Geotechnical Investigation

Proposed Residential Development
Northridge Subdivision

1020 and 1070 March Road
Ottawa, Ontario

Prepared for 1384341 Ontario Ltd.

Report PG6009-1 Revision 3 dated August 24, 2022

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1.0 Introduction

Paterson Group (Paterson) was commissioned by 1384341 Ontario Ltd. to conduct a geotechnical investigation for the proposed Northridge residential development to be located at 1020 and 1070 March Road, in the City of Ottawa, Ontario (refer to Figure 1 -Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

- ❒ determine the subsurface soil and groundwater conditions based on available subsoil information and geotechnical investigations.

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

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

2.0 Proposed Development

Based on available design plans, it is understood that the proposed development will consist of a series of single, townhouse and back-to-back townhouse style residential dwellings with basement or slab-on-grade construction, attached garages, associated driveways, local roadways and landscaped areas. It is further understood that park blocks, commercial/mixed-use blocks and an institution block are also proposed for the subject site. It is anticipated that the site will be municipally serviced by future water, sanitary and storm services.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

A geotechnical investigation was carried out on December 6, 2019. A total of 14 test pits were excavated to a maximum depth of 3.9 m below existing grade using a rubber-tired backhoe. It should be noted that previous investigations were conducted by this firm within the subject property in 2011, consisting of a total of 13 test pits excavated to a maximum depth of 4.6 m below existing grade. A follow-up Investigation was conducted by others and consisted of excavating 21 test pits to a maximum depth of 4.4 m below existing grade. The test holes were distributed in a manner to provide general coverage of the subject site.

All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test pit procedure consisted of excavating to the required depths at the selected locations and sampling the overburden. The approximate locations of the test holes are shown on Drawing PG6009-1 - Test Hole Location Plan included in Appendix 2.

A supplemental geotechnical investigation was carried out between September 30 and October 4, 2021. During that time, a total of 82 probeholes were advanced into the bedrock using an Air Track pneumatic crawler drill. The probeholes were completed for the purpose of bedrock delineation and the generation of bedrock elevation contours. Refer to Drawing PG6009-4 - Bedrock Contour Plan included in Appendix 2.

Sampling and In Situ Testing

Soil samples from the test pits from the current investigation were recovered from the side walls of the open excavation and all soil samples were initially classified on site. All samples were transported to our laboratory for further examination and classification. The depths at which the grab samples were recovered from the test holes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

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

The subsurface conditions observed at the test pits were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets and Test Pit Logs by Others in Appendix 1.

Groundwater

Open hole groundwater infiltration levels were observed at the time of excavation at each test pit location. Our observations are presented in the Soil Profile and Test Data sheets in Appendix 1

Sample Storage

All samples will be stored in the laboratory for a period of one (1) month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The location and ground surface elevation at each test hole location was recovered in the field by Paterson personnel. The ground surface elevation at each test hole location was referenced to a geodetic datum. The location and ground surface elevation at each test hole location is presented on Drawing PG6009-1 - Test Hole Location Plan attached to Appendix 1.

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.

A total of 11 Atterberg limit tests and 3 grain size distribution analyses were completed on selected soil samples. The results of our testing are presented in Subsection 4.2 and on the Atterberg Limits' Testing and Grain-Size Distribution Testing sheets attached in Appendix 1.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures by Paterson. The samples were submitted to determine the concentration of sulphate and chloride, the resistivity, and the pH of the samples. 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 is currently occupied by agricultural lands, with the exception of the east portion of 1020 March Road being occupied by trees and dense brush. The ground surface across the west portion of the subject site is relatively flat with a slight upward slope from the March Road to the central portion of the site, followed by a downward slope and grade lowering across the east portion of the subject site. An existing agricultural homestead building was noted within the central portion of 1070 March Road. A ditch was noted running north-south along March Road and the west portion of the site extending from the south neighbouring site. The site is bordered to the north by residential dwellings, to the east by an existing rail corridor running north-south, to the south by vacant agricultural lands, and to the west by March Road.

4.2 Subsurface Profile

Overburden

1020 March Road

Generally, the subsoil profile encountered at the test hole locations consists of topsoil overlying silty clay or silty sand within the west and east portion of the site, respectively. A glacial till layer was noted at all test pit locations east of TP 3-19 and TP 9-19 of the current investigation. Practical refusal to excavation was encountered between 0.3 and 2.4 m depth at test pits TP 4-19, TP 5-19, TP 11-19, TP 11B-19 and TP 12-19. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location.

1070 March Road

Generally, the subsoil profile encountered at the test hole locations consists of topsoil overlying silty clay or silty sand within the west and east portion of the site, respectively. A glacial till layer was noted at all test pit locations. Practical refusal to excavation was encountered between 0.9 and 3.7 m depth at all test pit locations completed by Paterson, with the exception of TP 6 from Paterson's 2010 investigation, which was extended to a depth of 4.6 m below existing ground surface.

Based on the bedrock delineation program, bedrock was generally encountered between 3.5 and 5 m below existing ground surface in the southwest side of the site, with local undulations from approximately 2 to 7 m below existing ground surface. In the northeast side of the site, bedrock was encountered from ground surface to 3.5 m below existing ground surface.

Bedrock outcrops were observed at the ground surface in the northeast portion of the site. The estimated bedrock depths are presented on Drawing PG6009-4 – Bedrock Contour Plan in Appendix 2.

Reference should be made to the Soil Profile and Test Data Sheets in Appendix 1 for the details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the subject site is underlain by interbedded sandstone and dolomite of the March Formation extending from the west to center of the property, followed by dolomite of the Oxford formation extending from the center of the property to the east with an overburden drift thickness varying between 0 to 5 m.

Laboratory Testing

Atterberg limits testing, as well as associated moisture content testing, were completed on the recovered silty clay samples at selected locations throughout the subject site. The results of the Atterberg limits tests are presented in Table 1 and on the Atterberg Limits' Results sheet in Appendix 1.

The results of the shrinkage limit test indicate a shrinkage limit of 17% and a shrinkage ratio of 1.85.

Table 1 – Summary of Atterberg Limits Results

Test Hole	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Classification
TP 1-19	0.6-0.7	46	32	14	ML
TP 2-19	1.8-1.9	56	22	34	CH
TP 3-19	1.5-1.6	55	22	34	CH
TP 4B-19	1.8-1.9	51	19	32	CH
TP 5-19	0.9-1.0	53	22	31	CH
TP 6-19	1.5-1.6	56	20	36	CH
TP 7-19	0.7-0.8	58	30	28	CH
TP 8-19	1.6-1.7	71	25	45	CH
TP 9-19	1.6-1.7	68	31	37	CH
TP 10-19	1.4-1.5	51	20	31	CH
TP 12-19	1.5-1.6	64	24	40	CH

Notes: CH: Inorganic Clay of High Plasticity; ML: Inorganic Silts of Low Plasticity

Grain Size Distribution and Hydrometer Testing

Grain size distribution (sieve analysis) was also completed on three (3) selected soil samples. The results of the grain size analysis are summarized in Table 2 and presented on the Grain-Size Distribution Testing Results sheets in Appendix 1.

Table 2 – Summary of Grain Size Distribution Analysis

Test Hole	Sample	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
TP 4B-19	G3	0	0.7	99.3	
TP 5-19	G4	0	0.2	98.2	
TP 8-19	G4	6.5	64.5	97.8	

4.3 Groundwater

Groundwater levels (GWL) were recorded at in each test pit at the completion of excavation. The results are summarized in Tables 3 and 4.

Table 3 – Summary of Groundwater Level Readings

Test Pit Number	Ground Surface Elevation (m)	Measured Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
TP 1-19	79.81	2.60	77.21	December 6, 2019
TP 2-19	79.17	2.60	76.57	December 6, 2019
TP 3-19	79.52	2.80	76.72	December 6, 2019
TP 4-19	73.35	Dry	-	December 6, 2019
TP 4B-19	79.18	1.30	77.88	December 6, 2019

TP 5-19	70.72	2.00	68.72	December 6, 2019

Table 3 (continued) – Summary of Groundwater Level Readings

Test Pit Number	Ground Surface Elevation (m)	Measured Groundwater Level		Recording Date
		Depth (m)	Elevation (m)	
TP 6-19	70.64	2.50	68.14	December 6, 2019
TP 7-19	79.12	2.50	76.62	December 6, 2019
TP 8-19	78.87	3.00	75.87	December 6, 2019
TP 9-19	79.48	1.70	77.78	December 6, 2019
TP 10-19	77.49	2.80	74.69	December 6, 2019
TP 11-19	70.62	Dry	-	December 6, 2019
TP 11B-19	70.57	Dry	-	December 6, 2019
TP12-19	70.54	2.20	68.34	December 6, 2019
TP 1	-	1.80	-	November 4, 2010
TP 2	-	2.40	-	November 4, 2010
TP 3	-	1.40	-	November 4, 2010
TP 4	-	1.80	-	November 4, 2010
TP 5	-	1.70	-	November 4, 2010
TP 6	-	Dry	-	November 4, 2010
TP 7	-	Dry	-	November 4, 2010
TP 8	-	2.10	-	November 4, 2010
TP 9	-	Dry	-	November 4, 2010
TP 10	-	1.80	-	November 4, 2010
TP 11	-	1.10	-	November 4, 2010
TP 12	-	2.00	-	November 4, 2010
TP 13	-	2.20	-	November 4, 2010
TP 1	81.35	3.00	78.35	December 10, 2012
TP 2	79.06	1.50	77.56	December 10, 2012
TP 3	78.49	1.50	76.99	December 10, 2012
TP 4	79.62	4.10	75.52	December 10, 2012
TP 5	79.45	2.70	76.75	December 10, 2012
TP 6	78.40	1.50	76.90	December 10, 2012
TP 7	79.41	4.00	75.41	December 10, 2012
TP 8	79.41	Dry	-	December 10, 2012
TP 9	79.59	Dry	-	December 10, 2012
TP 10	79.21	4.00	75.21	December 10, 2012
TP 11	78.57	0.80	77.77	December 10, 2012
TP 12	80.02	3.40	76.62	December 10, 2012
TP 13	72.12	Dry	-	December 10, 2012
TP 14	70.57	1.80	68.77	December 10, 2012
TP 15	70.32	3.90	66.42	December 10, 2012
TP 16	70.73	1.20	69.53	December 10, 2012
TP 17	70.77	1.20	69.57	December 10, 2012
TP 18	70.96	2.00	68.96	December 10, 2012
TP 19	70.36	Dry	-	December 10, 2012
TP 20	70.03	Dry	-	December 10, 2012
TP 21	70.09	Dry	-	December 10, 2012

All test holes were generally observed to be dry upon completion of the sampling program, with the exception of minor infiltration noted along the test pit sidewalls at the above-noted depths. Based on the moisture levels and colouring of the recovered soil samples, and our experience with the local area, the long-term groundwater table is expected at depths between 4 to 5 m below ground surface. The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

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

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is recommended that the proposed residential dwellings be founded on conventional spread footings placed on an undisturbed, very stiff silty clay, compact silty sand, compact glacial till, engineered fill and/or surface-sounded bedrock bearing surface.

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

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

5.2 Site 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. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Disturbance of the subgrade may result in having to sub-excavate the disturbed material and the placement of additional suitable fill material.

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

Bedrock Removal

It is expected that line-drilling in conjunction with hoe-ramming or controlled blasting may be required to remove the bedrock. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed.

A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities.

The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm per second during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Excavation side slopes in sound bedrock can be carried out using almost vertical side walls. Footings that are anticipated to be placed on a near-vertical ledge or side wall of bedrock at the time of construction should be reviewed by Paterson personnel to review the suitability for the near-vertical bedrock ledge to support the proposed structure. Improvements such as providing additional lateral support by placement of approved engineered fill for moderately weathered or fractured bedrock may be required and will be verified for applicability at the time of construction.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipments could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. The construction of the shoring system using soldier piles or sheet piling will require the use of this equipment. Vibrations, whether it is caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the adjoining buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). It should be noted that these guidelines are for today's construction standards.

Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed development.

Fill Placement

Fill placed for grading beneath the building footprint should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The imported fill material should be tested and approved prior to delivery to the site. The fill should be placed in maximum 300 mm thick loose lifts and compacted by suitable compaction equipment. Fill placed beneath the building should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

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

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

5.3 Foundation Design

Shallow Foundation

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, very stiff silty clay bearing surface can be designed using a bearing

resistance value at serviceability limit state (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit state (ULS) of **225 kPa**.
Footings placed on an undisturbed, compact 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**.

Footings placed on an undisturbed, compact silty sand bearing surface can be designed using a bearing resistance value at SLS of **100 kPa** and a factored bearing resistance value at ULS of **175 kPa**.

Footings placed over an approved engineered fill bearing surface over an undisturbed, very stiff silty clay or compact silty sand 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 placed over an approved engineered fill bearing surface over a clean, surface sounded bedrock bearing surface can be designed using a factored bearing resistance value at ULS of **1,000 kPa** using a geotechnical factor of 0.5.

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

Footings bearing on a clean, surface sounded bedrock and designed using the above noted bearing resistance values will be subjected to negligible post-construction total and differential settlements. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

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.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures, or open joints which can be detected from surface sounding with a rock hammer.

Permissible Grade Raise

A **permissible grade raise restriction of 2.5 m** is recommended for areas where building foundations are founded over a silty clay deposit. Areas affected by a permissible grade raise restriction due to the presence of a silty clay deposit are indicated in Drawing PG6009-2 - Permissible Grade Raise Areas in Appendix 2. Footings bearing on a compact glacial till, silty sand and/or bedrock bearing surface will not subjected to permissible grade raise restrictions.

