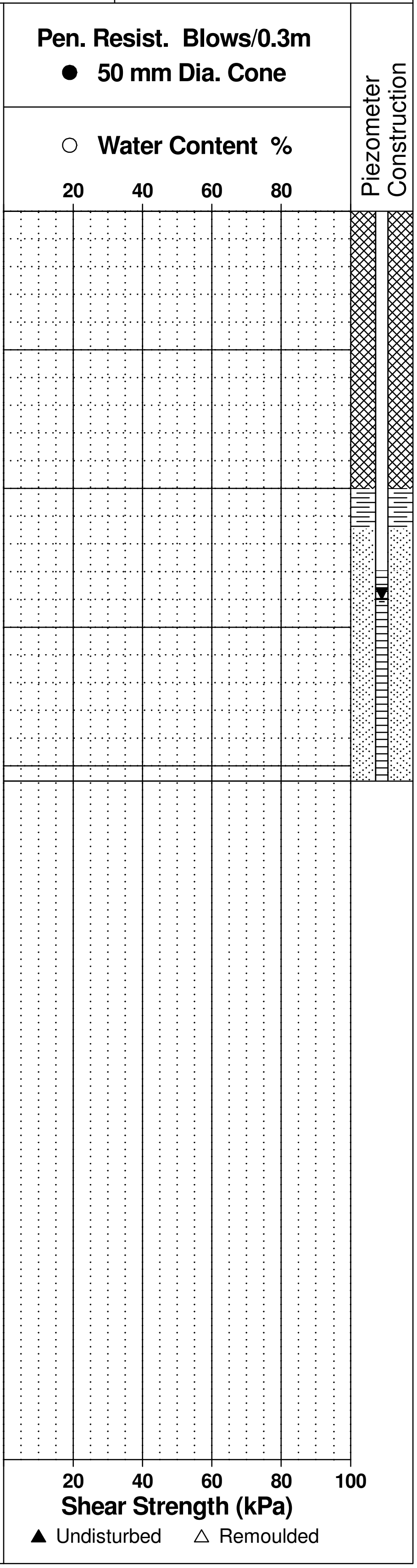
HOLE NO. BH16

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	74.85
TOPSOIL (to 0.53)	AU	1				
Very stiff, grey **SILTY CLAY** (0.53 to 4.11)	SS	2	100	8	1	73.85
	SS	3	100	12	2	72.85
	SS	4	100	10		
	SS	5	100	8	3	71.85
	SS	6	100	50+	4	70.85

End of Borehole

Practical refusal to augering at 4.11m depth

(GWL @ 2.80m - July 12, 2018)



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REMARKS

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DATE June 27, 2018

FILE NO. PG4554

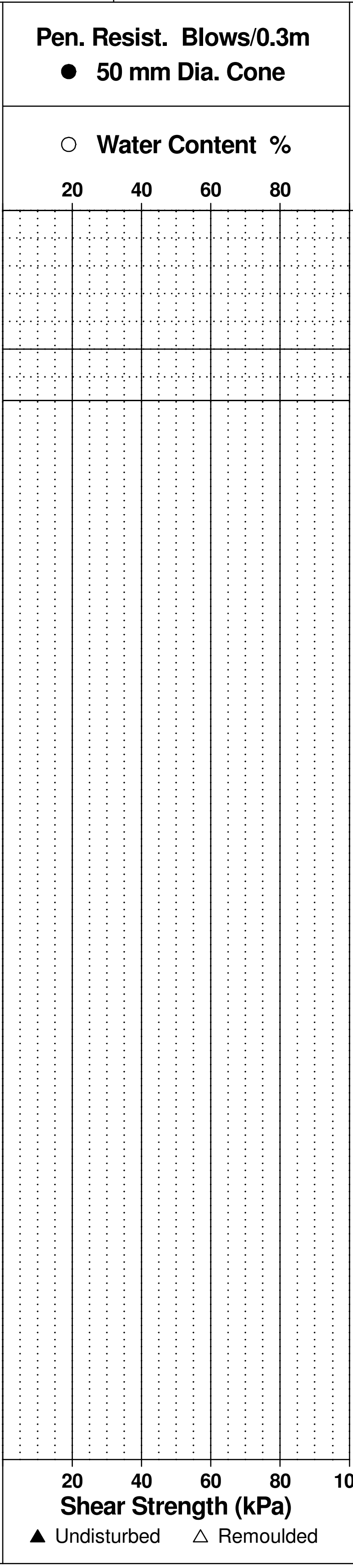
HOLE NO. BH17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	69.99	
TOPSOIL 0.30	■	AU	1					
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders 1.37	^^^	SS	2	100	5	1	68.99	

End of Borehole

Practical refusal to augering at 1.37m depth

(BH dry upon completion)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

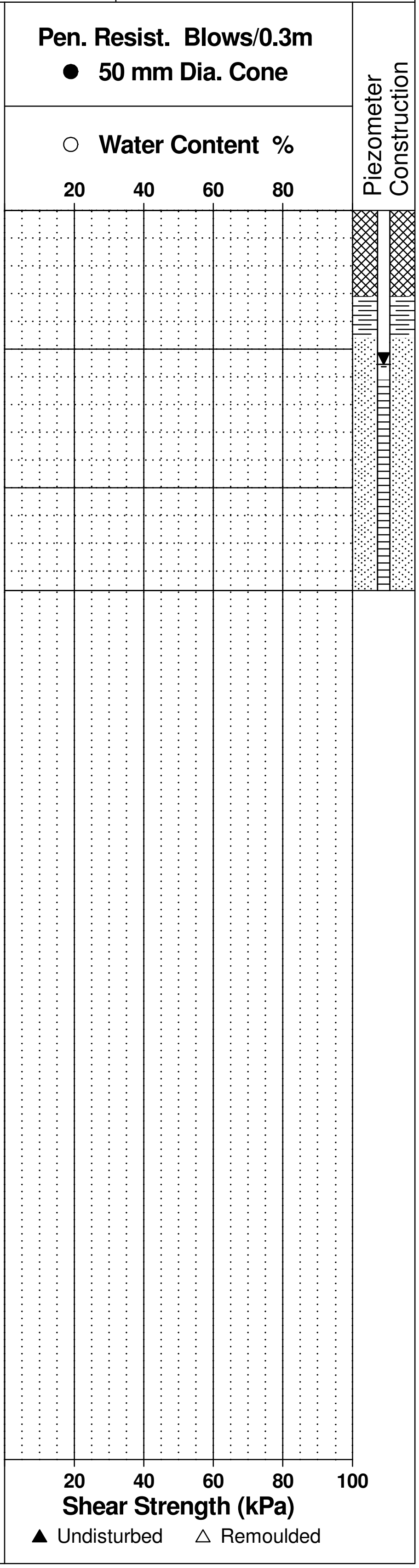
HOLE NO. BH18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	69.78
TOPSOIL 0.28		AU	1				
Very stiff, grey **SILTY CLAY** 1.52		SS	2	100	2	1	68.78
GLACIAL TILL: Grey clayey silt, some sand, trace gravel, cobbles, boulders 2.74		SS	3	100	50+	2	67.78

End of Borehole

Practical refusal to augering at 2.74m depth

(GWL @ 1.11m - July 12, 2018)



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Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4554**

REMARKS

HOLE NO. **BH19**

BORINGS BY CME 55 Power Auger

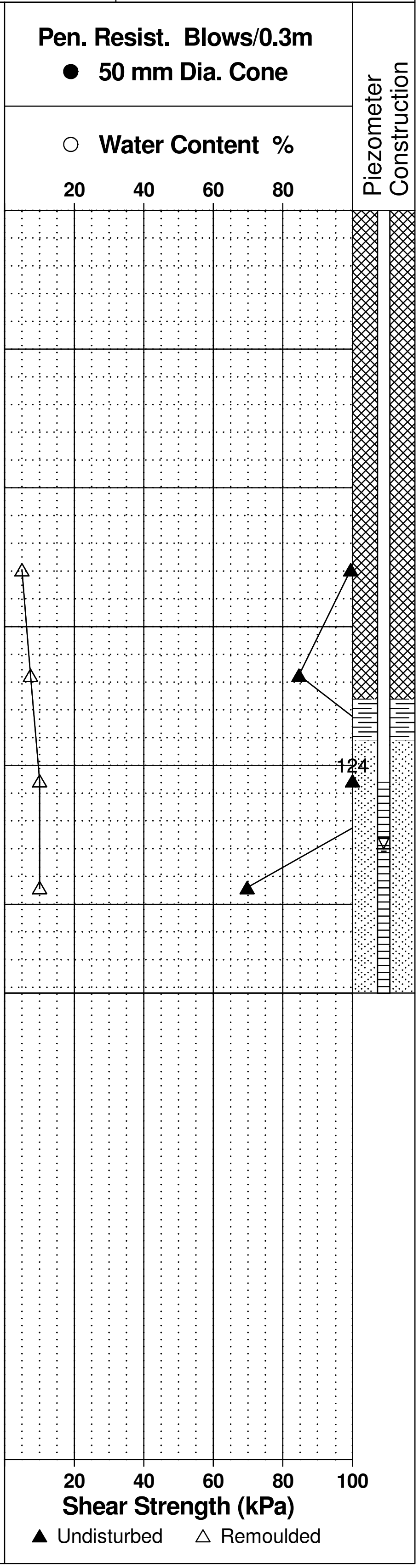
DATE June 28, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	69.39
TOPSOIL 0.15		AU	1				
Loose, brown **SILTY SAND,** trace clay 0.76		AU	2				
		SS	3	0	6	1	68.39
		SS	4	100	4	2	67.39
Very stiff to stiff, grey **SILTY CLAY**						3	66.39
						4	65.39
5.33						5	64.39
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles,boulders 5.64							

End of Borehole

Practical refusal to augering at 5.64m depth

(GWL @ 4.6m depth based on field observations)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 3, 2018

FILE NO. PG4554

HOLE NO. BH20

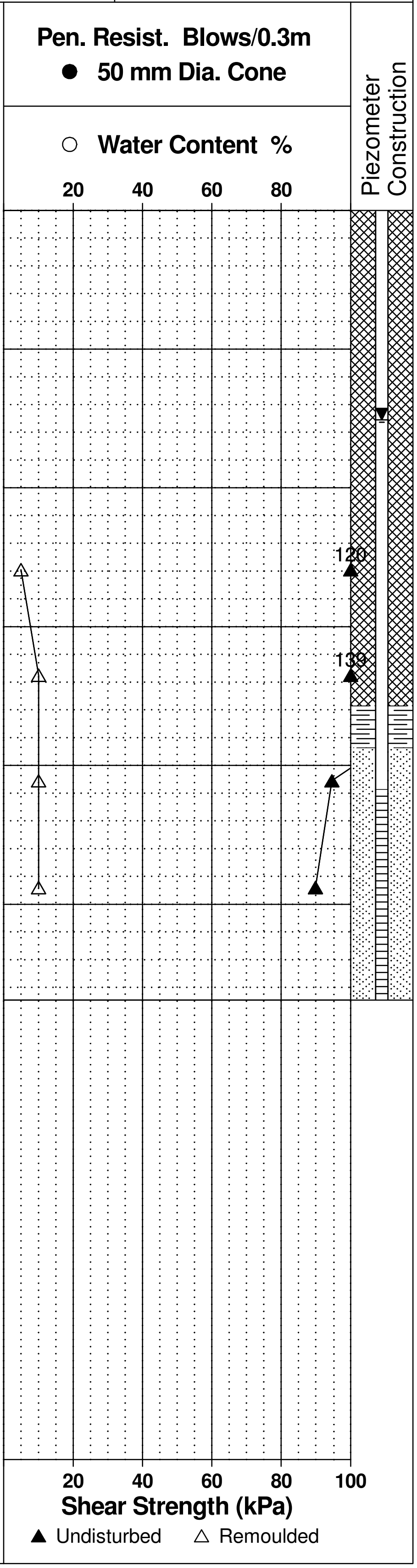
SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.28	AU	1		
Compact, brown **SILTY SAND,** trace clay	1.37	SS	2	79	11
Very stiff to stiff, brown **SILTY CLAY** - grey by 2.3m depth	5.18	SS	3	96	3
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	5.69	SS	4	100	50+

End of Borehole

Practical refusal to augering at 5.69m depth

(GWL @ 1.51m - July 12, 2018)