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

Scenario A

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

Scenario B

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

Option 1 – Use of Lightweight Fill

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

Option 2 - Preloading or Surcharging

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

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

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 stiff silty clay above the groundwater table when a plane extending down and out from the bottom edges of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Adequate lateral support is provided to a sound bedrock bearing medium when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1H:6V passing through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. A weathered bedrock should be provided with a lateral support zone of 1.5H:1V.

Soil/Bedrock Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also, at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the subexcavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for foundations considered for the subject site. A higher seismic site class such as Class A or B may be applicable for foundations located within the eastern portion of the subject site where shallow bedrock was encountered. However, the higher site class would have to be confirmed by site specific shear wave velocity testing. The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest version of the Ontario Building Code (OBC) 2012 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 materials within the footprint of the proposed building, the bedrock surface, approved by Paterson personnel at the time of construction, is considered to be an acceptable subgrade surface on which to commence backfilling for the 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 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.

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

5.8 Pavement Design

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

Table 5 - Recommended Pavement Structure – Driveways/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 approved fill, in situ soil or OPSS Granular B Type I and II material placed over in situ soil or approved fill. **Note**: Minimum Performance Grade (PG) 58-34 asphalt cement should be used for driveways.	

Table 6 - Recommended Pavement Structure – Local Residential Roadways	
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
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either approved fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or approved fill. **Note**: Minimum Performance Grade (PG) 58-34 asphalt cement should be used for local roadways.	

Table 7 - Recommended Pavement Structure – Roadways with Bus Traffic	
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
550	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil. **Note:** Minimum Performance Grade (PG) 64-34 asphalt cement should be used for roadways with bus traffic.	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase, or other measures that can be recommended at the time of construction as part of the field observation program.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for driveways and local roadways and (PG) 64-34 asphalt cement should be used for roadways with bus traffic. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

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

Where silty clay is anticipated at subgrade level, consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. 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.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

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

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

6.2 Protection of Footings Against Frost Action

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

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

6.3 Excavation Side Slopes

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

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level.

The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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

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

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

Excavation Base Stability

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

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

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

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

$$FS_b = N_b s_u / \sigma_z$$

where:

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

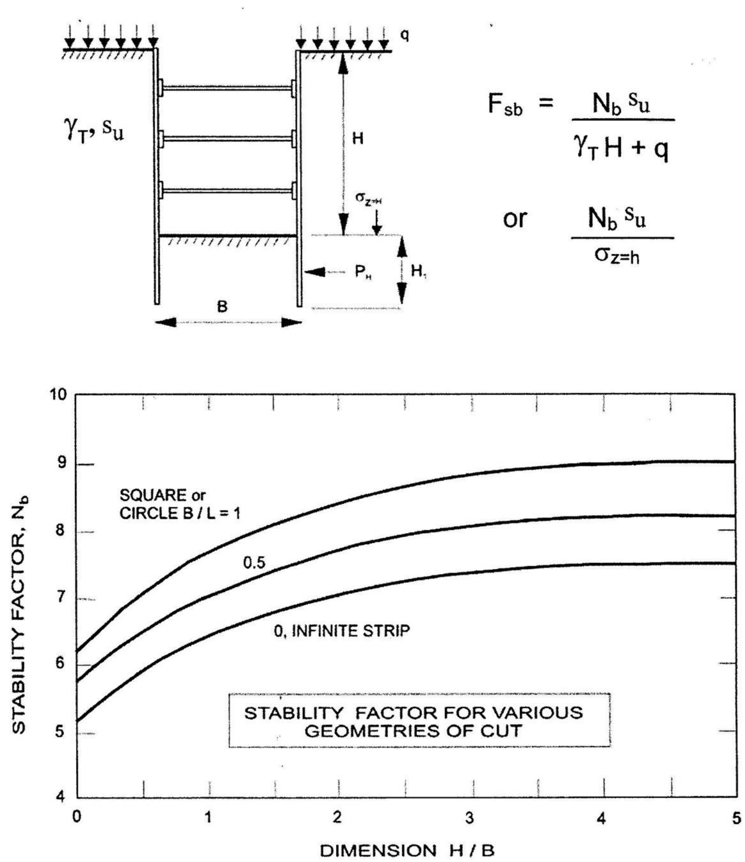

Figure 1 – Stability Factor of Various Geometries of Cut

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

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. However, the bedding thickness should be increased to 300 mm for areas over a bedrock subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe).

The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 99% of the material's SPMDD

Based on the soil profile encountered, the subgrade for the services will be placed in both bedrock and overburden soils. It is recommended that the subgrade medium be inspected in the field to determine how steeply the bedrock surface, where encountered, drops off. A transition should be provided where the bedrock slopes more than 3H:1V. At these locations, the bedrock should be excavated and replaced with addition bedding materials to provide a 3H:1V (or flatter) transition from the bedrock subgrade towards the soil subgrade. This treatment reduced the propensity for bending stress to occur in the service pipes.

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

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

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

6.5 Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavation.

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

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

6.6 Winter Construction

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

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

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

6.7 Corrosion Potential and Sulphate

The results of analytical testing from an adjacent site 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 results of chloride content, pH, and resistivity indicate the presence of a non-aggressive to slightly aggressive environment for exposed ferrous metals at this site.

6.8 Landscaping Considerations

Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks.
Atterberg limits testing was completed for the recovered silty clay samples at selected locations throughout the subject site. The soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Table 1 in Subsection 4.2 and in Appendix 1.

Based on the results of our review, three areas were defined within the subject site in which the tree planting restrictions are defined. The three areas are detailed below and are outlined in Drawing PG6009-3 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - No Tree Planting Restrictions Area

Due to the absence of sensitive marine clay in the subsurface profile encountered within this area, no tree planting restrictions will be required.

Area 2 – Low to Medium Sensitivity Clay Area

A low to medium sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below preliminary finished grade as per City Guidelines at the areas outlined in Drawing PG6009-3 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits' test results, the modified plasticity limit does not exceed 40% in these areas. The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met.

Area 3 - High Sensitivity Clay Area

A high sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below anticipated finished grade as per City Guidelines at the area outlined in Drawing PG6009-3 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits' test results, the modified plasticity limit generally exceeds 40% in this area. The following tree planting setbacks are recommended for these high sensitivity areas.

Large trees (mature height over 14 m) can be planted within this area provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space).

Tree planting setback limits is 7.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the following conditions are met:

- ❒ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.
- ❒ A small tree must be provided with a minimum of 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.
- ❒ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.
- ❒ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- ❒ Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Swimming Pools

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

Aboveground Hot Tubs

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

Installation of Decks or Additions

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

6.9 Slope Stability Analysis

Slope Conditions

The subject site hosts a 6 m high slope with the centre of the site running in the southeast to northwest direction. The slope is considered near flat with an inclination ranging between 15H:1V to 25H:1V. 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.

Two (2) slope cross-sections (Sections A and B) were studied as the worst case scenarios. The cross-section locations are presented on Drawing PG6009-1 – 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 and 3 in Appendix 2 from the topographic data identified on Drawing PG6009-1 - Test Hole Location Plan in Appendix 2.

Static Conditions

The static analysis results for slope sections A and B are presented in Figures 2A and 3A, respectively, provided in Appendix 2. The factor of safety for the slopes was greater than 1.5 for the slope sections analysed.

Seismic Loading

The results of the analyses with seismic loading are shown in Figures 2 and 3 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.

Based on the above noted analysis results, the existing slope is considered stable and acceptable from a geotechnical perspective.

7.0 Recommendations

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

- Grading plan review from a geotechnical perspective, once the final grading plan is available.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- 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 inspection program by the geotechnical consultant.

8.0 Statement of Limitations

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

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

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than 1384341 Ontario Ltd. or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
August 24, 2022
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

Fernanda Carozzi, PhD Geoph.

Faisal I. Abou-Seido, P.Eng.

Report Distribution:

❑ 1384341 Ontario Ltd. (Digital copy)
❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

ATTERBERG LIMITS' TESTING RESULTS

GRAIN-SIZE DISTRIBUTION TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP 1-19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	79.81		
TOPSOIL 0.30		G	1						
Compact, brown **SILTY SAND** 0.45		G	2						
Hard, brown **SILTY CLAY**		G	3					▲ 252	
						1	78.81		
		G	4					▲ 206	
		G	5			2	77.81	▲ 200	
2.95		G	6						▽
End of Test Pit (Groundwater infiltration at 2.6m depth)									

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

○ Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP 2-19

BORINGS BY Hydraulic Shovel

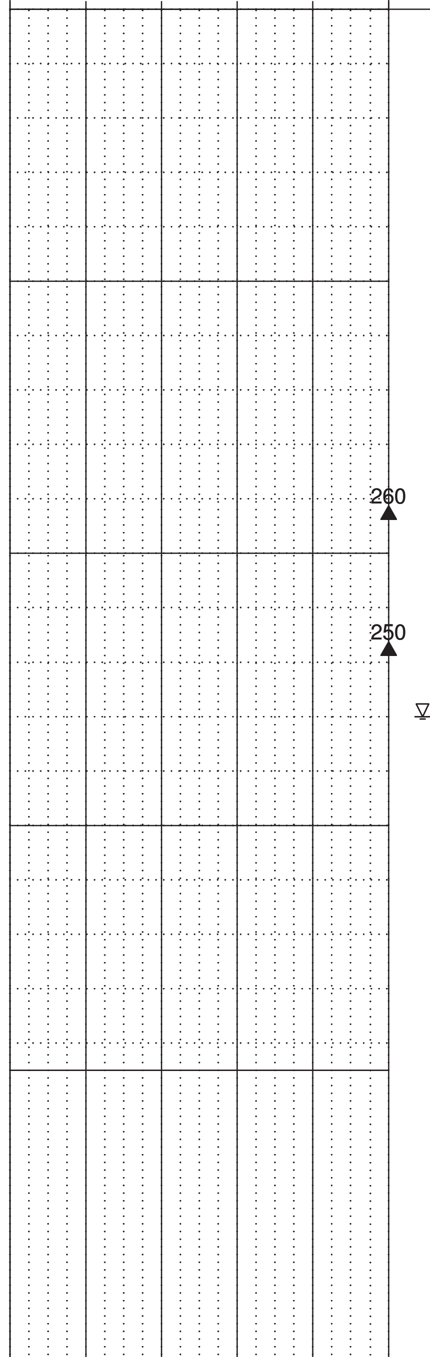
DATE 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	79.17
TOPSOIL 0.30							
Compact, brown **SILTY SAND** 1.60		G	1			1	78.17
Hard, brown **SILTY CLAY**		G	2			2	77.17
		G	3				
- grey by 2.8m depth		G	4			3	76.17
3.90		G	5				
End of Test Pit							
(Groundwater infiltration at 2.6m depth)							

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
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP 3-19

BORINGS BY Hydraulic Shovel **DATE** 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	79.52		
TOPSOIL 0.25									
Compact, brown **SILTY SAND**		G	1						
		G	2			1	78.52	▲ 260	
1.30									
Hard, brown **SILTY CLAY**						2	77.52		
		G	3					▲ 260	
									▽
						3	76.52		
- trace gravel by 3.3m depth		G	4						
3.70									
End of Test Pit									
(Groundwater infiltration at 2.8m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP 4-19

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	73.35		
TOPSOIL 0.30		G	1						
End of Test Pit Practical refusal to excavation on bedrock surface at 0.30m depth (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP 4B-19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % / Shear Strength (kPa) ▲ Undisturbed △ Remoulded	Piezometer Construction
GROUND SURFACE						0	79.18		
TOPSOIL 0.15									
Compact, brown **SILTY SAND**		G	1						
1.00						1	78.18		
Hard, brown **SILTY CLAY**		G	2					▲ 260	▽
		G	3					▲ 260	
						2	77.18		
		G	4					▲ 235	
						3	76.18		
3.50		G	5						
End of Test Pit									
(Groundwater infiltration at 1.3m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa) axis: 20 40 60 80 100

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP 5-19

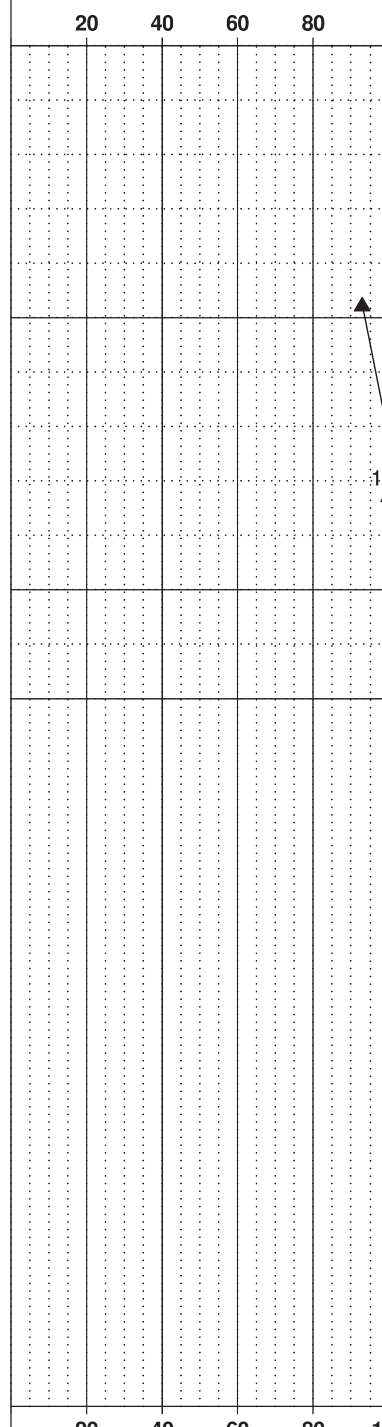
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	70.72
TOPSOIL (to 0.25)	G	1				
Compact, brown **SILTY SAND** (0.25 to 0.85)	G	2				
Stiff to very stiff, brown **SILTY CLAY** (0.85 to 1.90)	G	3			1	69.72
	G	4				
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders (1.90 to 2.40)	G	5			2	68.72
End of Test Pit (2.40)						