DEPTH (m)	ELEV. (m)
0	69.37
1	68.37
2	67.37
3	66.37
4	65.37
5	64.37



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

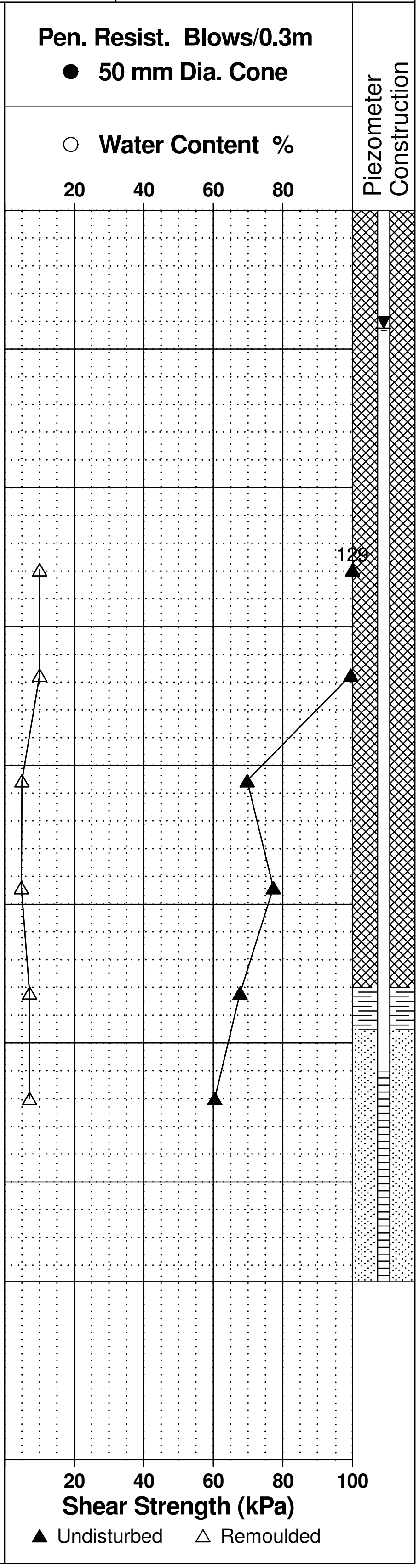
HOLE NO. BH21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.23					0	66.25
	AU	1				
	SS	2	100	10	1	65.25
	SS	3	100	4	2	64.25
					3	63.25
Very stiff to stiff, grey **SILTY CLAY**						
					4	62.25
					5	61.25
					6	60.25
6.86						
					7	59.25
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders						
7.72	SS	4	100	50+		

End of Borehole

Practical refusal to augering at 7.72m depth

(GWL @ 0.85m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

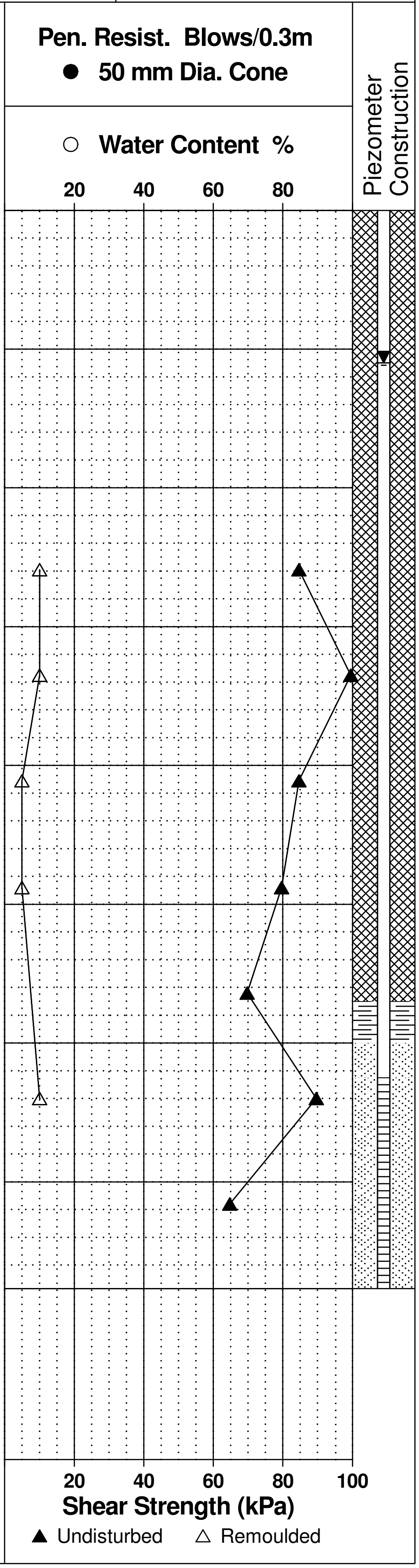
BORINGS BY CME 55 Power Auger

DATE July 3, 2018

FILE NO. PG4554

HOLE NO. BH22

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.25					0	65.61
	AU	1				
Very stiff to stiff, brown **SILTY CLAY**					1	64.61
	SS	2	96	10		
- grey by 1.4m depth	SS	3	96	5		
					2	63.61
					3	62.61
					4	61.61
					5	60.61
					6	59.61
					7	58.61
7.77	SS	4	83	50+		
End of Borehole Practical refusal to augering at 7.77m depth (GWL @ 1.10m - July 12, 2018)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

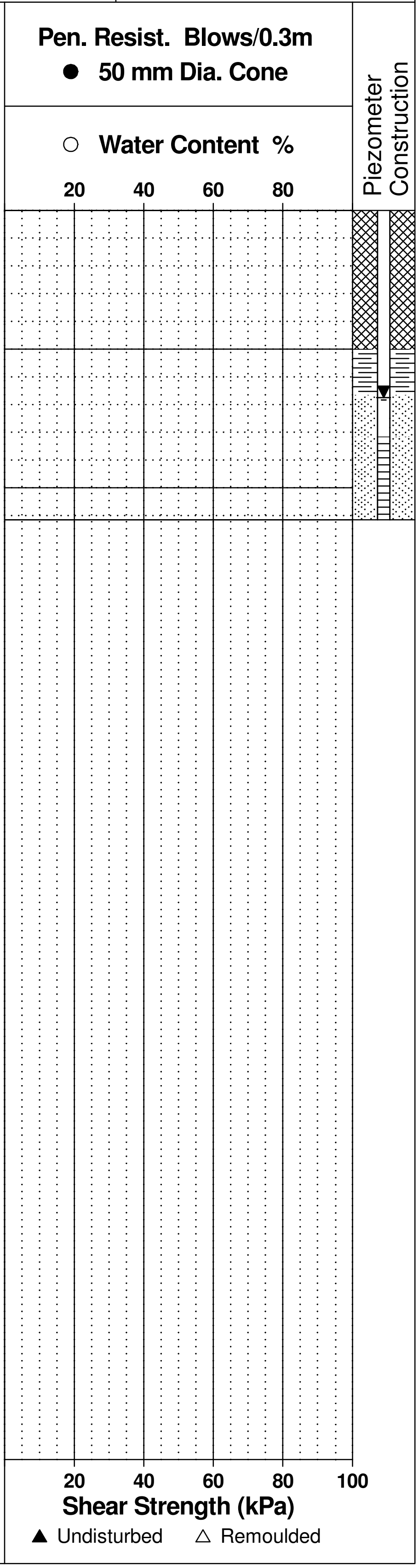
BORINGS BY CME 55 Power Auger

DATE July 3, 2018

FILE NO. PG4554

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	78.70
TOPSOIL 0.20		AU	1				
Very stiff, brown **SILTY CLAY**		SS	2	69	11	1	77.70
1.52							
GLACIAL TILL: Brown silty clay with gravel, sand, cobbles, boulders 2.23		SS	3	50	11	2	76.70
End of Borehole Practical refusal to augering at 2.23m depth (GWL @ 1.35m - July 12, 2018)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

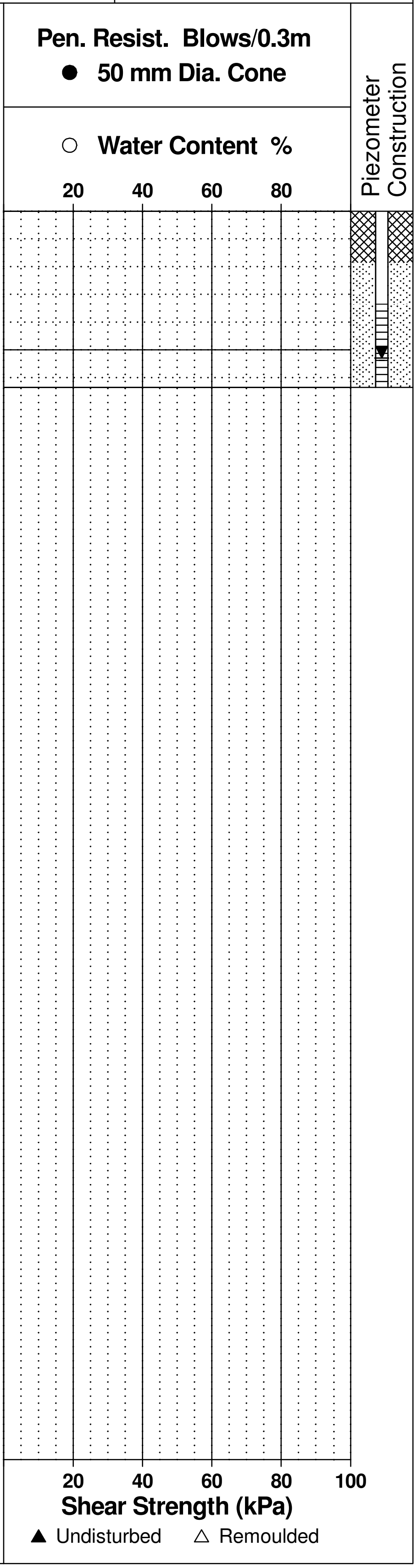
BORINGS BY CME 55 Power Auger

DATE June 26, 2018

FILE NO. PG4554

HOLE NO. BH24

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	77.03
TOPSOIL 0.30		AU	1				
Very stiff, brown **SILTY CLAY** 1.27		SS	2		6	1	76.03
End of Borehole Practical refusal to augering at 1.27m depth (GWL @ 1.06m - July 12, 2018)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4554**

REMARKS

HOLE NO. **BH25**

BORINGS BY CME 55 Power Auger

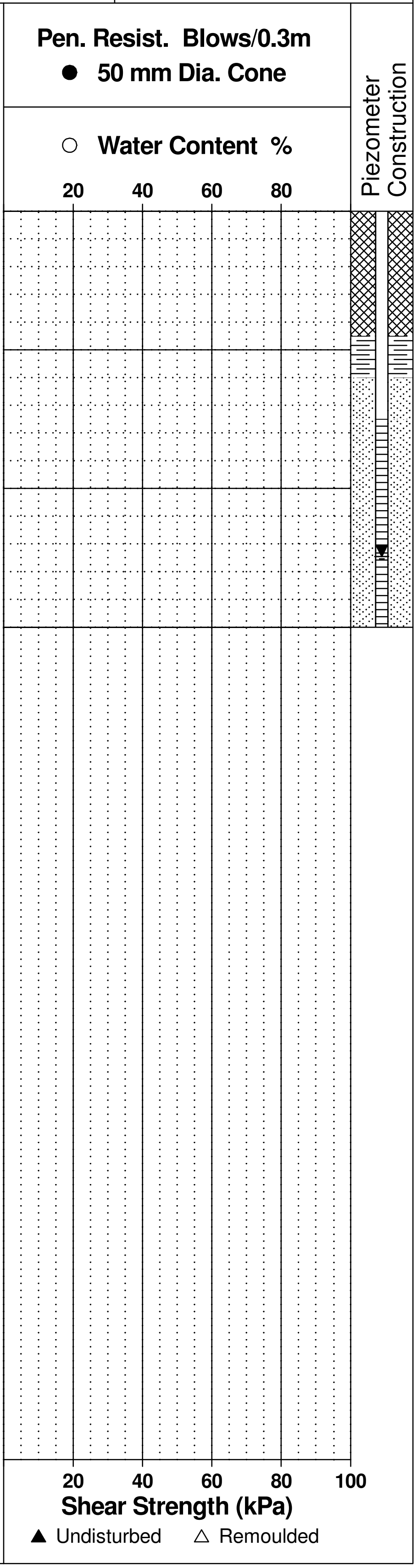
DATE June 27, 2018

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	74.86
TOPSOIL 0.53		AU	1				
Very stiff to stiff, grey **SILTY CLAY**		SS	2	100	12	1	73.86
		SS	3	100	10	2	72.86
3.00		SS	4	100	8	3	71.86

End of Borehole

Practical refusal to augering at 3.00m depth

(GWL @ 2.49m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

HOLE NO. BH26

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	70.45		
TOPSOIL 0.28		AU	1						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders 1.45		SS	2	100	50+	1	69.45		
End of Borehole Practical refusal to augering at 1.45m depth (BH dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