Practical refusal to excavation on bedrock surface at 2.40m depth

(Groundwater infiltration at 2.0m depth)

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP 6-19

BORINGS BY Hydraulic Shovel

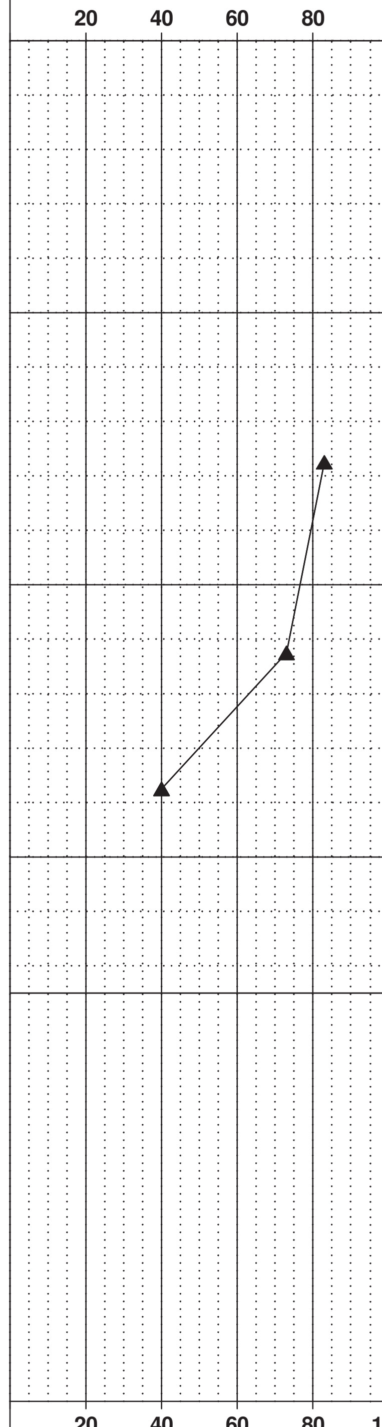
DATE 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.64
TOPSOIL (to 0.25)		G	1				
Compact, brown **SILTY SAND** (to 1.10)		G	2			1	69.64
Stiff, brown **SILTY CLAY**		G	3				
		G	4			2	68.64
- firm and grey by 2.6m depth (to 2.90)		G	5				
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles and boulders (to 3.50)		G	6			3	67.64
End of Test Pit							
(Groundwater infiltration at 2.5m depth)							

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

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP 7-19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Shear Strength (kPa) ▲ Undisturbed	Piezometer Construction
GROUND SURFACE						0	79.12		
TOPSOIL 0.20		G	1						
Hard to very stiff, brown **SILTY CLAY**		G	2						
		G	3					241	
						1	78.12		
		G	4					195	
						2	77.12		
		G	5					180	
									∇
						3	76.12		
3.20		G	6					111	
End of Test Pit (Groundwater infiltration at 2.5m depth)									

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP 8-19

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

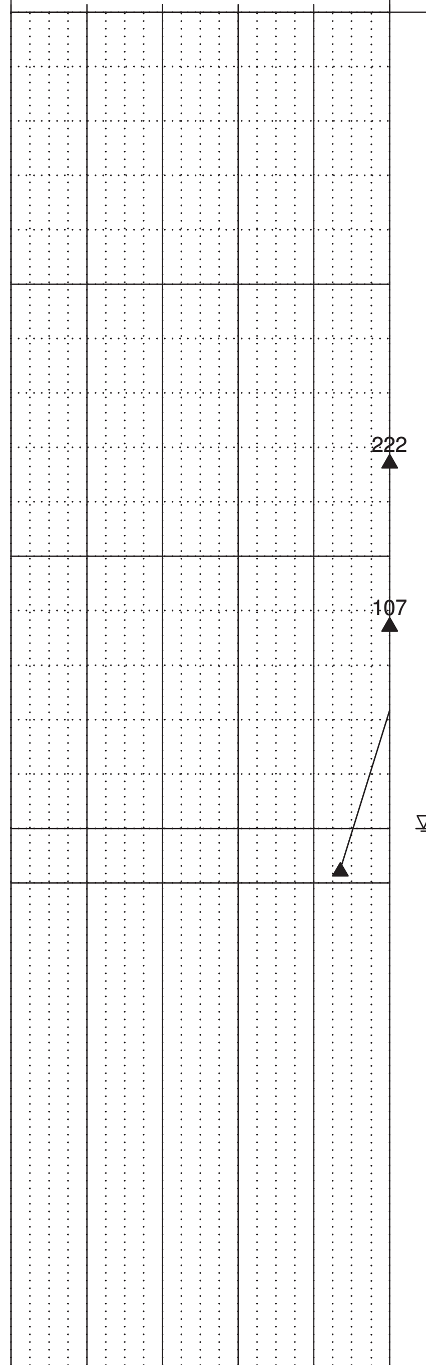
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	78.87
TOPSOIL (to 0.20)		G	1				
Compact, brown **SILTY SAND** (0.20 to 1.40)		G	2				
		G	3			1	77.87
Hard to very stiff, brown **SILTY CLAY** (1.40 to 3.20)		G	4				
		G	5			2	76.87
- stiff and grey by 3.0m depth		G	6			3	75.87
End of Test Pit (3.20)							

(Groundwater infiltration at 3.0m depth)

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
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP 9-19

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % / Shear Strength (kPa)	Piezometer Construction
GROUND SURFACE						0	79.48		
TOPSOIL 0.20		G	1						
Compact, brown **SILTY SAND** 1.15		G	2			1	78.48		
Hard, brown **SILTY CLAY**		G	3					▲ 260	▽
						2	77.48		
		G	4					▲ 247	
		G	5					▲ 203	
- grey by 3.3m depth						3	76.48		
3.50		G	6					▲ 220	
End of Test Pit (Groundwater infiltration at 1.7m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP10-19

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

SOIL DESCRIPTION	Depth to base of layer (m)
GROUND SURFACE	
TOPSOIL	0.20
Compact, brown **SILTY SAND**	1.30
Hard to very stiff, brown **SILTY CLAY**	2.80
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles and boulders	3.00
End of Test Pit	
(Groundwater infiltration at 2.8m depth)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		
G	4		
G	5		

DEPTH (m)	ELEV. (m)
0	77.49
1	76.49
2	75.49
3	74.49

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

○ Water Content %

20 40 60 80

Shear Strength (kPa), ▲ Undisturbed
260
199

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP11-19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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	70.62		
TOPSOIL 0.20		G	1						
Compact, brown **SILTY SAND** 0.50		G	2						
End of Test Pit Practical refusal to excavation on bedrock surface at 0.50m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

FILE NO. PG5145

HOLE NO. TP11B-19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	70.57
TOPSOIL (to 0.15)		G	1				
Compact, brown **SILTY SAND** with clay - with gravel by 0.7m depth (to 1.10)		G	2			1	69.57
End of Test Pit Practical refusal to excavation on bedrock surface at 1.10m 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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1020-1070 March Rd.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5145

REMARKS

HOLE NO. TP12-19

BORINGS BY Hydraulic Shovel

DATE 2019 December 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	70.54		
TOPSOIL 0.20		G	1						
Compact, brown **SILTY SAND** 1.35		G	2						
		G	3			1	69.54		
Very stiff, brown **SILTY CLAY** 2.30		G	4					▲ 101	
		G	5			2	68.54		∇
End of Test Pit									

Practical refusal to excavation on bedrock surface at 2.30m depth

(Groundwater infiltration at 2.2m depth)

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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

SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 1

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.25				
Stiff, brown **SILTY CLAY** with sand	0.56	G	1		
GLACIAL TILL: Dense, brown silty clay with sand, gravel, cobbles and boulders	3.35	G	2		
		G	3		

End of Test Pit

Practical refusal to excavation @ 3.35m depth

(Groundwater infiltration @ 1.8m depth)

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

ELEV. (m)

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
Prop. Residential Development - Dekok Lands
March Road, Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL 0.30									
		G	1						
		G	2						
Very stiff, brown **SILTY CLAY,** some sand						1			
2.39						2			▽
		G	3						
GLACIAL TILL: Dense to very dense, grey silty clay with sand and gravel						3			
3.63		G	4						
End of Test Pit									
Practical refusal to excavation @ 3.63m depth									
(Groundwater infiltration @ 2.4m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	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			
TOPSOIL 0.18									
Brown **SILTY CLAY** with sand 0.33		G	1						
						1			
GLACIAL TILL: Dense, brown silty clay with sand and gravel						2			∇ (1.4m)
						3			
3.66		G	2						
End of Test Pit Practical refusal to excavation @ 3.66m depth (Groundwater infiltration @ 1.4m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL 0.18									
Stiff, brown **SILTY CLAY,** some sand 0.71		G	1						
		G	2						
GLACIAL TILL: Dense to very dense, grey-brown silty clay with sand, gravel and cobbles		G	3			1			
						2			∇
3.05						3			
End of Test Pit Practical refusal to excavation @ 3.05m depth (Groundwater infiltration @ 1.8m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa) axis: 20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 5

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE	0				
TOPSOIL	0.20				
Compact, brown **SILTY SAND**	0.97	G	1		
GLACIAL TILL: Compact to dense, brown silty clay with sand, gravel, cobbles and boulders	3.66	G	2		

End of Test Pit

Practical refusal to excavation @ 3.66m depth

(Groundwater infiltration @ 1.7m depth)

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

ELEV. (m)

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
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March Road, Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 6

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			
TOPSOIL 0.10									
Compact, brown **SILTY SAND** 1.22		G	1			1			
GLACIAL TILL: Compact to dense, grey silty clay with sand, gravel, cobbles and boulders 4.55		G	2			2, 3, 4			
End of Test Pit (TP dry upon completion)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

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			
TOPSOIL 0.25									
GLACIAL TILL: Compact, grey silty clay with sand, gravel, cobbles and boulders 0.91									
End of Test Pit Practical refusal to excavation @ 0.91m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 8

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			
TOPSOIL 0.30									
GLACIAL TILL: Compact, grey-brown silty clay with sand, gravel, cobbles and boulders						1			
2.13						2			▽
End of Test Pit Practical refusal to excavation @ 2.13m depth (Groundwater infiltration @ 2.1m depth)									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Dekok Lands
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DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL 0.30									
GLACIAL TILL: Compact, grey silty clay with sand, gravel, cobbles and boulders		G	1			1			
2.44		G	2			2			
End of Test Pit Practical refusal to excavation @ 2.44m depth (TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL 0.30									
Compact, brown **SILTY SAND,** trace clay 0.86		G	1						
		G	2						
GLACIAL TILL: Compact, grey silty clay with sand, gravel, cobbles and boulders						1			
						2			∇
2.44		G	3						
End of Test Pit Practical refusal to excavation @ 2.44m depth (Groundwater infiltration @ 1.8m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa) axis: 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM	FILE NO. PG2256
REMARKS	HOLE NO. TP11
BORINGS BY Backhoe	DATE 4 November 2010

SOIL DESCRIPTION	Depth to (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
TOPSOIL	0.15							
Compact, brown **SILTY SAND**	0.74							
GLACIAL TILL: Compact to dense, brown silty clay with sand, gravel, cobbles and boulders	2.84					1		∇ (1.1 m)
						2		
End of Test Pit Practical refusal to excavation @ 2.84m depth (Groundwater infiltration @ 1.1m depth)								

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

○ Water Content %

20 40 60 80

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

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0			
TOPSOIL — 0.25									
Compact, brown **SILTY SAND** — 0.76									
GLACIAL TILL: Compact to dense, grey-brown silty clay with sand, gravel, cobbles and boulders — 1.98						1			
End of Test Pit Practical refusal to excavation @ 1.98m depth (Groundwater infiltration @ bottom of test pit)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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

DATUM

REMARKS

BORINGS BY Backhoe

DATE 4 November 2010

FILE NO. PG2256

HOLE NO. TP13

SOIL DESCRIPTION	Depth to base (m)	DEPTH (m)
GROUND SURFACE		0
TOPSOIL	0.30	
Compact, brown **SILTY SAND**	0.74	1
GLACIAL TILL: Compact to dense, grey silty clay with sand, gravel, cobbles and boulders	2.49	2
End of Test Pit Practical refusal to excavation @ 2.49m depth (Groundwater infiltration @ 2.2m depth)		

Column headings: STRATA PLOT; SAMPLE (TYPE, NUMBER, % RECOVERY, 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

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

TABLE II

PRELIMINARY RECORD OF TEST PITS
PROPOSED RESIDENTIAL DEVELOPMENT
1020 MARCH ROAD, KANATA
CITY OF OTTAWA, ONTARIO

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP1 Elev. 81.35m	0.00 – 0.23	TOPSOIL
	0.23 – 3.66	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	3.66 – 3.76	Grey brown coarse sand, some silt, clay, gravel and cobbles (GLACIAL TILL)
	3.76	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.5	>100

Groundwater seepage into test pit observed at about 3.0 metres below existing ground surface, December 10, 2012.