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FILE NO. **PG4554**

REMARKS

BORINGS BY CME 55 Power Auger

DATE June 28, 2018

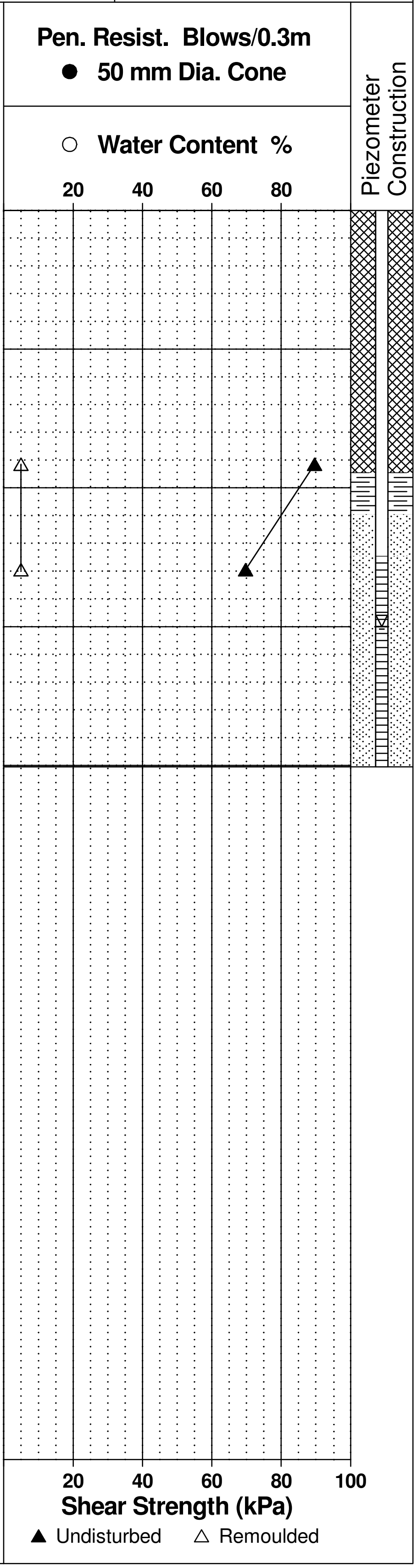
HOLE NO. **BH27**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	69.66
TOPSOIL 0.18		AU	1				
Loose, brown **SILTY SAND,** trace clay 0.76		AU	2				
Stiff, grey **SILTY CLAY**		SS	3	100	2	1	68.66
						2	67.66
3.05						3	66.66
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	4	83	17		
4.01		SS	5	86	50+	4	65.66

End of Borehole

Practical refusal to augering at 4.01m depth

(GWL @ 3.0m depth based on field observations)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

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FILE NO. **PG4554**

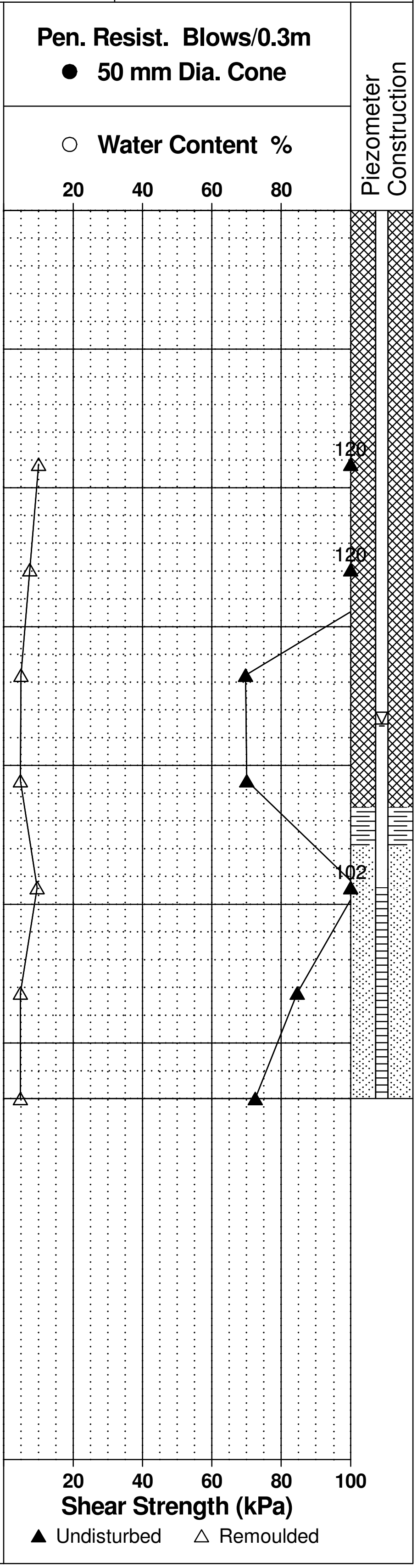
REMARKS

HOLE NO. **BH28**

BORINGS BY CME 55 Power Auger

DATE June 28, 2018

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	69.44
TOPSOIL 0.05	AU	1				
Loose, brown **SILTY SAND,** trace clay 0.76	AU	2				
	SS	3	100	5	1	68.44
					2	67.44
					3	66.44
Very stiff to stiff, brown **SILTY CLAY**						
					4	65.44
					5	64.44
					6	63.44
6.40						
End of Borehole (GWL @ 3.7m depth based on field observations)						



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SOIL PROFILE AND TEST DATA

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Prop. Residential Development - 936 March Road
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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

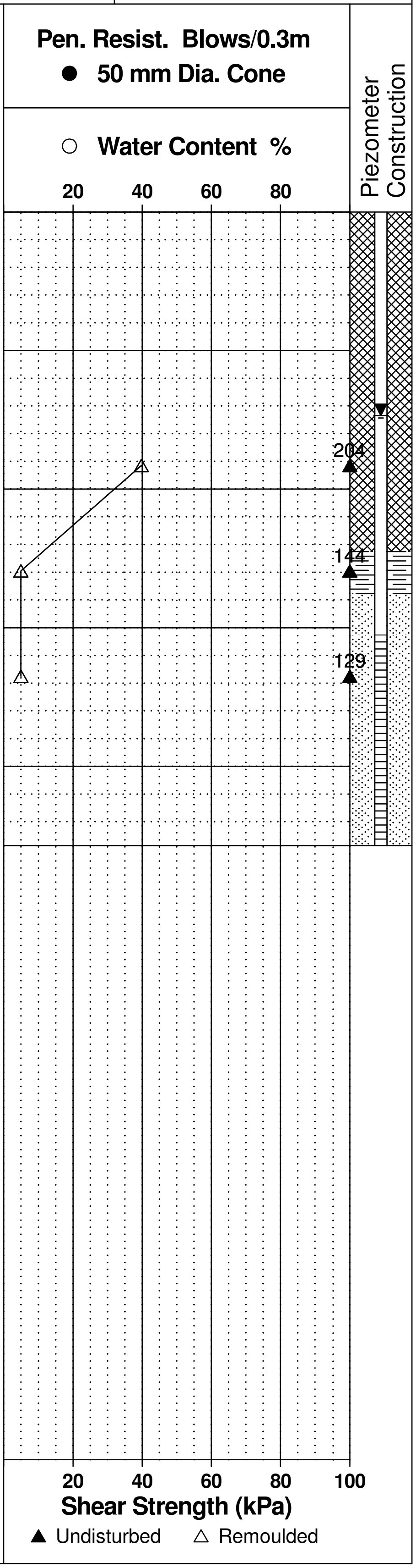
HOLE NO. BH29

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
TOPSOIL 0.20		AU	1			0	68.94
Loose, brown **SILTY SAND** 0.91		AU	2				
Hard to very stiff, grey **SILTY CLAY**		SS	3	100	8	1	67.94
						2	66.94
3.35						3	65.94
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders		SS	4	100	4	4	64.94
4.57							

End of Borehole

Practical refusal to augering at 4.57m depth

(GWL @ 1.47m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

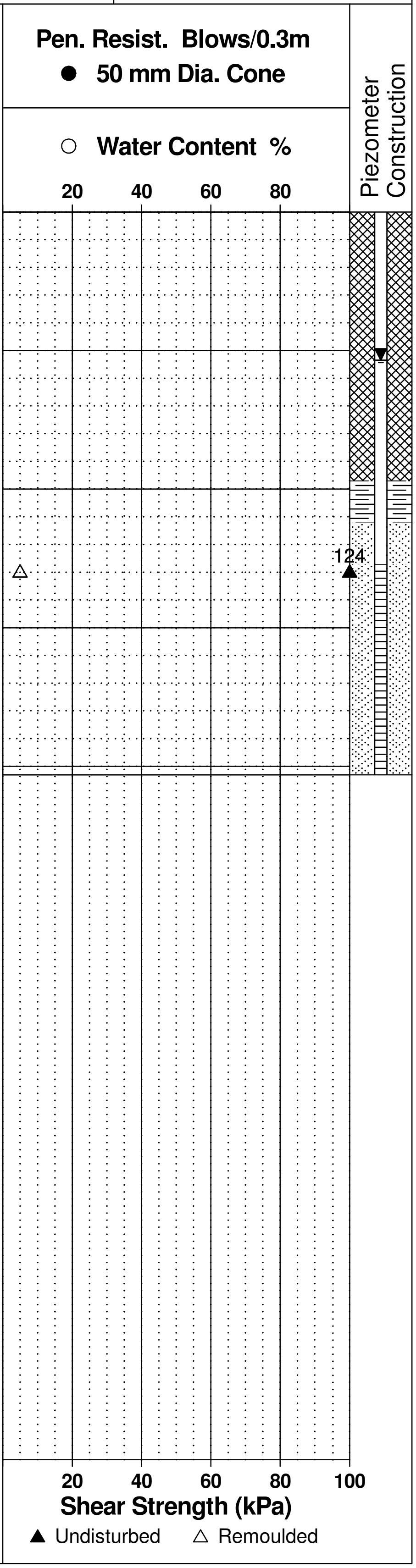
HOLE NO. BH30

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	66.95
TOPSOIL 0.23	AU	1				
Very stiff, grey **SILTY CLAY**	SS	2	100	7	1	65.95
	SS	3	100	4	2	64.95
2.74					3	63.95
GLACIAL TILL: Grey silty sand, trace clay, gravel, cobbles, boulders	SS	4	100	19		
4.06	SS	5	100	50+	4	62.95

End of Borehole

Practical refusal to augering at 4.06m depth

(GWL @ 1.07m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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Prop. Residential Development - 936 March Road
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

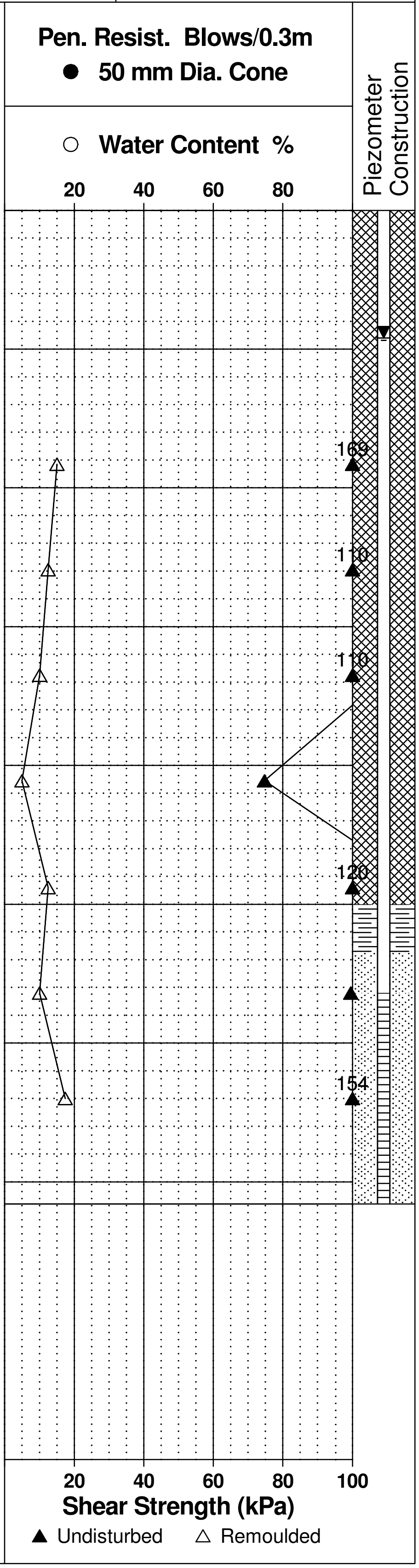
HOLE NO. BH31

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	66.06
TOPSOIL 0.25		AU	1				
		SS	2	100	7	1	65.06
						2	64.06
Very stiff to stiff, grey **SILTY CLAY**						3	63.06
						4	62.06
						5	61.06
6.10						6	60.06
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders							
7.16		SS	3	100	50+	7	59.06

End of Borehole

Practical refusal to augering at 7.16m depth

(GWL @ 0.92m - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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Prop. Residential Development - 936 March Road
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

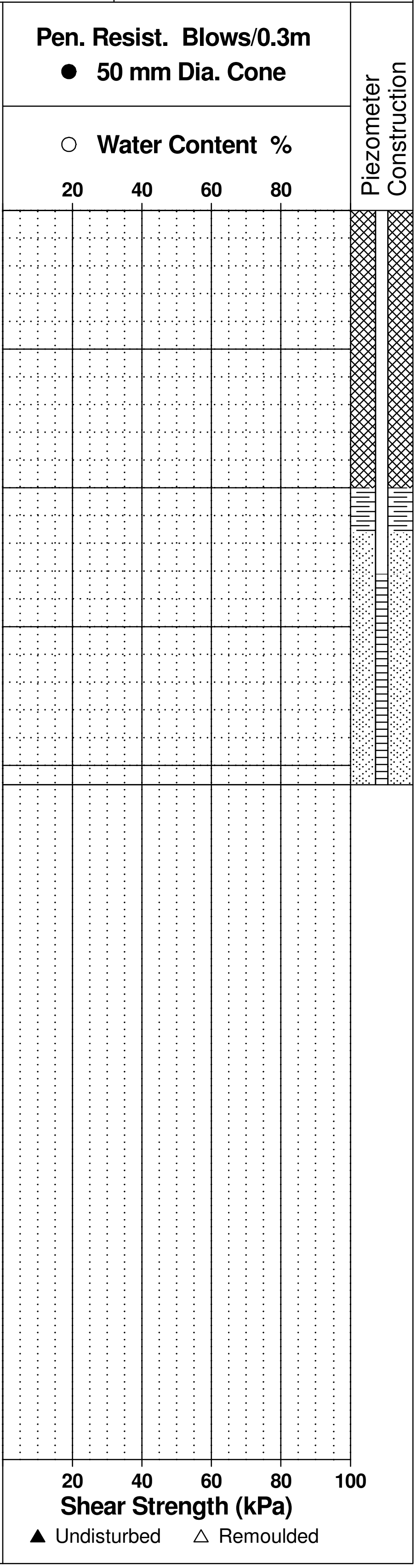
HOLE NO. BH32

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	76.95
TOPSOILB 0.30		AU	1				
Very stiff, grey **SILTY CLAY**		SS	2	100	10	1	75.95
		SS	3	100	8	2	74.95
2.74		SS	4	100	8		
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles, boulders		SS	5	71	50+	3	73.95
4.14						4	72.95

End of Borehole

Practical refusal to augering at 4.14m depth

(BH dry - July 12, 2018)



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SOIL PROFILE AND TEST DATA

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Prop. Residential Development - 936 March Road
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

HOLE NO. BH33

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	71.39
TOPSOIL 0.28	AU	1				
Very stiff, grey **SILTY CLAY** 0.91						
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles, boulders 1.40	SS	2	100	23	1	70.39

End of Borehole

Practical refusal to augering at 1.40m depth

(BH dry - July 12, 2018)

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

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 27, 2018

FILE NO. PG4554

HOLE NO. BH34

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	69.83		
TOPSOIL 0.28		AU	1						
Very stiff, grey **SILTY CLAY** 0.76									
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles, boulders 1.40		SS	2		10	1	68.83		
End of Borehole Practical refusal to augering at 1.40m depth (BH dry upon completion)									

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

SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

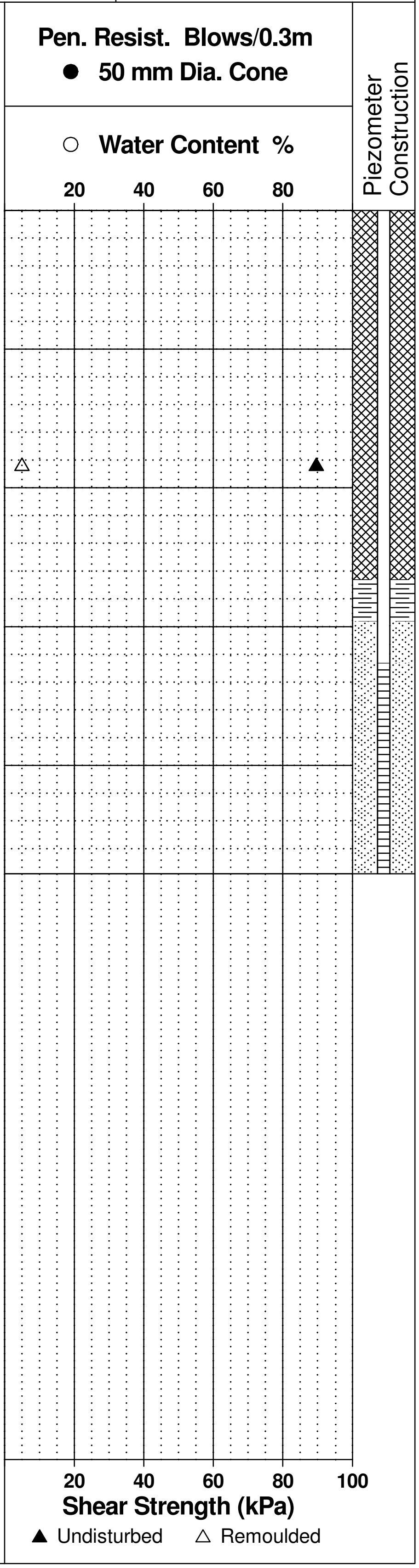
BORINGS BY CME 55 Power Auger

DATE June 28, 2018

FILE NO. PG4554

HOLE NO. BH35

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.28	AU	1			0	69.58
Loose, brown **SILTY SAND,** trace clay 0.76	AU	2				
Stiff, grey **SILTY CLAY** 2.29	SS	3	100	3	1	68.58
					2	67.58
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles, boulders					3	66.58
	SS	4	75	4	4	65.58
	SS	5	88	20		
4.78	SS	6	100	50+		
End of Borehole						
Practical refusal to augering at 4.78m depth						



SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 28, 2018

FILE NO. PG4554

HOLE NO. BH36

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	69.60
TOPSOIL 0.23	AU	1				
Loose, brown **SILTY SAND,** trace clay 0.84	AU	2				
Stiff, grey **SILTY CLAY** 1.83	SS	3	100	5	1	68.60
	SS	4	100	7	2	67.60
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles, boulders 5.13	SS	5	29	4	3	66.60
	SS	6	83	15		
	SS	7	33	22	4	65.60
	SS	8	100	11	5	64.60
End of Borehole Practical refusal to augering at 5.13m depth						

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

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Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

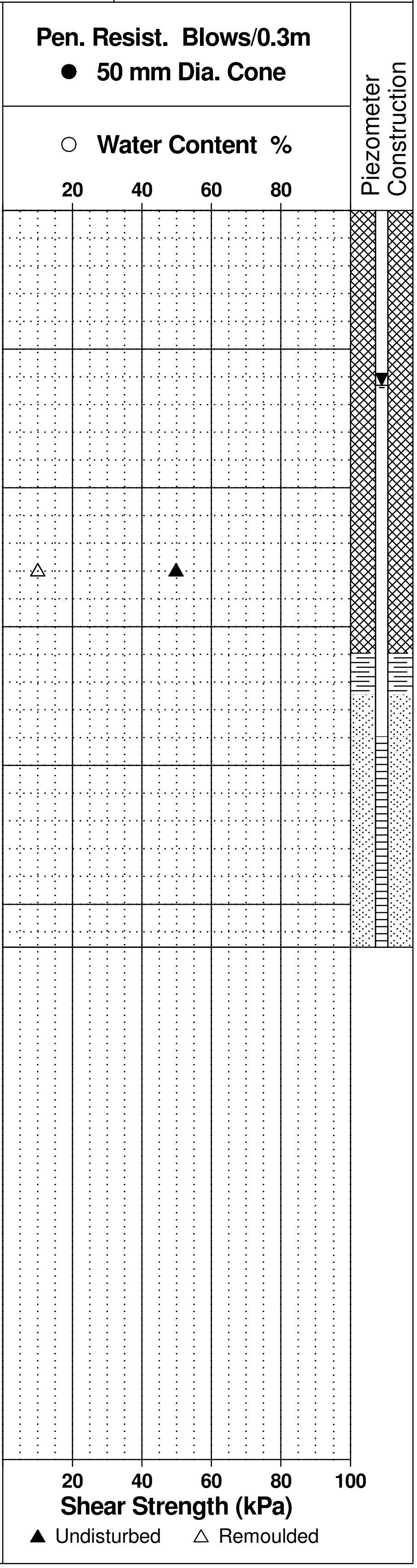
HOLE NO. BH37

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	68.89
TOPSOIL 0.18	AU	1				
Loose, brown **SAND,** some silt 0.91	AU	2				
	SS	3	96	6	1	67.89
Stiff to firm, grey **SILTY CLAY**	SS	4	100	4	2	66.89
3.05					3	65.89
	SS	5	100	6		
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles, boulders	SS	6	100	5	4	64.89
	SS	7	100	9	5	63.89
5.31						

End of Borehole

Practical refusal to augering at 5.31m depth

(GWL @ 1.26m - July 12, 2018)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE June 29, 2018

FILE NO. PG4554

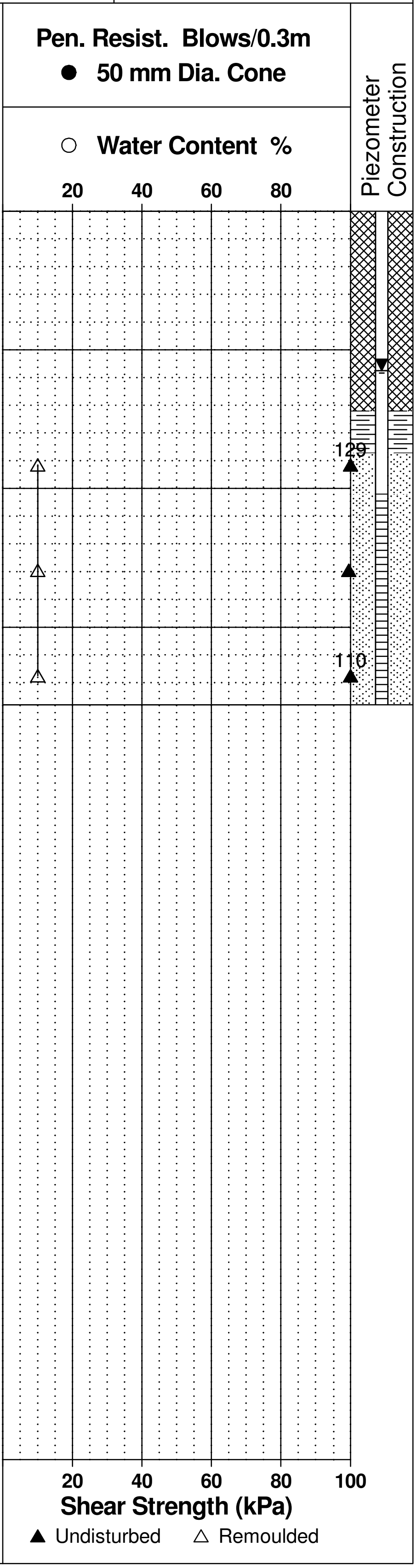
HOLE NO. BH38

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	67.01
TOPSOIL 0.23	AU	1				
	SS	2	100	6	1	66.01
Very stiff, grey **SILTY CLAY**					2	65.01
3.56					3	64.01

End of Borehole

Practical refusal to augering at 3.56m depth

(GWL @ 1.15m - July 12, 2018)