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP2 Elev. 79.06m	0.00 – 0.30	TOPSOIL
	0.30 – 3.51	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	3.51	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.2	>100
2.4	60

Groundwater seepage into test pit observed at about 1.5 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP3 Elev. 78.49m	0.00 – 0.23	TOPSOIL
	0.23 – 0.69	Grey brown SILTY SAND
	0.69 – 1.14	Grey medium to coarse SAND, trace silt
	1.14 – 4.27	Very stiff to stiff SILTY CLAY
	4.27 – 4.42	Grey brown coarse sand, some silt, clay, gravel and cobbles (GLACIAL TILL)
	4.42	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
2.4	84
3.4	56

Groundwater seepage into test pit observed at about 1.5 metres below existing ground surface, December 10, 2012.

TEST PIT NUMBER	DEPTH (METRES)	DESCRIPTION
TP4 Elev. 79.62m	0.00 – 0.30	TOPSOIL
	0.30 – 1.45	Yellow brown becoming grey brown at 0.7 metres depth SILTY SAND
	1.45 – 4.11	Very stiff to stiff grey brown, becoming grey at about 3.0 metres depth SILTY CLAY
	4.11	End of test pit

Groundwater seepage into test pit observed at about 4.1 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP5 Elev. 79.42m	0.00 – 0.48	TOPSOIL
	0.48 – 2.92	Very stiff to stiff grey brown, becoming grey at about 1.1 metres depth SILTY CLAY
	2.92	End of test pit, refusal on large boulder or possible bedrock

Groundwater seepage into test pit observed at about 2.7 metres below existing ground surface, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP6 Elev. 78.40m	0.00 – 0.30	TOPSOIL
	0.30 – 4.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	4.00	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.4	>100
2.0	60
3.0	50
4.0	50

Groundwater seepage into test pit observed at about 1.5 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP7 Elev. 79.41m	0.00 – 0.30	TOPSOIL
	0.30 – 1.40	Yellow brown medium to coarse SAND, trace silt
	1.40 – 4.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	4.00	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.6	>100
3.0	60
4.0	50

Groundwater seepage into test pit observed at about 4.0 metres below existing ground surface, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP8 Elev. 79.41m	0.00 – 0.30	TOPSOIL
	0.30 – 1.60	Yellow brown to grey brown medium to coarse SAND, trace silt
	1.60 – 4.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	4.00	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
3.0	>100
4.0	>100

No groundwater seepage observed in test pit, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP9 Elev. 79.59m	0.00 – 0.30	TOPSOIL
	0.30 – 1.60	Yellow brown to grey brown medium to coarse SAND, trace silt
	1.60 – 4.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	4.00	End of test pit

No groundwater seepage observed in test pit, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP10 Elev. 79.21m	0.00 – 0.30	TOPSOIL
	0.30 – 1.40	Yellow brown medium to coarse SAND, trace silt
	1.40 – 4.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	4.00	End of test pit

Groundwater seepage into test pit observed at about 4.0 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP11 Elev. 78.57m	0.00 – 0.30	TOPSOIL
	0.30 – 3.60	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	3.60 – 3.90	Grey brown coarse sand, some silt, clay, gravel and cobbles (GLACIAL TILL)
	3.90	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
0.8	>100
1.5	80
2.0	70
3.0	80

Groundwater seepage observed in test pit at about 0.8 metres below existing ground surface, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP12 Elev. 80.02m	0.00 – 0.30	TOPSOIL
	0.30 – 3.80	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	3.80 – 4.00	Grey brown coarse sand, some silt, clay, gravel and cobbles (GLACIAL TILL)
	4.00	End of test pit

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.0	>100
3.0	80

Groundwater seepage observed in test pit at about 3.4 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP13 Elev. 72.12m	0.00 – 0.20	TOPSOIL
	0.20	End of test pit, refusal on large boulder or possible bedrock

No groundwater seepage observed in test pit, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP14 Elev. 70.57m	0.00 – 0.30	TOPSOIL
	0.30 – 1.20	Grey brown SILTY SAND
	1.20 – 2.00	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	2.00	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.8	80

Groundwater seepage observed in test pit at about 1.8 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP15 Elev. 70.32m	0.00 – 0.30	TOPSOIL
	0.30 – 1.40	Grey brown SILTY SAND
	1.40 – 3.90	Very stiff to firm grey brown, becoming grey with depth SILTY CLAY
	3.90	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.6	80
2.0	60
3.0	52
3.6	40

Groundwater seepage observed in test pit at about 3.9 metres below existing ground surface, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP16 Elev. 70.73m	0.00 – 0.30	TOPSOIL
	0.30 – 1.00	Grey brown medium SAND
	1.00 – 2.10	Very stiff to firm grey brown, becoming grey with depth SILTY CLAY
	2.10	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.5	>100
1.8	50
2.0	40

Groundwater seepage observed in test pit at about 1.2 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP17 Elev. 70.77m	0.00 – 0.30	TOPSOIL
	0.30 – 1.00	Grey brown medium SAND
	1.00 – 2.10	Very stiff to firm grey brown, becoming grey with depth SILTY CLAY
	2.10	End of test pit, refusal on large boulder or possible bedrock

Groundwater seepage observed in test pit at about 1.2 metres below existing ground surface, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP18 Elev. 70.96m	0.00 – 0.30	TOPSOIL
	0.30 – 0.60	Grey brown fine to medium SAND
	0.60 – 2.60	Very stiff to firm grey brown, becoming grey with depth SILTY CLAY
	2.60	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.2	>100
1.8	50
2.4	38

Groundwater seepage observed in test pit at about 2.0 metres below existing ground surface, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP19 Elev. 70.36m	0.00 – 0.30	TOPSOIL
	0.30 – 1.20	Grey brown SILTY SAND
	1.20	End of test pit, refusal on large boulder or possible bedrock

No groundwater seepage observed in test pit, December 10, 2012.

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP20 Elev. 70.03m	0.00 – 0.30	TOPSOIL
	0.30 – 0.70	Grey brown SILTY SAND
	0.70 – 2.40	Very stiff to stiff grey brown, becoming grey with depth SILTY CLAY
	2.40	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.4	>100
1.8	80
2.2	50

No groundwater seepage observed in test pit, December 10, 2012.

TABLE II (continued)

TEST HOLE NUMBER	DEPTH (METRES)	DESCRIPTION
TP21 Elev. 70.09m	0.00 – 0.30	TOPSOIL
	0.30 – 1.10	Grey brown medium SAND
	1.10 – 3.30	Very stiff to firm grey brown, becoming grey with depth SILTY CLAY
	3.30	End of test pit, refusal on large boulder or possible bedrock

Depth (m)	Undrained Shear Strength, Cu (kPa)
1.5	>100
2.6	70
2.8	52
3.1	30

No groundwater seepage observed in test pit, December 10, 2012.

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. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

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

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.

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 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

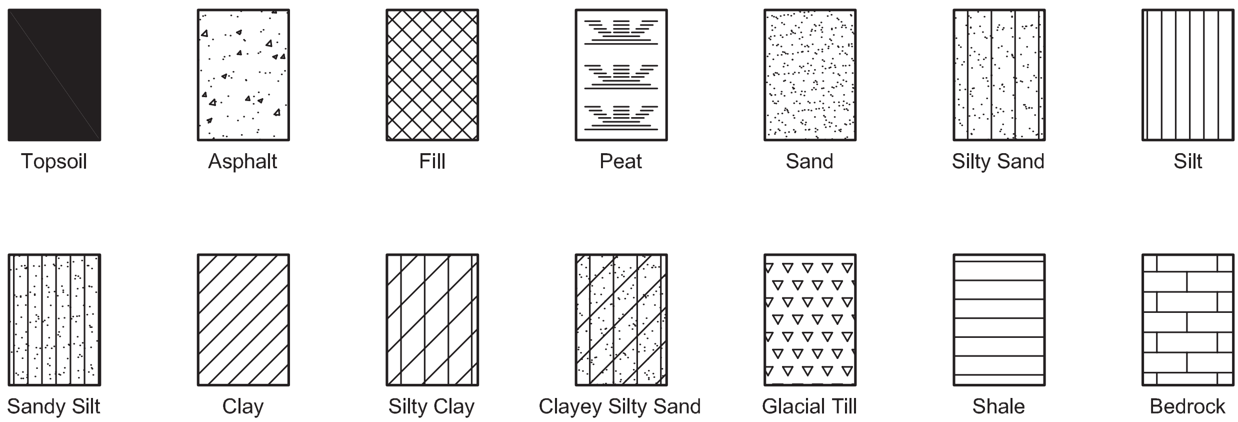
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

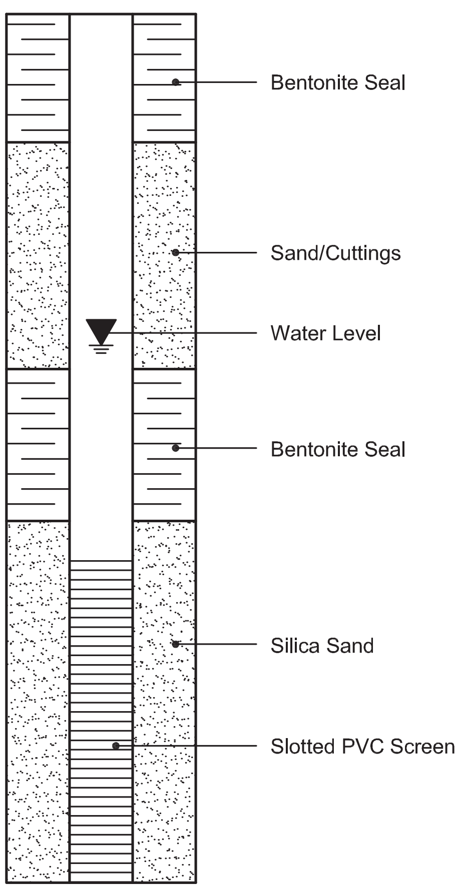
SYMBOLS AND TERMS (continued)

STRATA PLOT

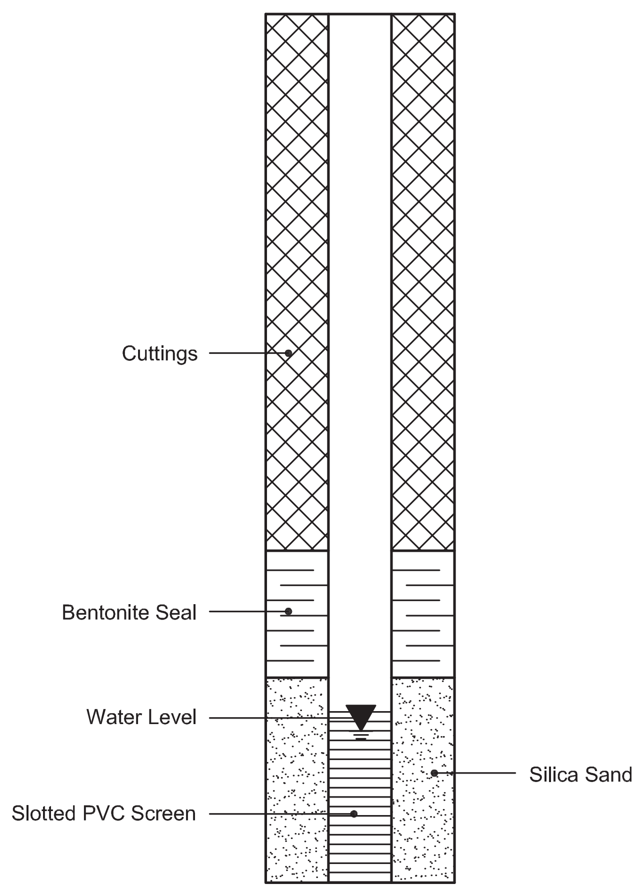


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



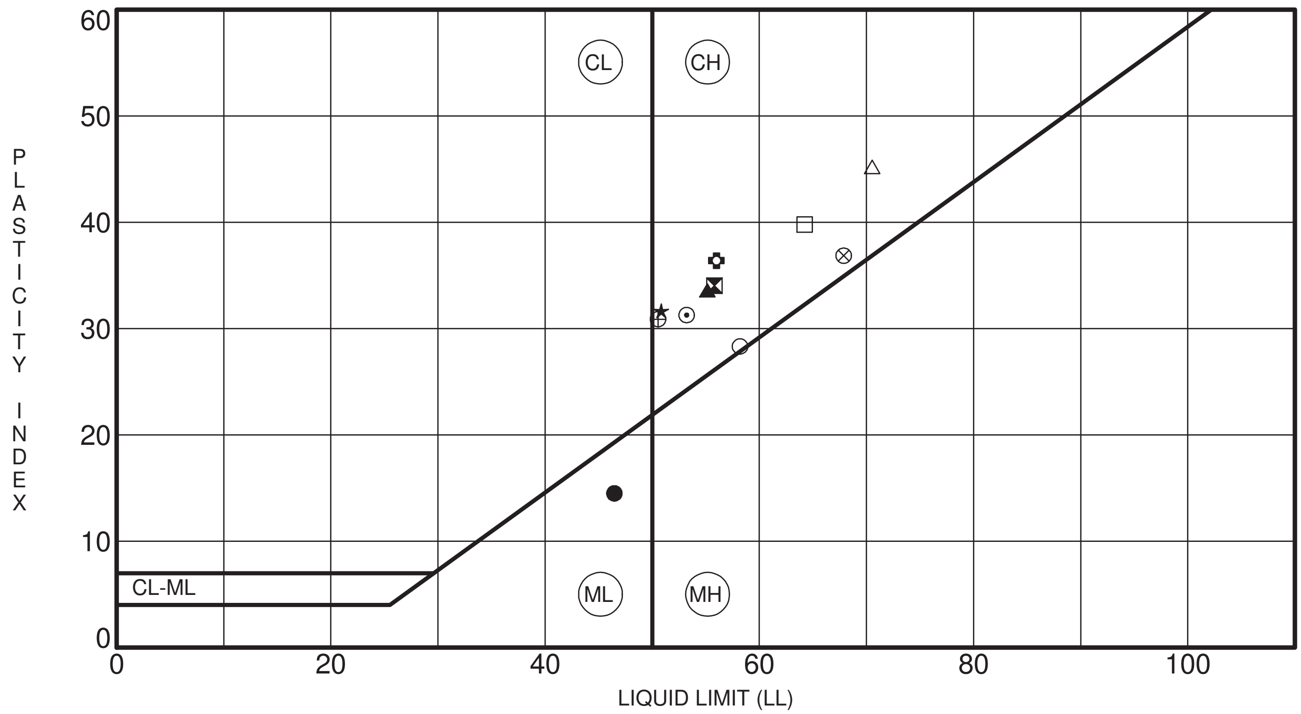
PIEZOMETER CONSTRUCTION



Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 26993

Report Date: 19-Dec-2019
Order Date: 13-Dec-2019
Project Description: PG5145

	Client ID:	TP9-G3	-	-	-
	Sample Date:	06-Dec-19 14:00	-	-	-
	Sample ID:	1950640-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	74.5	-	-	-
General Inorganics					
pH	0.05 pH Units	6.75	-	-	-
Resistivity	0.10 Ohm.m	157	-	-	-
Anions					
Chloride	5 ug/g dry	8	-	-	-
Sulphate	5 ug/g dry	13	-	-	-