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 4, 2018

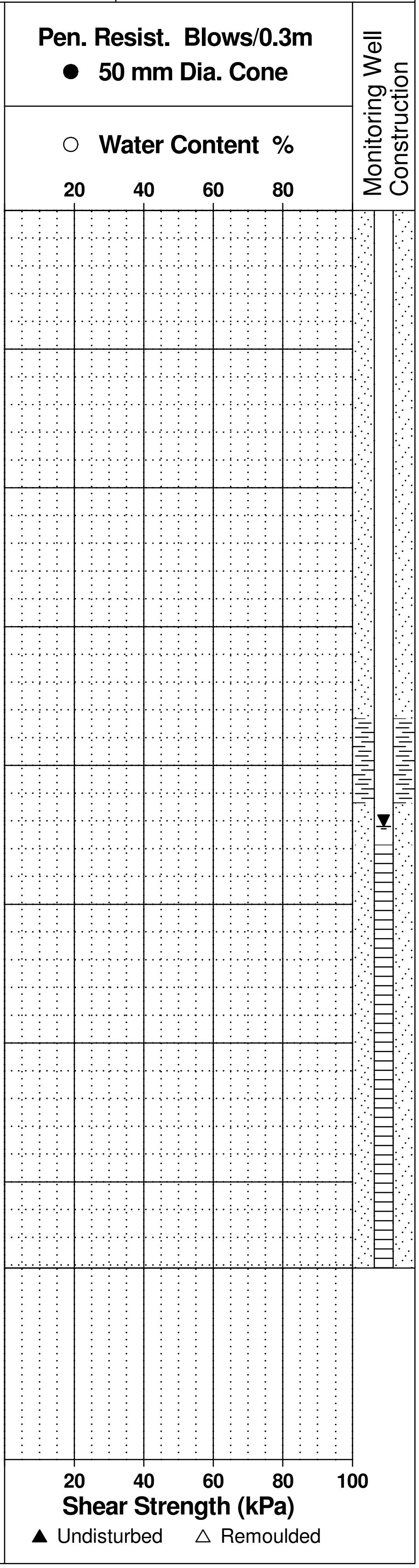
FILE NO. PG4554

HOLE NO. BH40

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	79.19
TOPSOIL 0.25	AU	1				
Compact, brown **SILTY SAND,** trace clay	SS	2	71	11	1	78.19
1.52						
Stiff, brown **SILTY CLAY,** trace sand	SS	3	96	8	2	77.19
	SS	4	96	7	3	76.19
	SS	5	96	7		
- grey by 3.8m depth	SS	6	94	6	4	75.19
	SS	7	96	5	5	74.19
	SS	8	96	4	6	73.19
	SS	9	96	W		
6.86						
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	SS	10	96	2	7	72.19
7.62						

End of Borehole

(GWL @ 4.44m - July 13, 2018)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG4554**

REMARKS

HOLE NO. **BH41**

BORINGS BY CME 55 Power Auger

DATE July 4, 2018

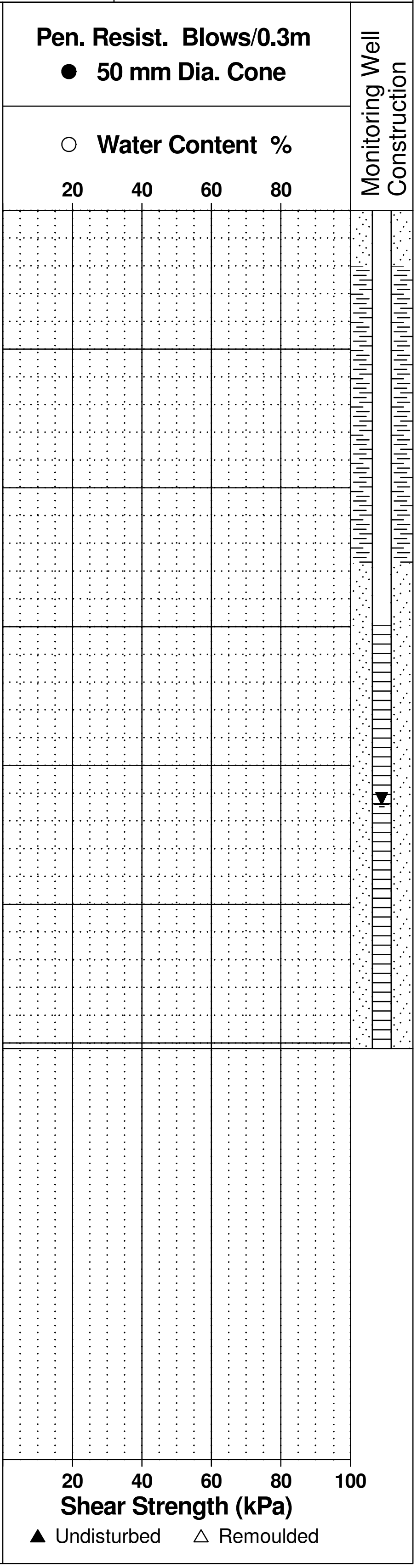
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE				
TOPSOILB 0.25	AU	1		
Compact, brown **SILTY SAND,** trace clay 1.52	SS	2	75	12
Stiff to firm, brown **SILTY CLAY,** trace sand - grey by 2.3m depth	SS	3	21	6
	SS	4	54	8
	SS	5	62	8
	SS	6	88	3
	SS	7	96	1
6.04	SS	8	88	W

End of Borehole

Practical refusal to augering at 6.04m depth

(GWL @ 4.28m - July 13, 2018)

DEPTH (m)	ELEV. (m)
0	78.67
1	77.67
2	76.67
3	75.67
4	74.67
5	73.67
6	72.67



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 936 March Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 4, 2018

FILE NO. PG4554

HOLE NO. BH42

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.18
Compact, brown **SILTY SAND,** trace clay	1.52
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders	1.73
BEDROCK: Grey limestone with shale seams	7.21
End of Borehole	
(GWL @ 4.04m - July 13, 2018)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	21	10
SS	3	20	50+
RC	1	98	98
RC	2	98	79
RC	3	100	93
RC	4	100	81

DEPTH (m)	ELEV. (m)
0	73.50
1	72.50
2	71.50
3	70.50
4	69.50
5	68.50
6	67.50
7	66.50

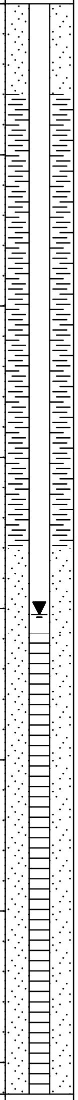
Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

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

Monitoring Well Construction



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

TW - Thin wall tube or Shelby tube

PS - Piston sample

AU - Auger sample or bulk sample

WS - Wash sample

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

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

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

CONSOLIDATION TEST

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

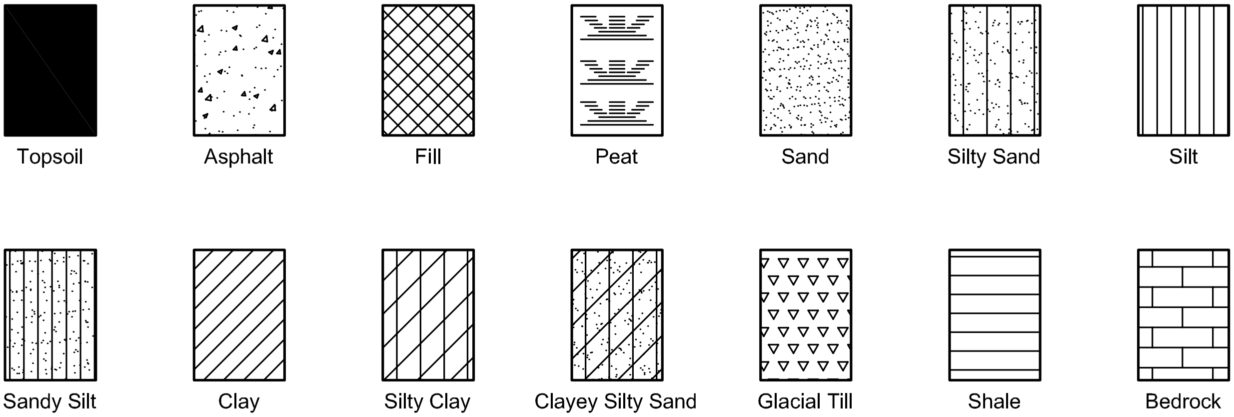
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

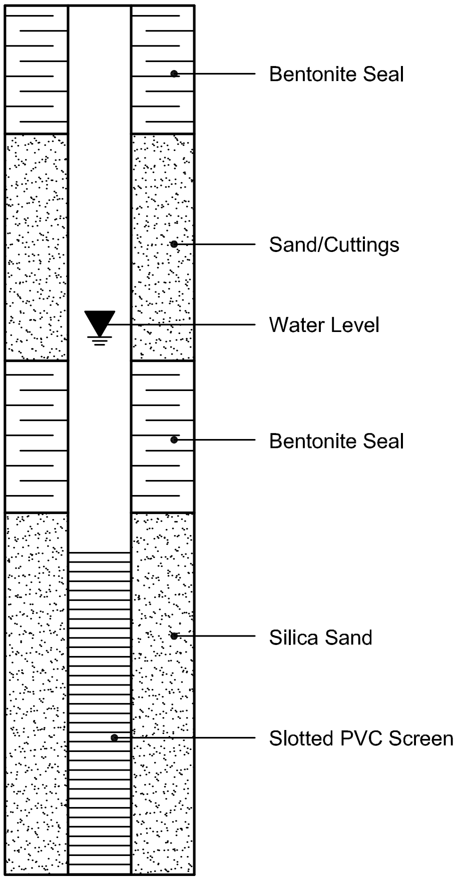
SYMBOLS AND TERMS (continued)

STRATA PLOT

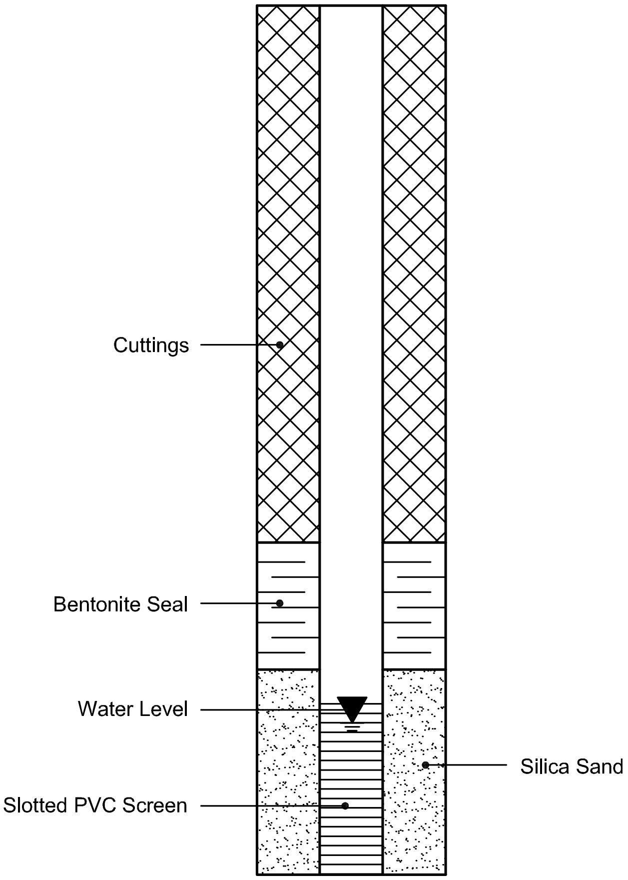


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24592

Report Date: 11-Jul-2018

Order Date: 5-Jul-2018

Project Description: PG4554

Client ID:		BH10-SS4 5'-7'	-	-	-
Sample Date:		06/26/2018 12:00	-	-	-
Sample ID:		1827414-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	67.5	-	-	-
General Inorganics					
pH	0.05 pH Units	7.73	-	-	-
Resistivity	0.10 Ohm.m	105	-	-	-
Anions					
Chloride	5 ug/g dry	8	-	-	-
Sulphate	5 ug/g dry	14	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 TO 9 - SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG4554-1 - TEST HOLE LOCATION PLAN