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**TP 1-19**	**G 3**	**46**	**32**	**14**		**ML - Inorganic silts of low plasticity**
⧗	**TP 2-19**	**G 2**	**56**	**22**	**34**		**CH - Inorganic clays of high plasticity**
▲	**TP 3-19**	**G 2**	**55**	**22**	**34**		**CH - Inorganic clays of high plasticity**
★	**TP 4B-19**	**G 3**	**51**	**19**	**32**	**99.3**	**CH - Inorganic clays of high plasticity CH**
⊙	**TP 5-19**	**G 3**	**53**	**22**	**31**		**CH - Inorganic clays of high plasticity**
✿	**TP 6-19**	**G 3**	**56**	**20**	**36**		**CH - Inorganic clays of high plasticity**
○	**TP 7-19**	**G 3**	**58**	**30**	**28**		**CH - Inorganic clays of high plasticity**
△	**TP 8-19**	**G 4**	**71**	**25**	**45**	**97.8**	**CH - Inorganic clays of high plasticity CH**
⊗	**TP 9-19**	**G 3**	**68**	**31**	**37**		**CH - Inorganic clays of high plasticity**
⊕	**TP10-19**	**G 3**	**51**	**20**	**31**		**CH - Inorganic clays of high plasticity**
□	**TP12-19**	**G 4**	**64**	**24**	**40**		**CH - Inorganic clays of high plasticity**

CLIENT **Valecraft Homes**

FILE NO. **PG5145**

PROJECT **Geotechnical Investigation - 1020-1070 March Road**

DATE **6 Dec 19**

patersongroup **Consulting Engineers**

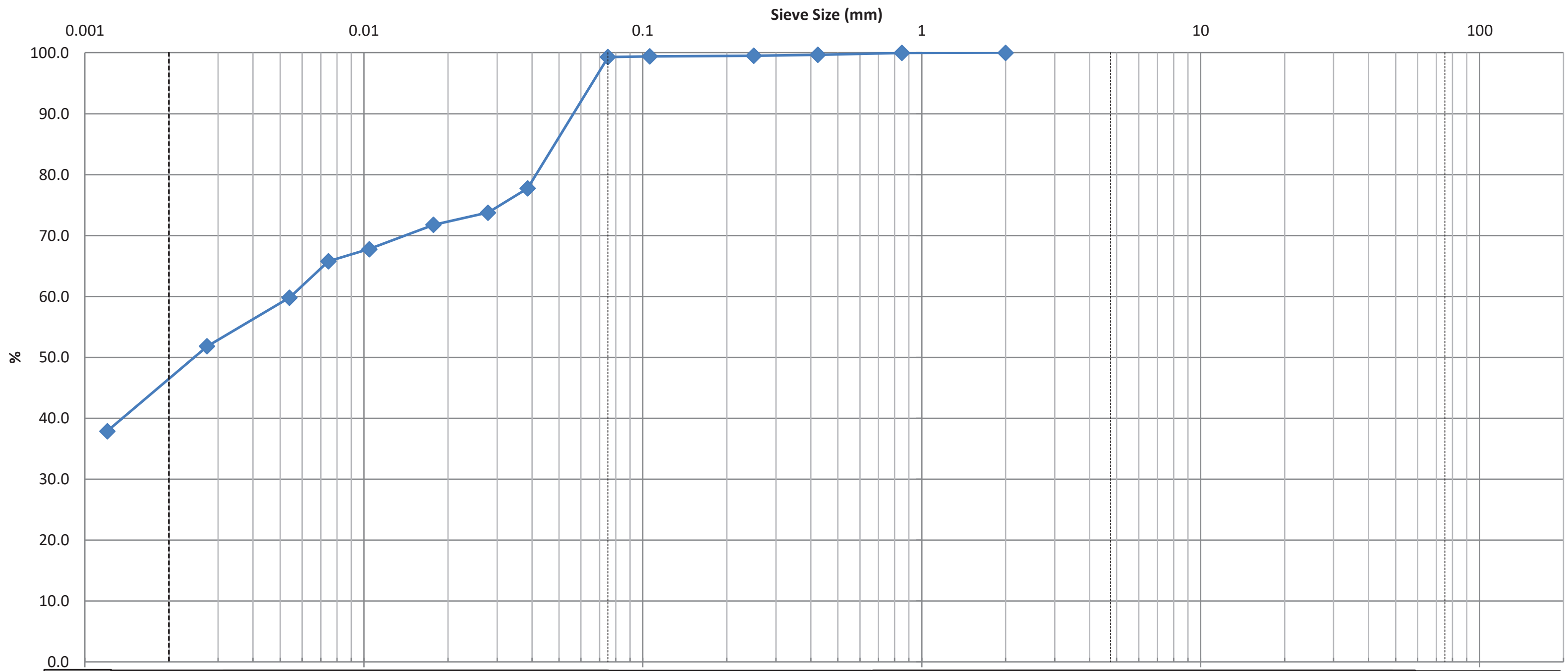
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Valecraft Homes	DEPTH:	1.8 - 1.9m	FILE NO:	PG5145
CONTRACT NO.:		BH OR TP No.:	TP4B - G3	LAB NO:	14615
PROJECT:	1020 to 1070 March Road			DATE RECEIVED:	12-Dec-19
				DATE TESTED:	13-Dec-19
DATE SAMPLED:	6-Dec-19			DATE REPORTED:	17-Dec-19
SAMPLED BY:	D.P.			TESTED BY:	O.M.



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					25.4					
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)		
					0.0	0.7	52.8	46.5		

Comments:

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

patersongroup
consulting engineers

HYDROMETER
LS-702 ASTM-422

CLIENT:	Valecraft Homes	DEPTH:	1.8 - 1.9m	FILE NO.:	PG5145
PROJECT:	1020 to 1070 March Road	BH OR TP No.:	TP4B - G3	DATE SAMPLED	06-Dec-19
LAB No. :	14615	TESTED BY:	O.M.	DATE RECEIVE	12-Dec-19
SAMPLED BY:	D.P.	DATE REPT'D:	17-Dec-19	DATE TESTED:	13-Dec-19

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
121.3	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	49.60	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.36	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	149.20	99.20
		CORRECTED	0.992	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
13.2				
9.5				
4.75				
2.0		**0.0**	0.0	**100.0**
Pan		**121.3**		
0.850		**0.01**	0.0	**100.0**
0.425		**0.16**	0.3	**99.7**
0.250		**0.23**	0.5	**99.5**
0.106		**0.30**	0.6	**99.4**
0.075		**0.35**	0.7	**99.3**
Pan		**0.36**		
SIEVE CHECK	0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:31	45.0	6.0	22.0	0.0387	77.7	**77.7**
2	8:32	43.0	6.0	22.0	0.0279	73.8	**73.8**
5	8:35	42.0	6.0	22.0	0.0178	71.8	**71.8**
15	8:45	40.0	6.0	22.0	0.0105	67.8	**67.8**
30	9:00	39.0	6.0	22.0	0.0075	65.8	**65.8**
60	9:30	36.0	6.0	22.0	0.0054	59.8	**59.8**
250	12:40	32.0	6.0	22.0	0.0027	51.8	**51.8**
1440	8:30	25.0	6.0	22.0	0.0012	37.9	**37.9**

COMMENTS:

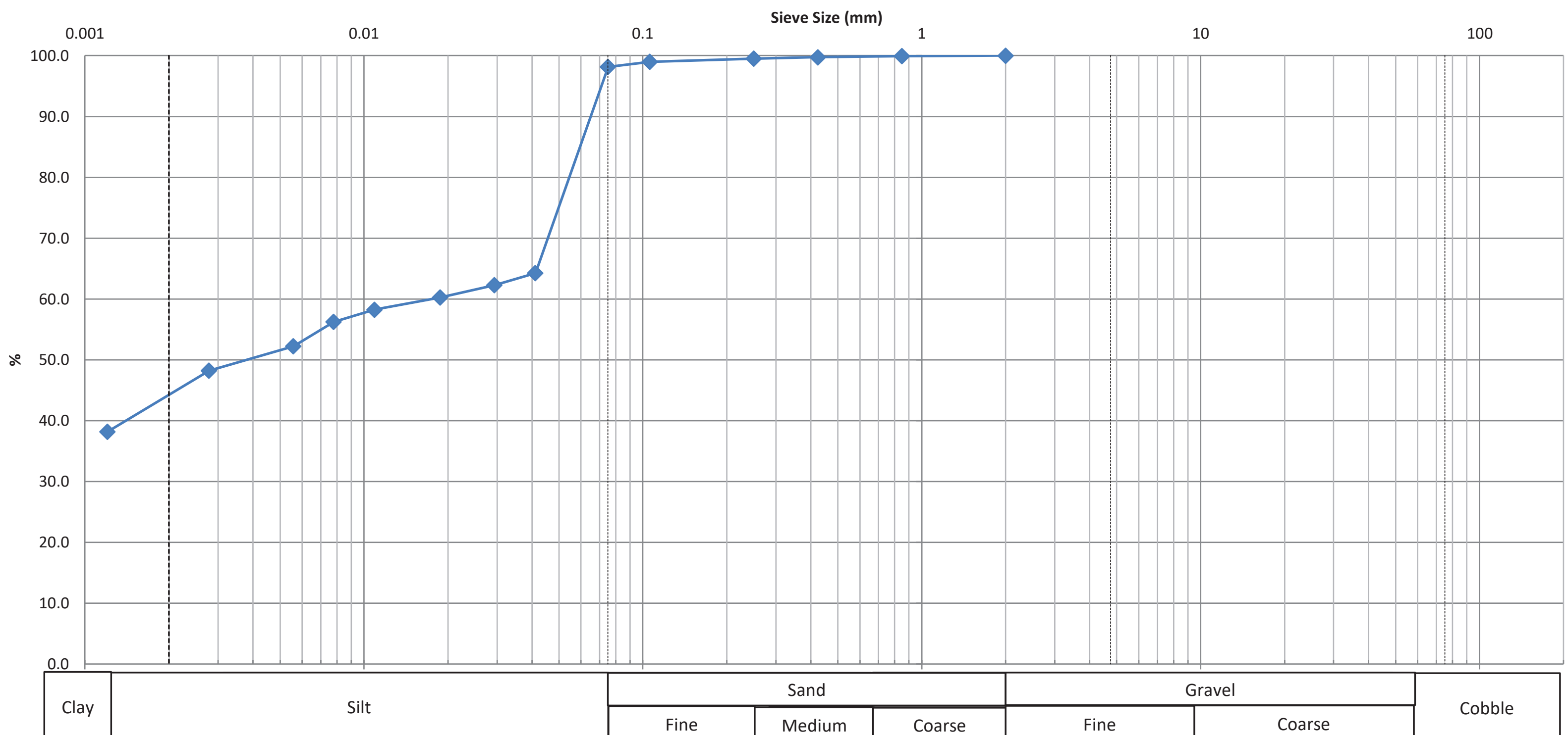
Moisture Content = 25.4

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Valecraft Homes	DEPTH:	1.6 - 1.7m	FILE NO:	PG5145
CONTRACT NO.:		BH OR TP No.:	TP5 - G4	LAB NO:	14616
PROJECT:	1020 to 1070 March Road			DATE RECEIVED:	12-Dec-19
				DATE TESTED:	13-Dec-19
DATE SAMPLED:	6-Dec-19			DATE REPORTED:	17-Dec-19
SAMPLED BY:	D.P.			TESTED BY:	O.M.



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					34.6					
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)		
					0.0	1.8	55.0	43.2		

Comments:

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

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Valecraft Homes	DEPTH:	1.6 - 1.7m	FILE NO.:	PG5145
PROJECT:	1020 to 1070 March Road	BH OR TP No.:	TP5 - G4	DATE SAMPLED	06-Dec-19
LAB No. :	14616	TESTED BY:	O.M.	DATE RECEIVE	12-Dec-19
SAMPLED BY:	D.P.	DATE REPT'D:	17-Dec-19	DATE TESTED:	13-Dec-19

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
105.6	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	49.23	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.90	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	148.45	98.45
		CORRECTED	0.985	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
13.2				
9.5				
4.75				
2.0		**0.0**	0.0	**100.0**
Pan		**105.6**		
0.850		**0.04**	0.1	**99.9**
0.425		**0.12**	0.2	**99.8**
0.250		**0.23**	0.5	**99.5**
0.106		**0.50**	1.0	**99.0**
0.075		**0.90**	1.8	**98.2**
Pan		**0.90**		
SIEVE CHECK	0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:51	38.0	6.0	22.0	0.0412	64.3	**64.3**
2	8:53	37.0	6.0	22.0	0.0294	62.3	**62.3**
5	8:55	36.0	6.0	22.0	0.0188	60.3	**60.3**
15	9:05	35.0	6.0	22.0	0.0109	58.3	**58.3**
30	9:20	34.0	6.0	22.0	0.0078	56.2	**56.2**
60	9:50	32.0	6.0	22.0	0.0056	52.2	**52.2**
250	13"00	30.0	6.0	22.0	0.0028	48.2	**48.2**
1440	8:50	25.0	6.0	22.0	0.0012	38.2	**38.2**

COMMENTS:

Moisture Content = 34.6

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.

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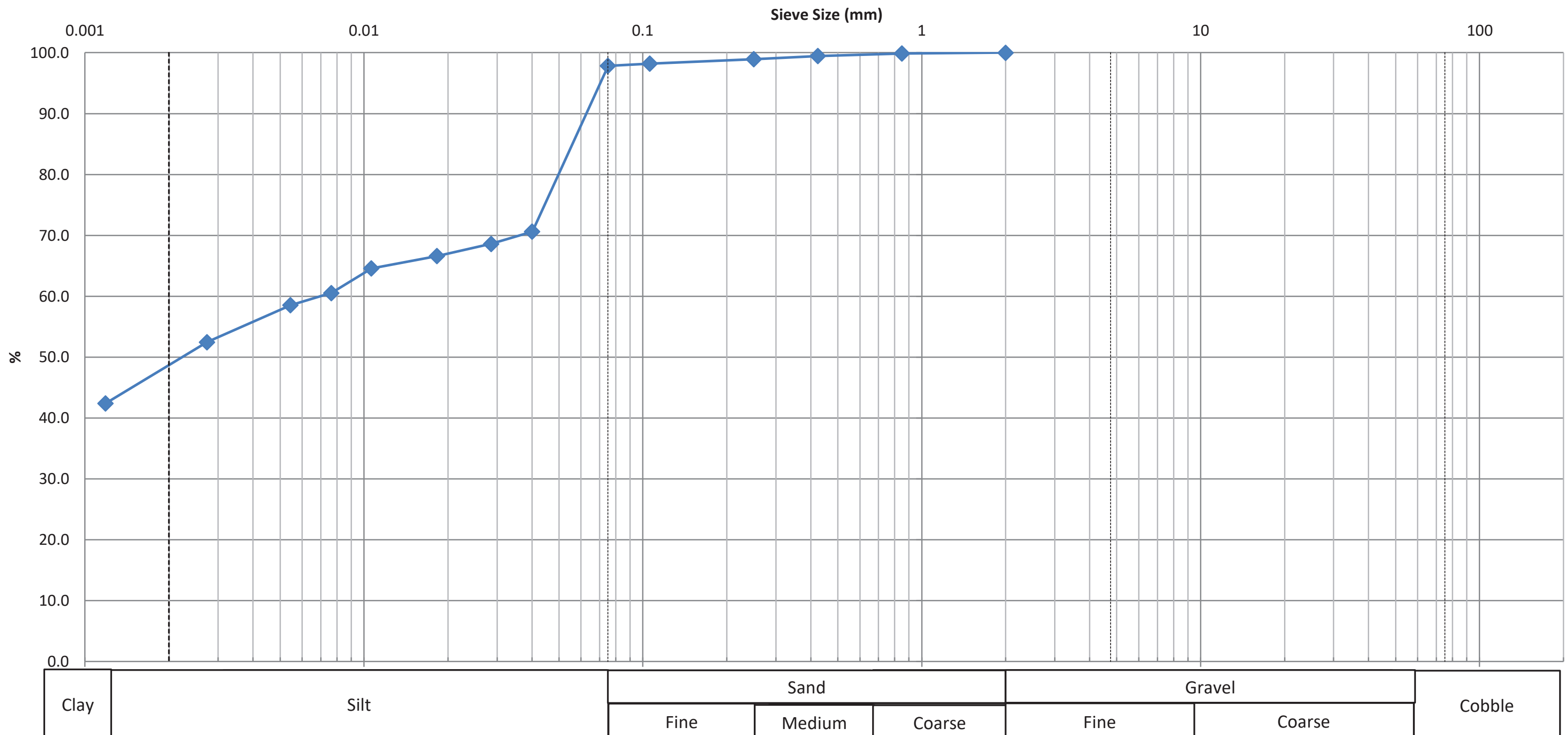
SIEVE ANALYSIS
ASTM C136

CLIENT:	Valecraft Homes	DEPTH:	1.6 - 1.7m	FILE NO:	PG5145
CONTRACT NO.:		BH OR TP No.:	TP8 - G4	LAB NO:	14617
PROJECT:	1020 to 1070 March Road			DATE RECEIVED:	12-Dec-19
				DATE TESTED:	13-Dec-19
DATE SAMPLED:	6-Dec-19			DATE REPORTED:	17-Dec-19
SAMPLED BY:	D.P.			TESTED BY:	O.M.



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					33.0					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	2.2		49.3		48.5

Comments:

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

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Valecraft Homes	DEPTH:	1.6 - 1.7m	FILE NO.:	PG5145
PROJECT:	1020 to 1070 March Road	BH OR TP No.:	TP8 - G4	DATE SAMPLED	06-Dec-19
LAB No. :	14617	TESTED BY:	O.M.	DATE RECEIVE	12-Dec-19
SAMPLED BY:	D.P.	DATE REPT'D:	17-Dec-19	DATE TESTED:	13-Dec-19

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
111.4	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	49.00	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	1.07	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	148.00	98.00
		CORRECTED	0.980	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)		WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
13.2				
9.5				
4.75				
2.0		**0.0**	0.0	**100.0**
Pan		**111.4**		
0.850		**0.06**	0.1	**99.9**
0.425		**0.27**	0.6	**99.4**
0.250		**0.52**	1.1	**98.9**
0.106		**0.88**	1.8	**98.2**
0.075		**1.06**	2.2	**97.8**
Pan		**1.07**		
SIEVE CHECK	0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:11	41.0	6.0	22.0	0.0401	70.6	**70.6**
2	9:13	40.0	6.0	22.0	0.0286	68.6	**68.6**
5	9:15	39.0	6.0	22.0	0.0183	66.6	**66.6**
15	9:25	38.0	6.0	22.0	0.0106	64.6	**64.6**
30	9:40	36.0	6.0	22.0	0.0077	60.5	**60.5**
60	10:10	35.0	6.0	22.0	0.0055	58.5	**58.5**
250	13:20	32.0	6.0	22.0	0.0027	52.5	**52.5**
1440	9:10	27.0	6.0	22.0	0.0012	42.4	**42.4**

COMMENTS:

Moisture Content = 33.0

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

APPENDIX 2

FIGURE 1 – KEY PLAN

FIGURES 2 TO 3 – SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG6009-1 – TEST HOLE LOCATION PLAN

DRAWING PG6009-2 – PERMISSIBLE GRADE RAISE AREAS

DRAWING PG6009-3 – TREE PLANTING SETBACK RECOMMENDATIONS

DRAWING PG6009-4 – BEDROCK CONTOUR PLAN

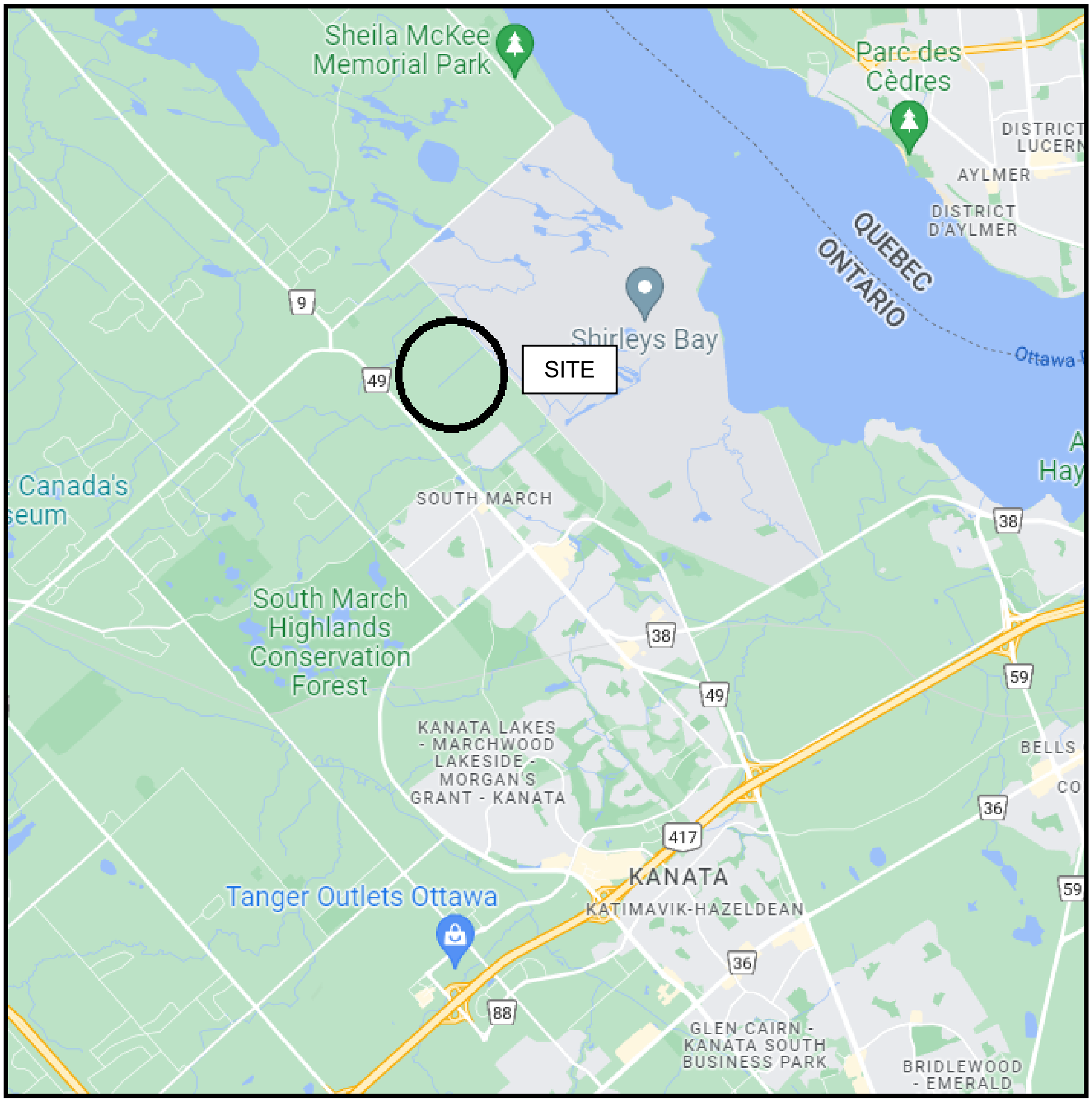


FIGURE 1

KEY PLAN

PATERSON GROUP

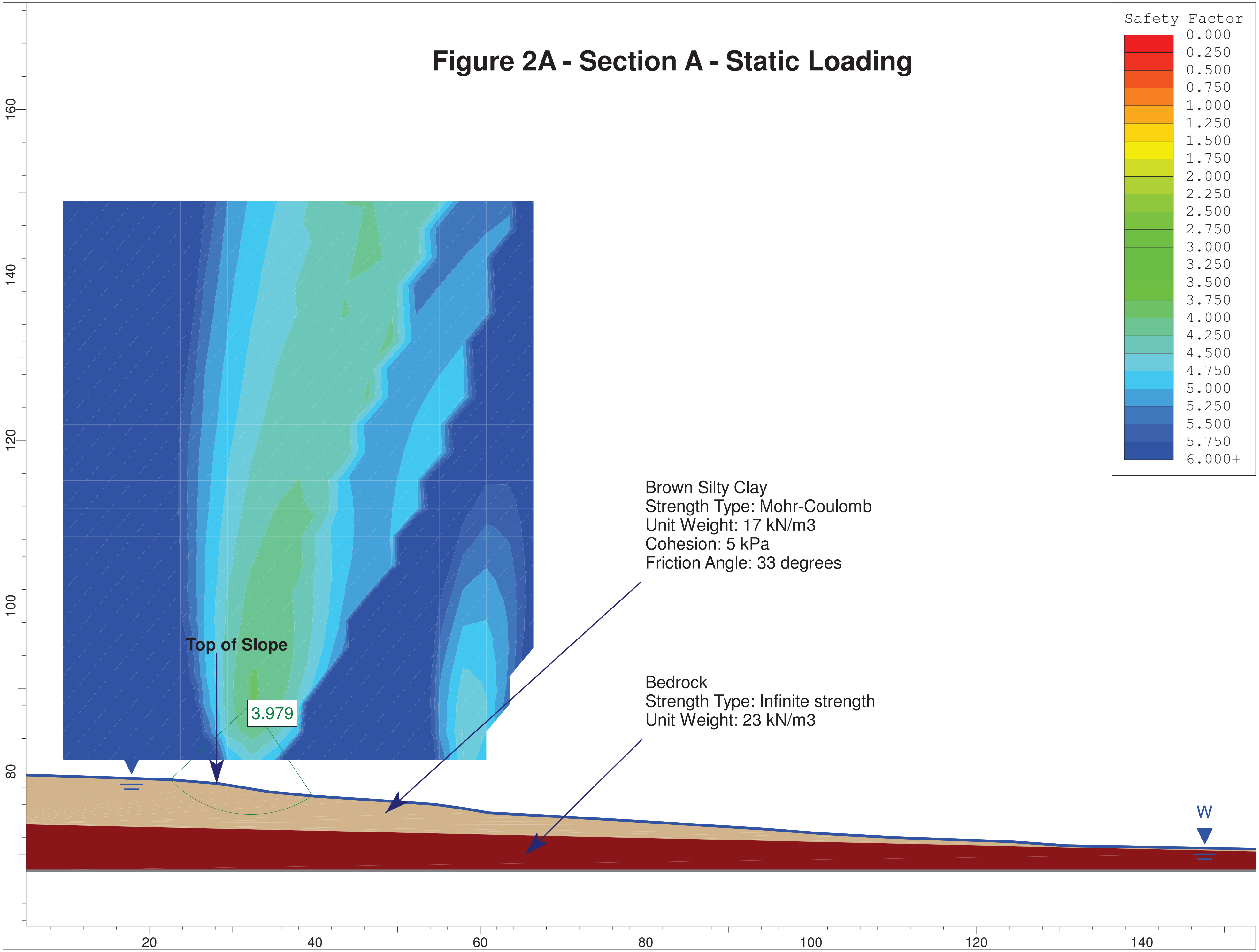


Figure 2A - Section A - Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Brown Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 17 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees
Top of Slope
3.979
Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3
W
160
140
120
100
80
20
40
60
80
100
120
140