DRAWING PG4554-2 - LIMIT OF HAZARD LANDS

FIGURE 1

KEY PLAN

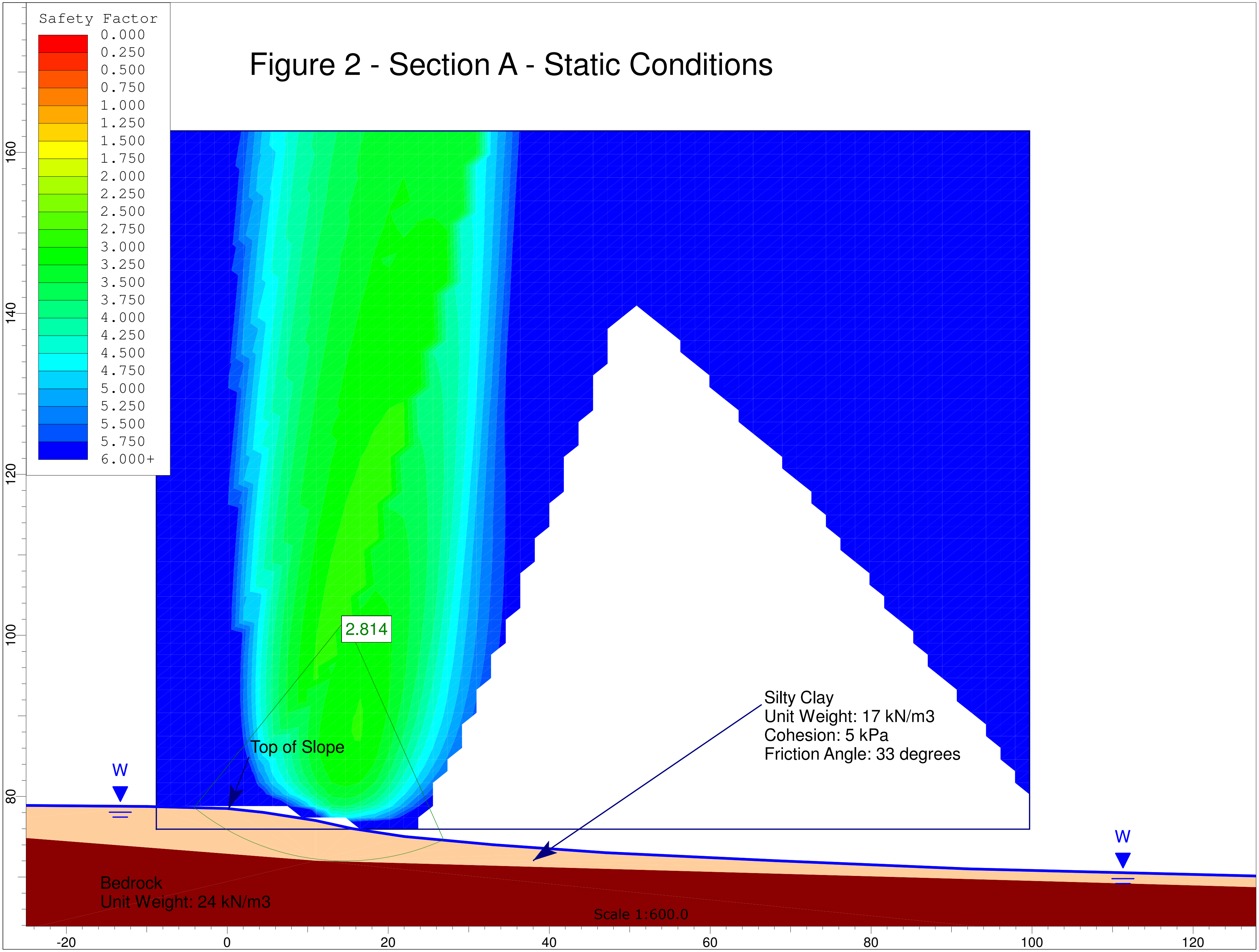


Figure 2 - Section A - Static Conditions

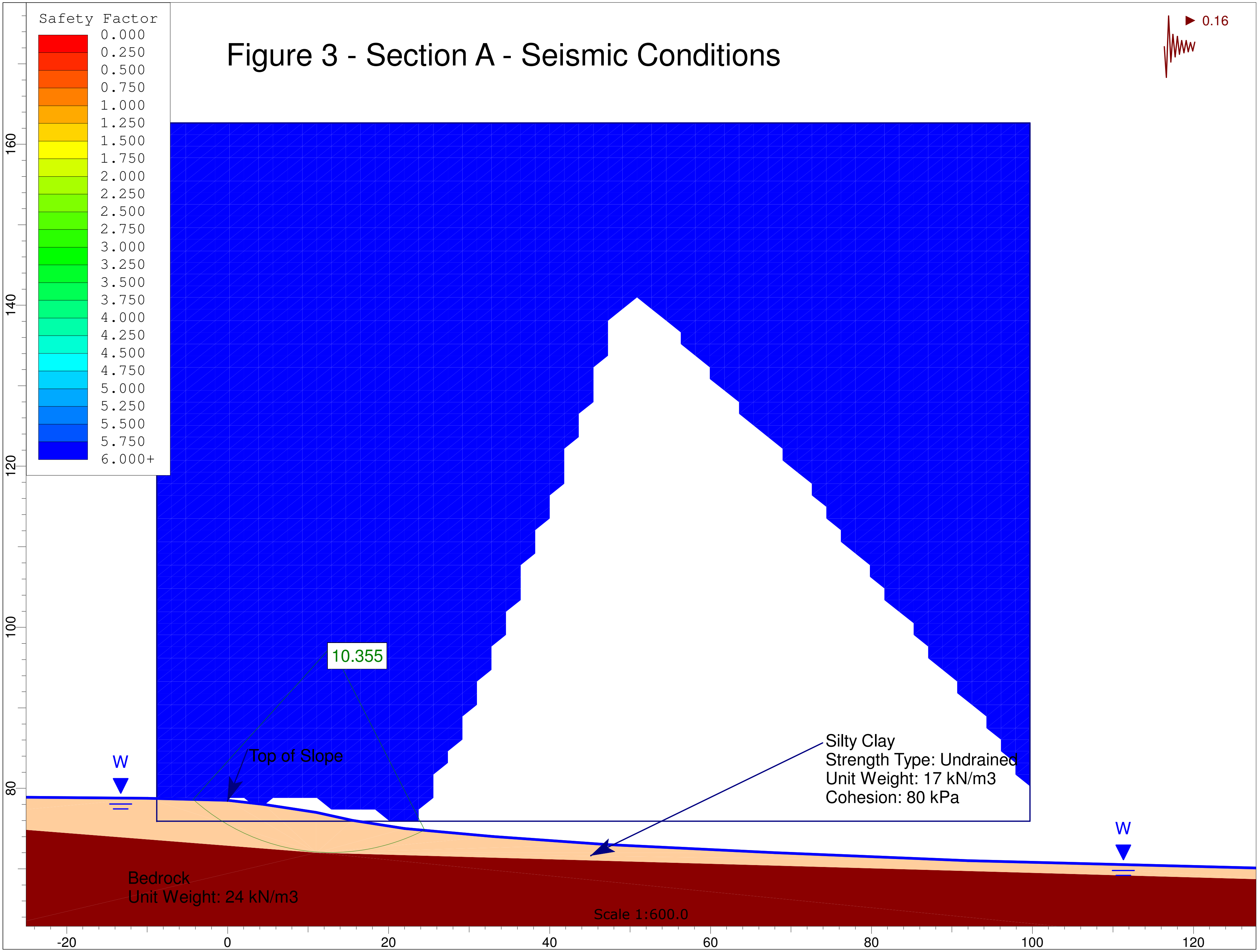


Figure 3 - Section A - Seismic Conditions

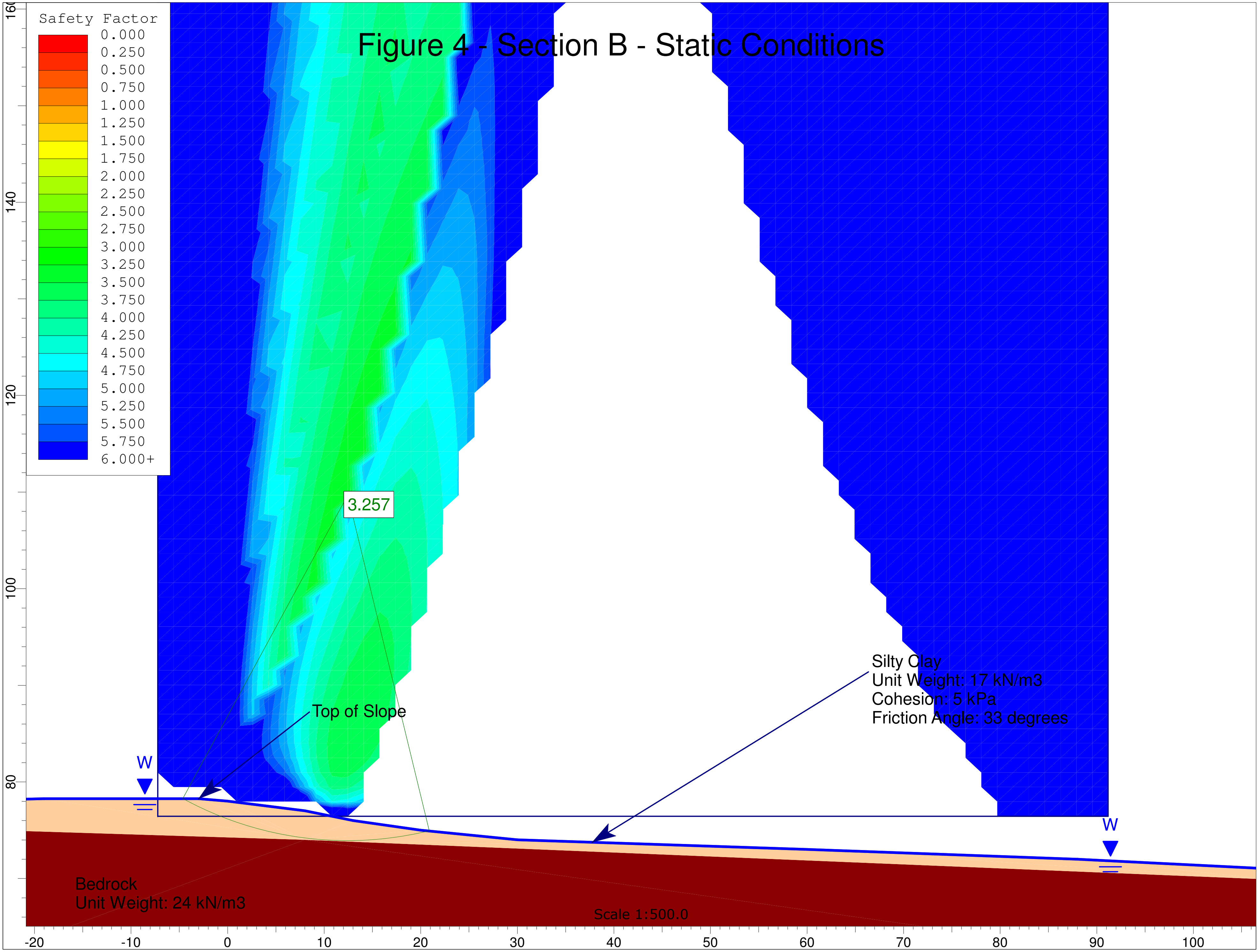


Figure 4 - Section B - Static Conditions

Silty Clay
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees

Bedrock
Unit Weight: 24 kN/m3

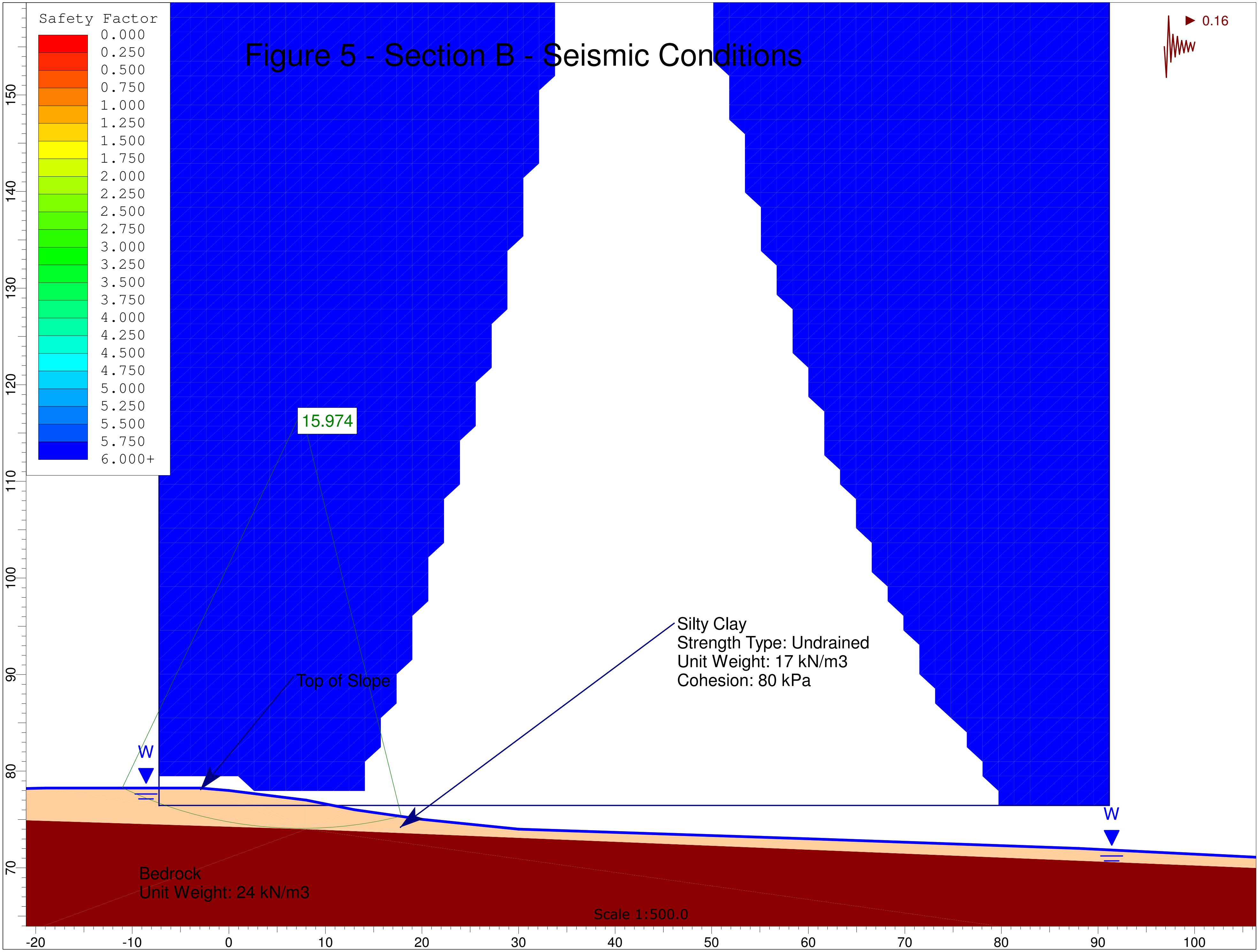


Figure 5 - Section B - Seismic Conditions
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
15.974
Top of Slope
Silty Clay
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion: 80 kPa
W
W
Bedrock
Unit Weight: 24 kN/m3
Scale 1:500.0
150
140
130
120
110
100
90
80
70
-20
-10
0
10
20
30
40
50
60
70
80
90
100