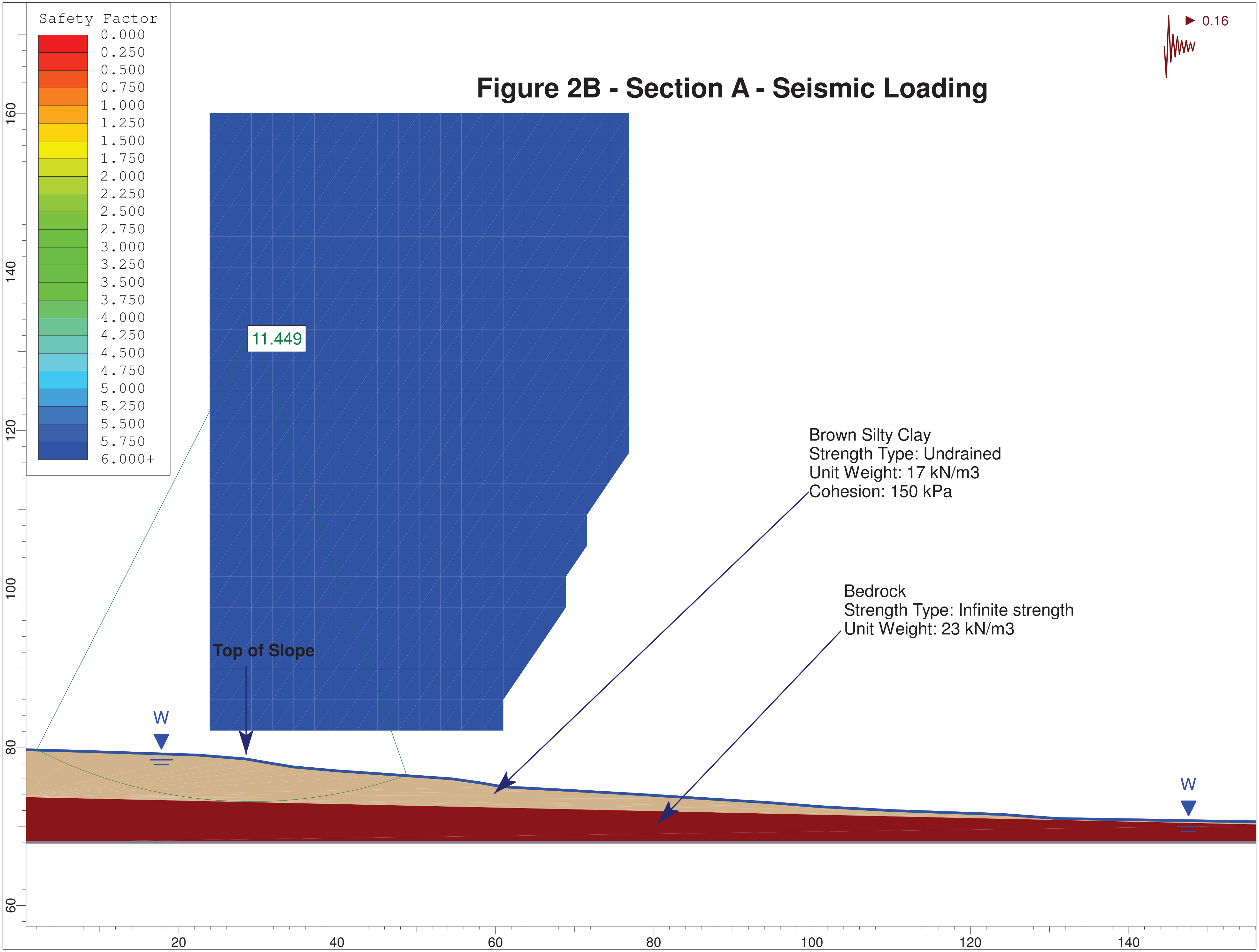


Figure 2B - Section A - Seismic Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
11.449
Brown Silty Clay
Strength Type: Undrained
Unit Weight: 17 kN/m3
Cohesion: 150 kPa
Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3
Top of Slope
W
W
160
140
120
100
80
60
20
40
60
80
100
120
140

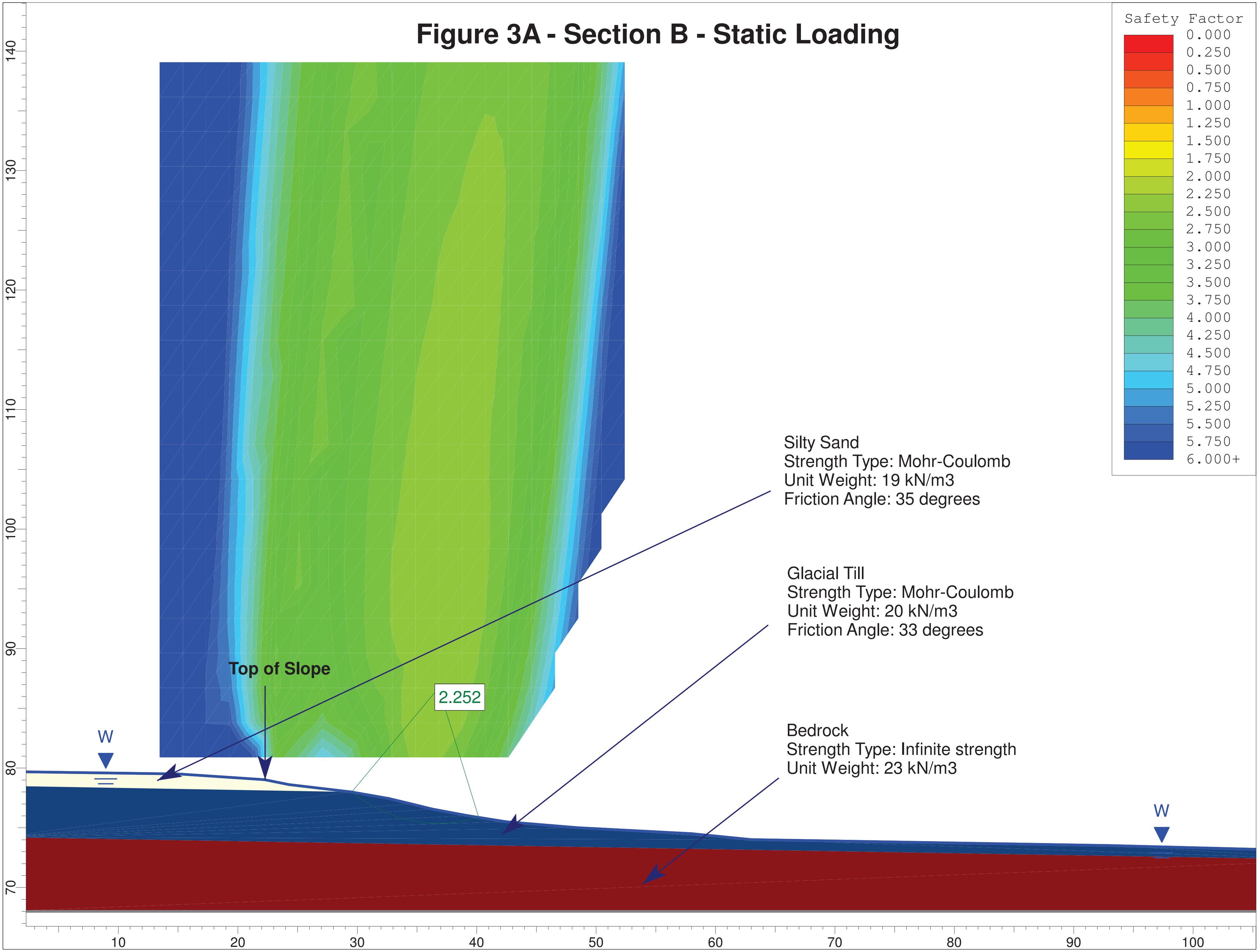
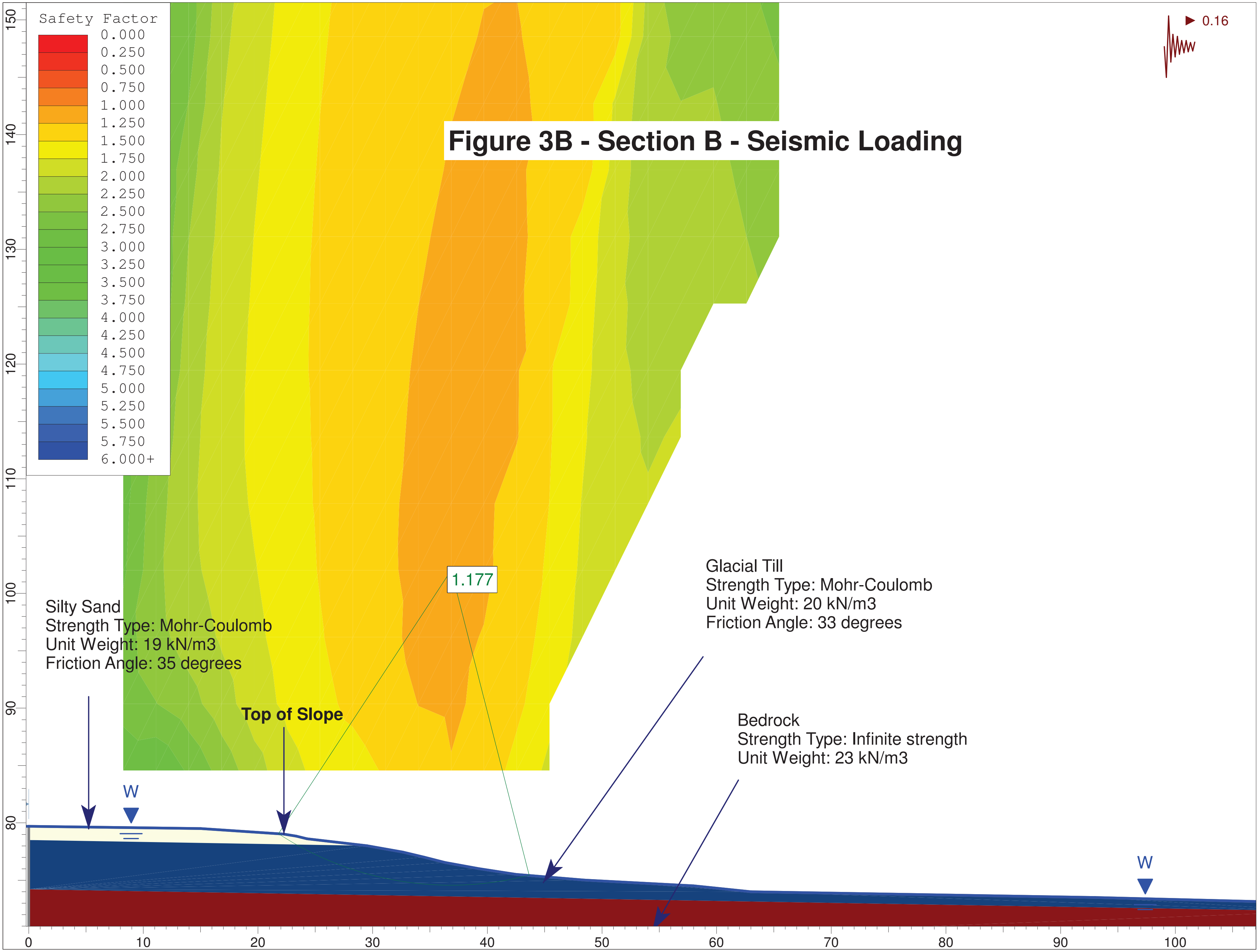
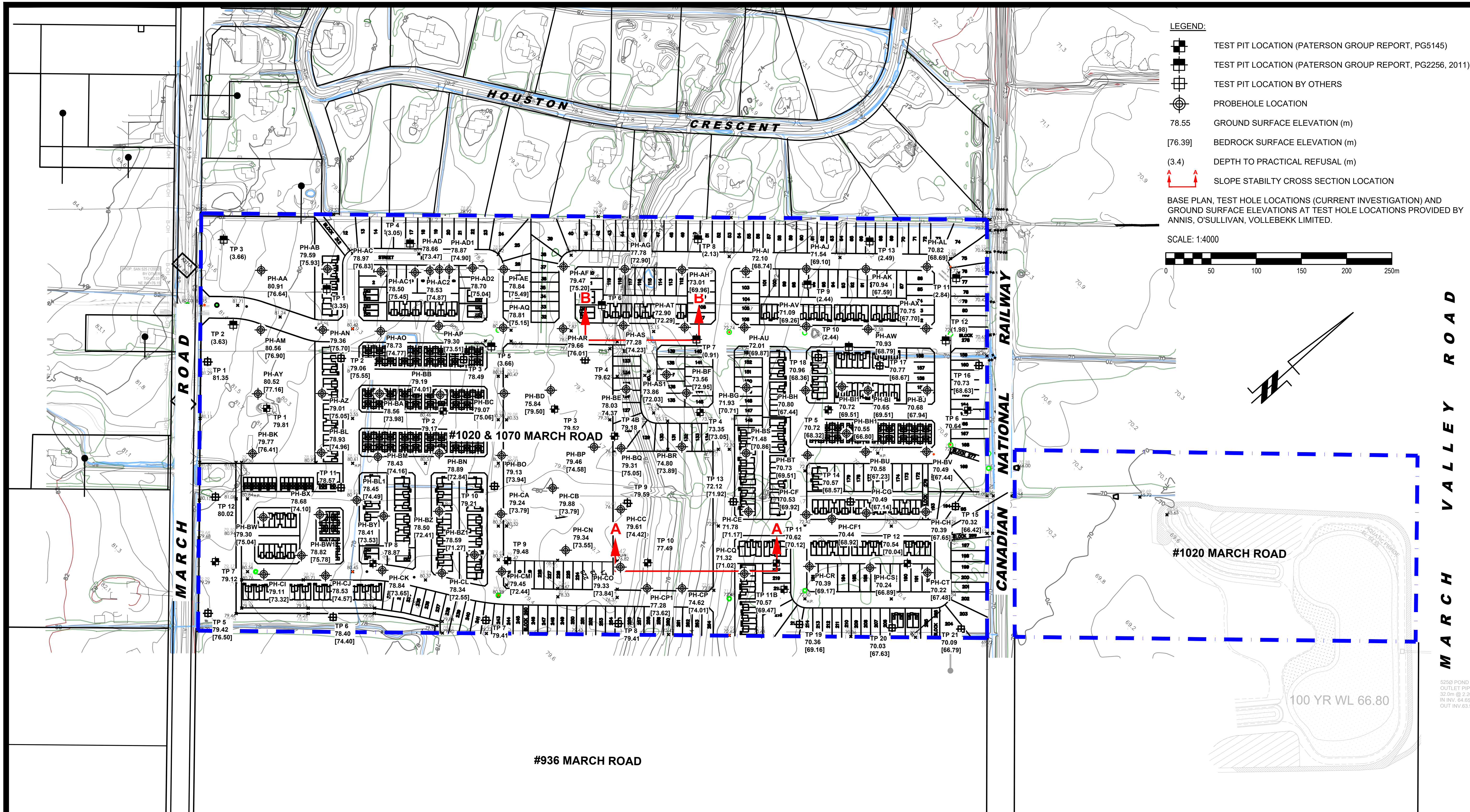