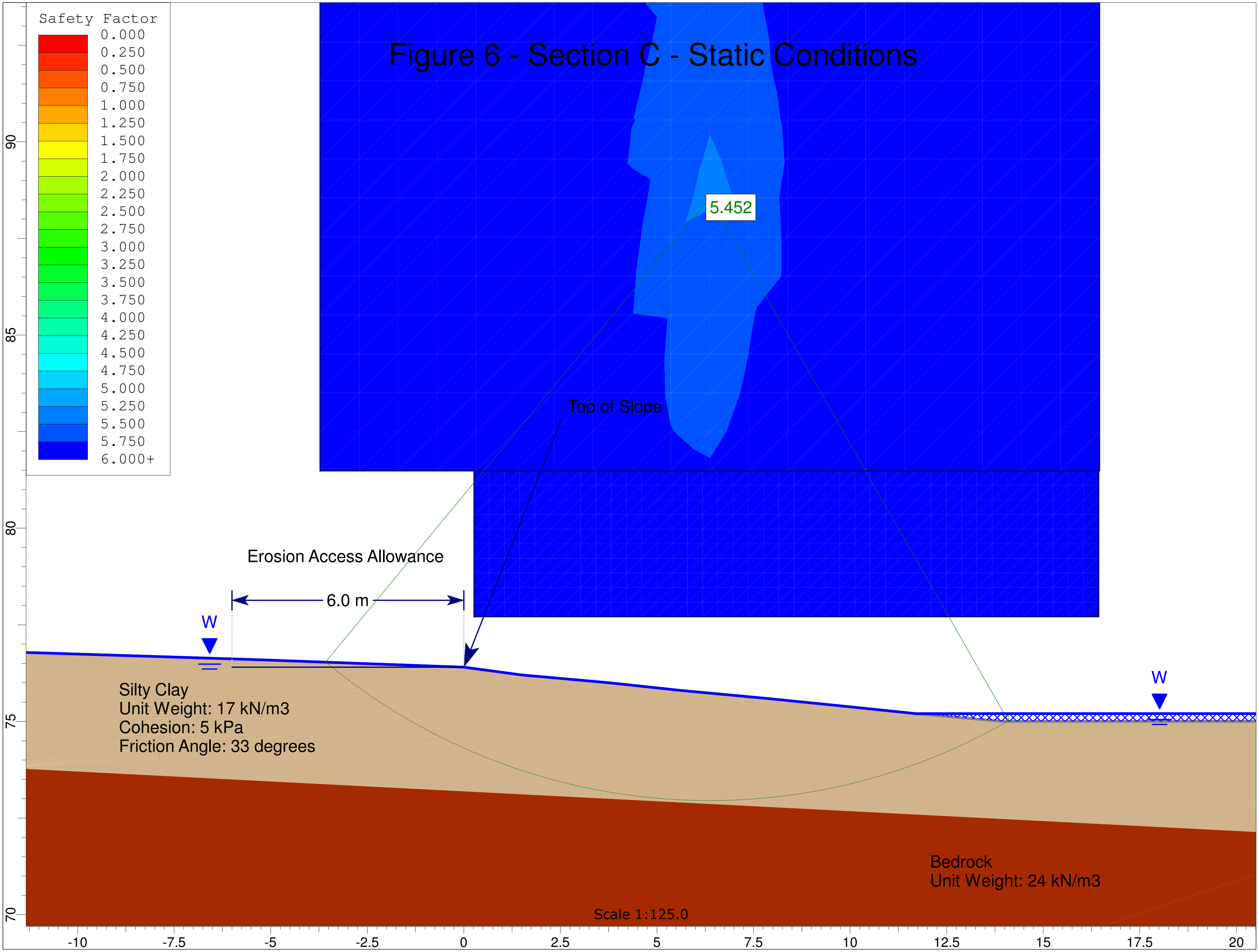


Figure 6 - Section C - Static Conditions

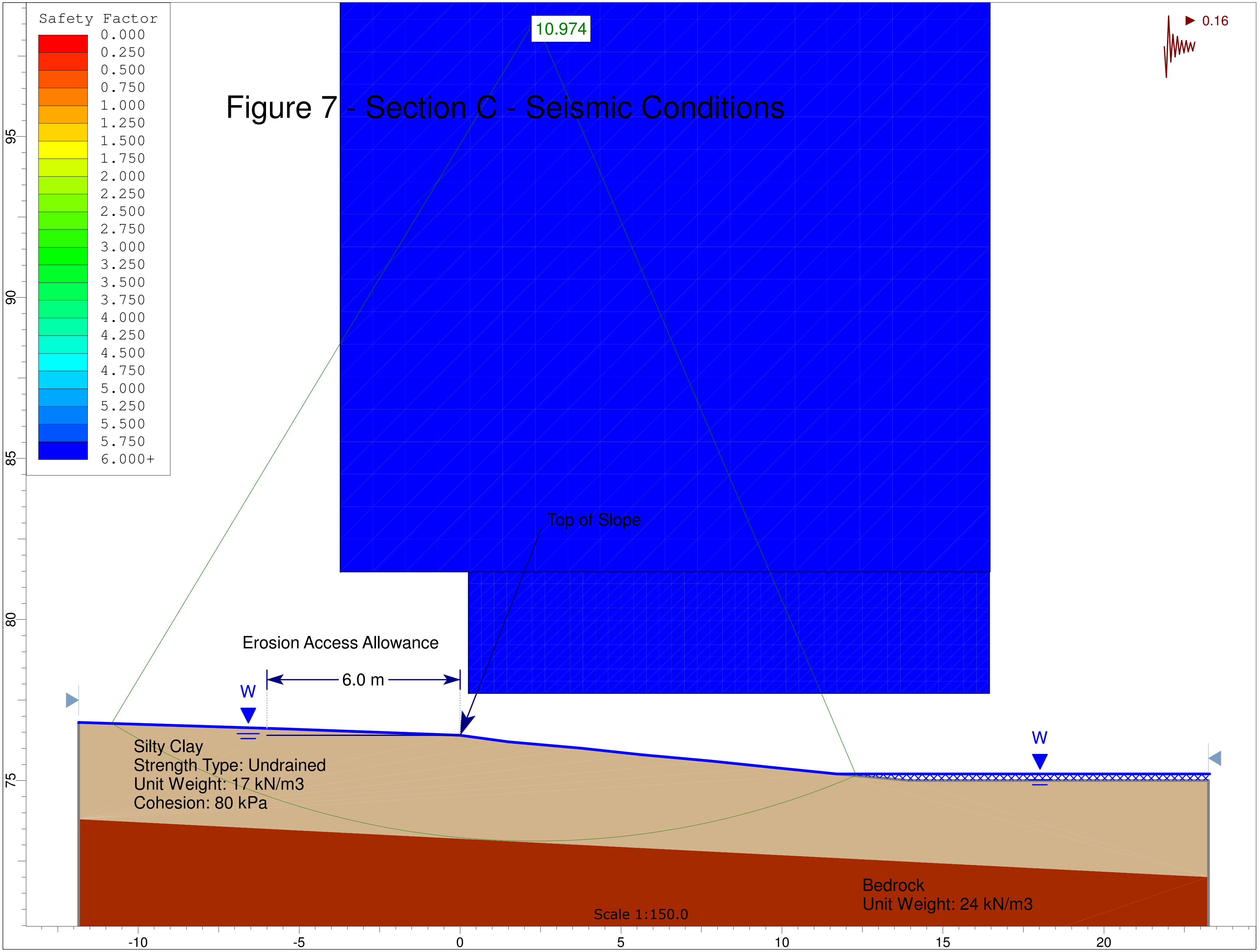


Figure 7 - Section C - Seismic Conditions

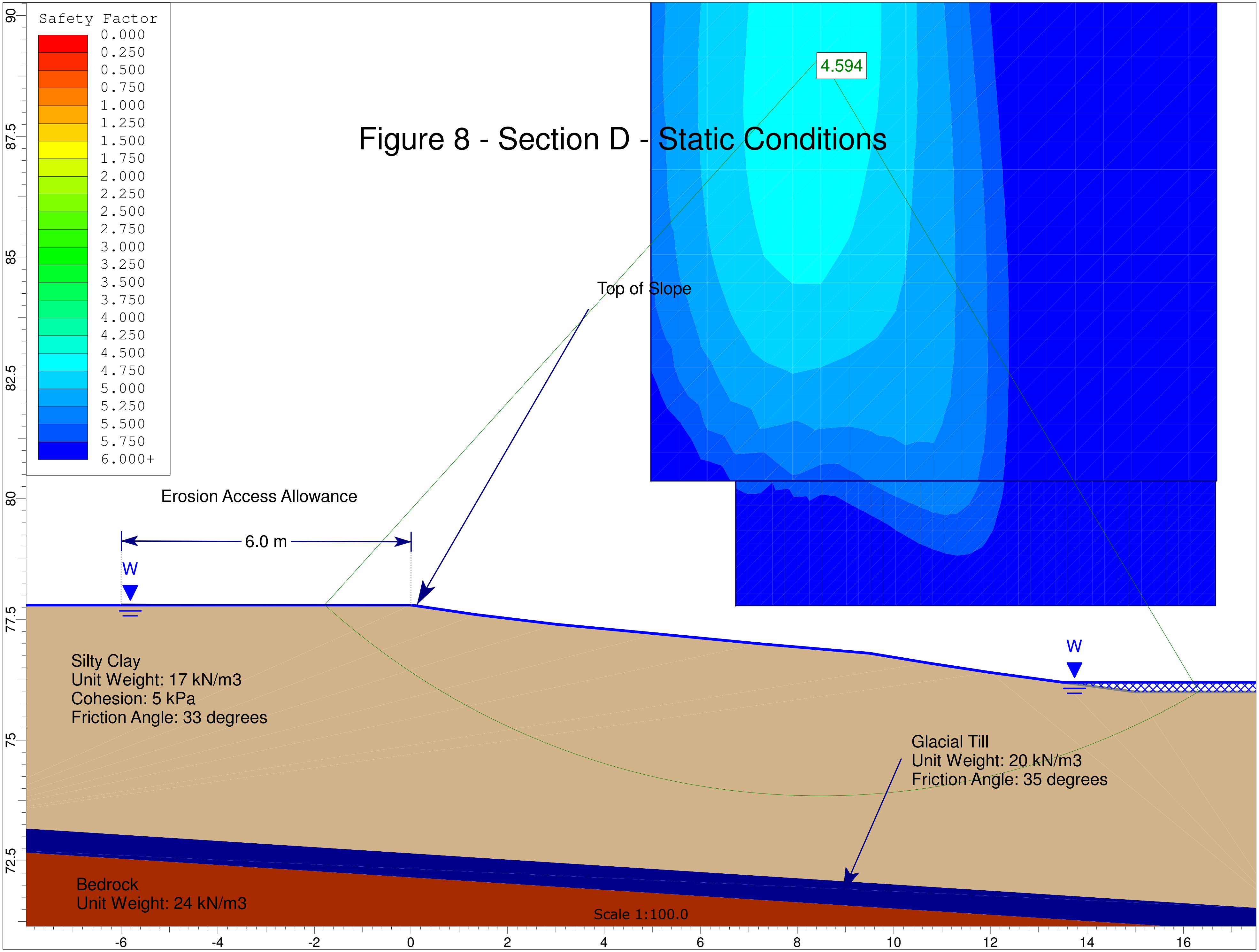


Figure 8 - Section D - Static Conditions

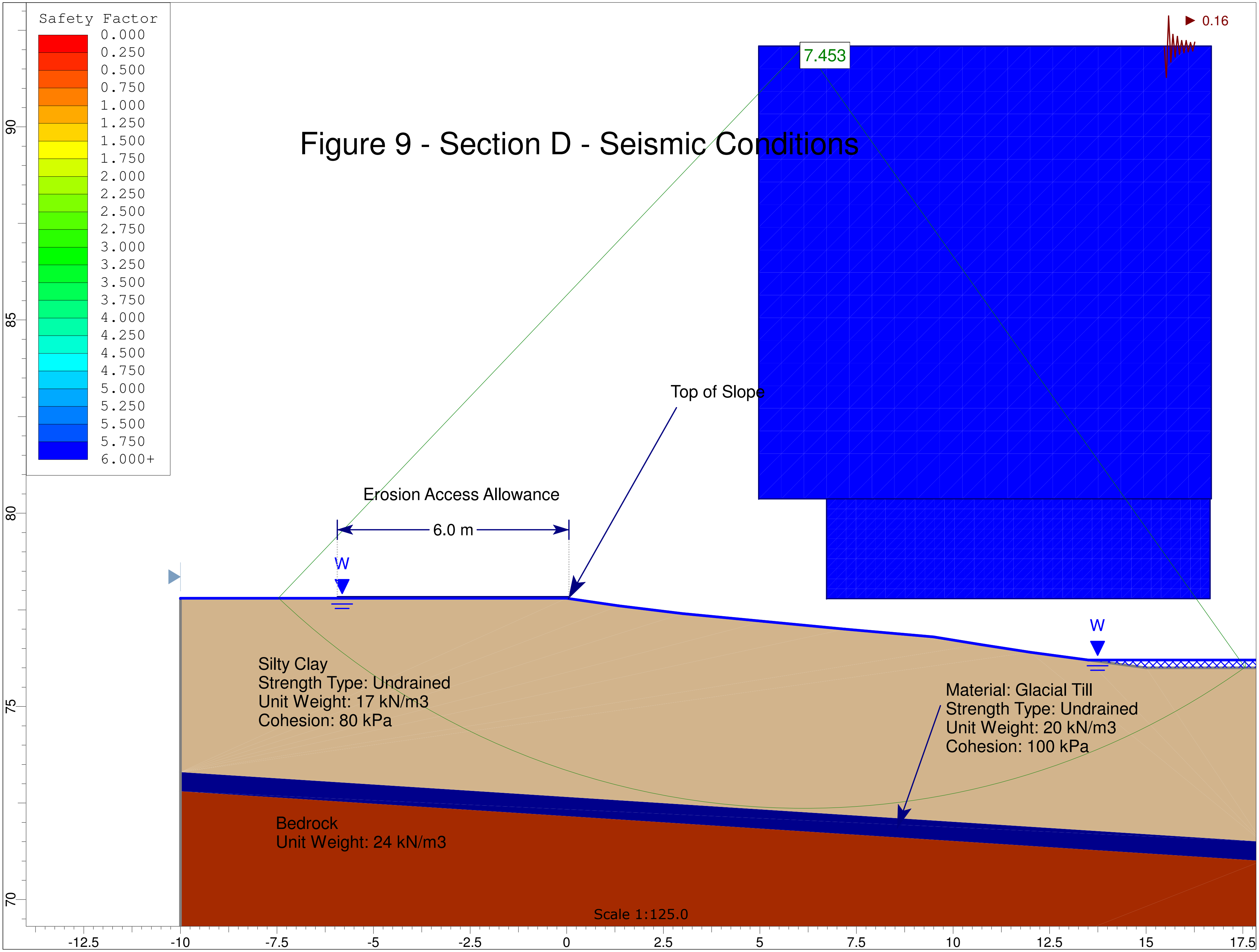
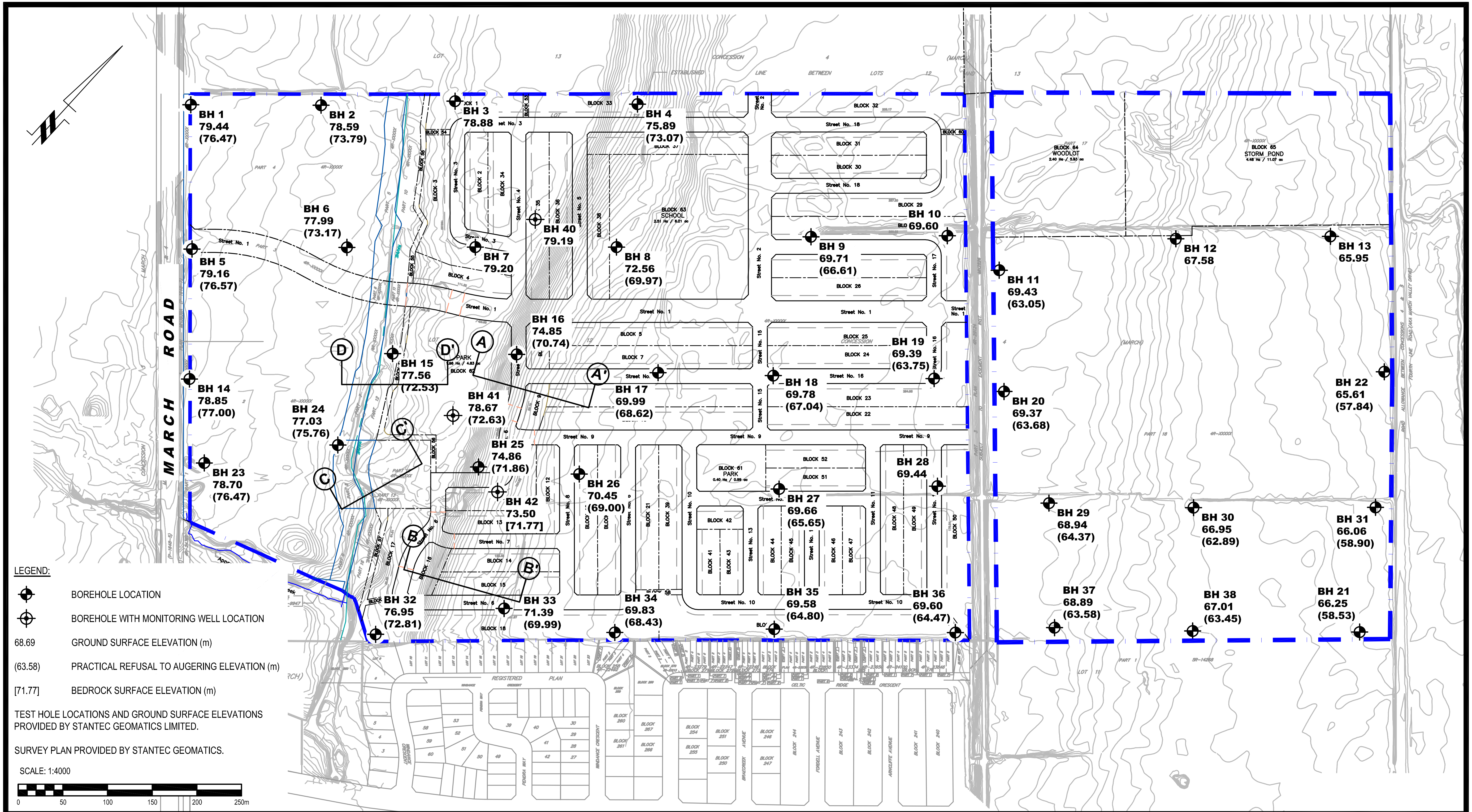


Figure 9 - Section D - Seismic Conditions



LEGEND:

⊕	BOREHOLE LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
68.69	GROUND SURFACE ELEVATION (m)
(63.58)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
[71.77]	BEDROCK SURFACE ELEVATION (m)

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

SURVEY PLAN PROVIDED BY STANTEC GEOMATICS.

SCALE: 1:4000

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
2	BASE PLAN UPDATED	23/11/2018	SD
1	BASE PLAN UPDATED	30/08/2018	SD

MINTO COMMUNITIES / 2559688 ONTARIO INC.

GEOTECHNICAL INVESTIGATION
PROPOSED DEVELOPMENT - 936 MARCH ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:4000
Date: 07/2018
Drawn by: RCG
Report No.: PG4554-1
Checked by: SD
Dwg. No.: PG4554-1
Approved by: SD
Revision No.: 2

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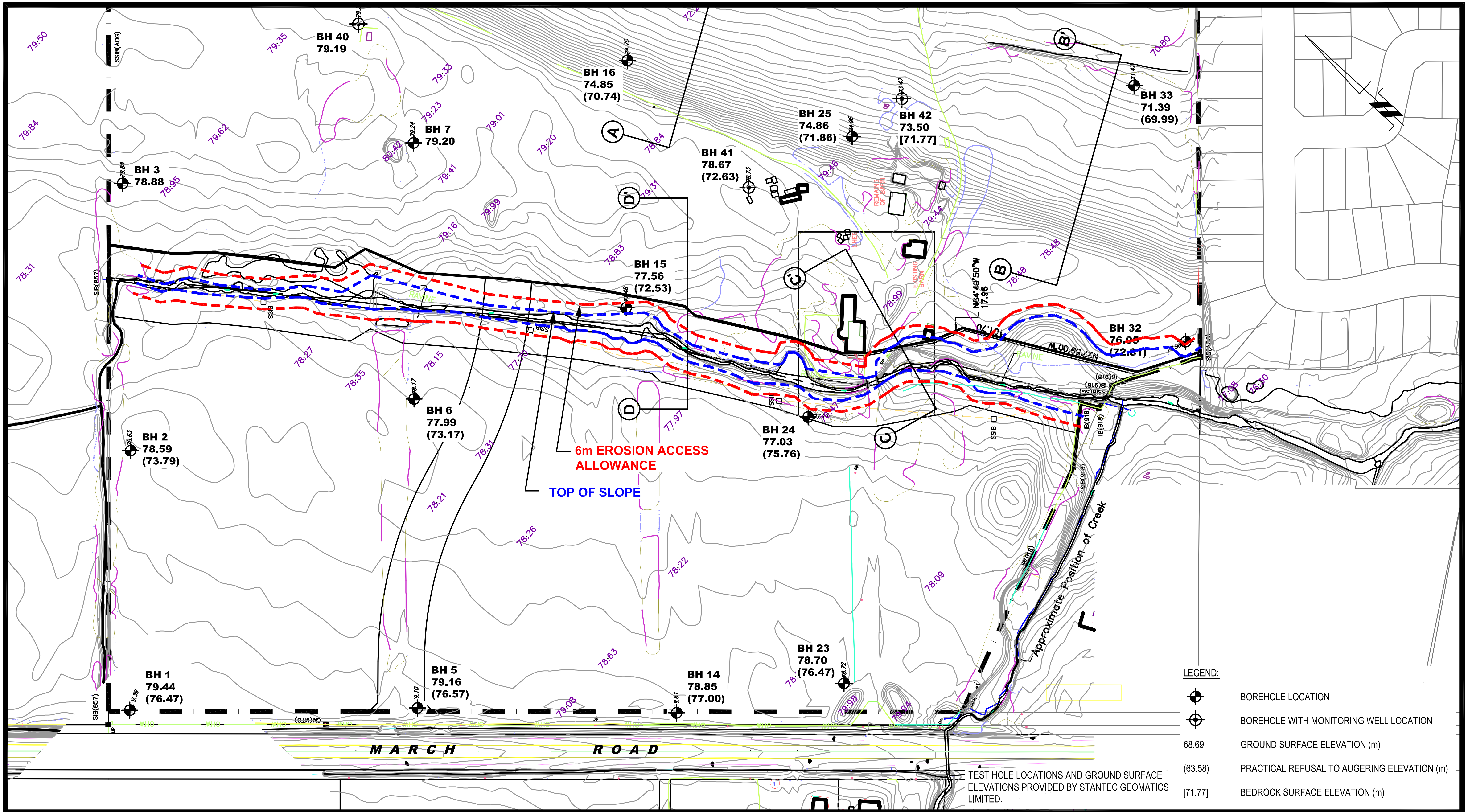

LEGEND:

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[71.77]	BEDROCK SURFACE ELEVATION (m)

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

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
0			

MINTO COMMUNITIES / 2559688 ONTARIO INC.
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - 936 MARCH ROAD
OTTAWA, ONTARIO

Title:
LIMIT OF HAZARD LANDS

Scale: 1:4000
Date: 07/2018
Drawn by: MPG
Report No.: PG4554-1
Checked by: SD
Dwg. No.: PG4554-2
Approved by: SD
Revision No.: 0

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