Figure 3A - Section B - Static Loading
Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Friction Angle: 35 degrees
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Friction Angle: 33 degrees
Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3
Top of Slope
2.252
W
W
140
130
120
110
100
90
80
70
10
20
30
40
50
60
70
80
90
100



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
Figure 3B - Section B - Seismic Loading
1.177
Glacial Till
Strength Type: Mohr-Coulomb
Unit Weight: 20 kN/m3
Friction Angle: 33 degrees
Silty Sand
Strength Type: Mohr-Coulomb
Unit Weight: 19 kN/m3
Friction Angle: 35 degrees
Top of Slope
Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3
W
W
150
140
130
120
110
100
90
80
0
10
20
30
40
50
60
70
80
90
100



Scale: 1:4000	Date: 10/2021
Drawn by: RG	Report No.: P6009-1
Checked by: OC	Dwg. No.: PG6009-1
Approved by: DJG	Revision No.:

PATERSON GROUP
SOLUTION ORIENTED ENGINEERING

9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

CAVANAGH CONSTRUCTION
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
PART OF LOT 13 CONCESSION 4

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

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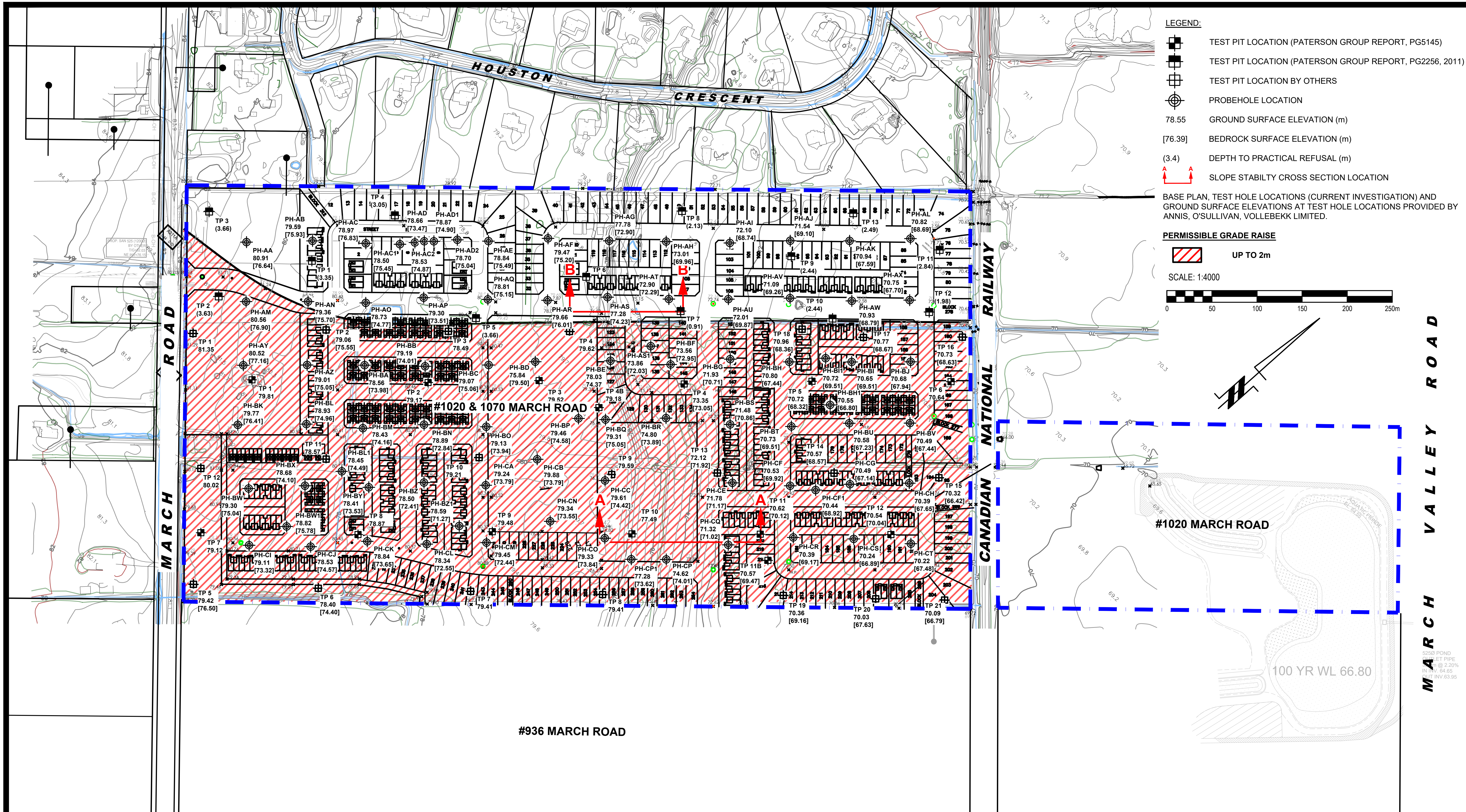

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CAVANAGH CONSTRUCTION
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PROPOSED RESIDENTIAL DEVELOPMENT
PART OF LOT 13 CONCESSION 4

OTTAWA, ONTARIO

Title:
PERMISSIBLE GRADE RAISE PLAN

Scale: 1:4000	Date: 10/2021
Drawn by: RG	Report No.: P6009-1
Checked by: OC	Dwg. No.: PG6009-2
Approved by: DJG	Revision No.:

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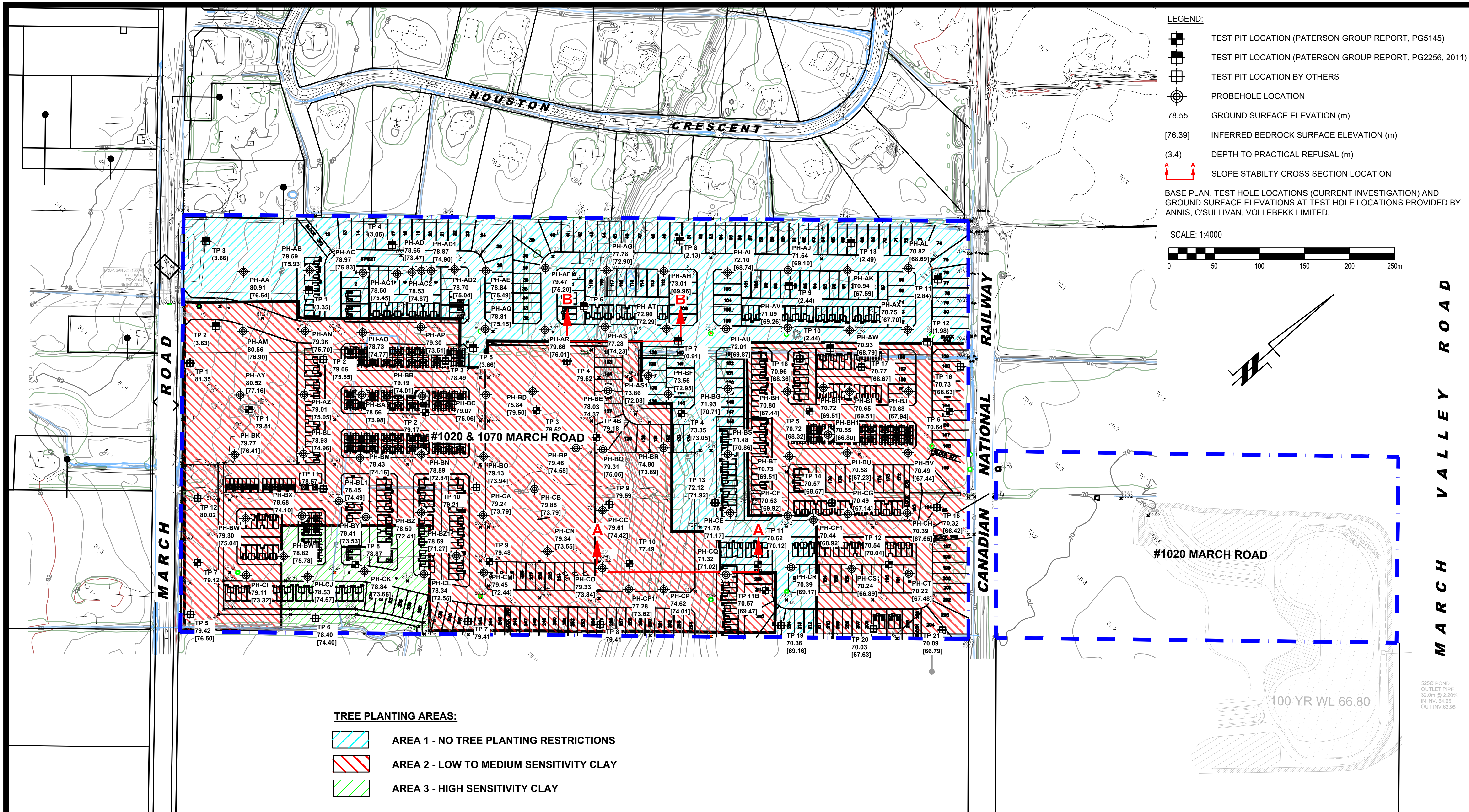

LEGEND:

- TEST PIT LOCATION (PATERSON GROUP REPORT, PG5145)
- TEST PIT LOCATION (PATERSON GROUP REPORT, PG2256, 2011)
- TEST PIT LOCATION BY OTHERS
- PROBEHOLE LOCATION
- 78.55 GROUND SURFACE ELEVATION (m)
- [76.39] INFERRED BEDROCK SURFACE ELEVATION (m)
- (3.4) DEPTH TO PRACTICAL REFUSAL (m)
- A A SLOPE STABLITY CROSS SECTION LOCATION

BASE PLAN, TEST HOLE LOCATIONS (CURRENT INVESTIGATION) AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LIMITED.

SCALE: 1:4000

0 50 100 150 200 250m

TREE PLANTING AREAS:

- AREA 1 - NO TREE PLANTING RESTRICTIONS
- AREA 2 - LOW TO MEDIUM SENSITIVITY CLAY
- AREA 3 - HIGH SENSITIVITY CLAY

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CAVANAGH CONSTRUCTION
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PART OF LOT 13 CONCESSION 4

OTTAWA, ONTARIO

Title:

TREE PLANTING SETBACK PLAN

Scale: 1:4000	Date: 10/2021
Drawn by: RG	Report No.: P6009-1
Checked by: OC	Dwg. No.: PG6009-3
Approved by: DJG	Revision No.:

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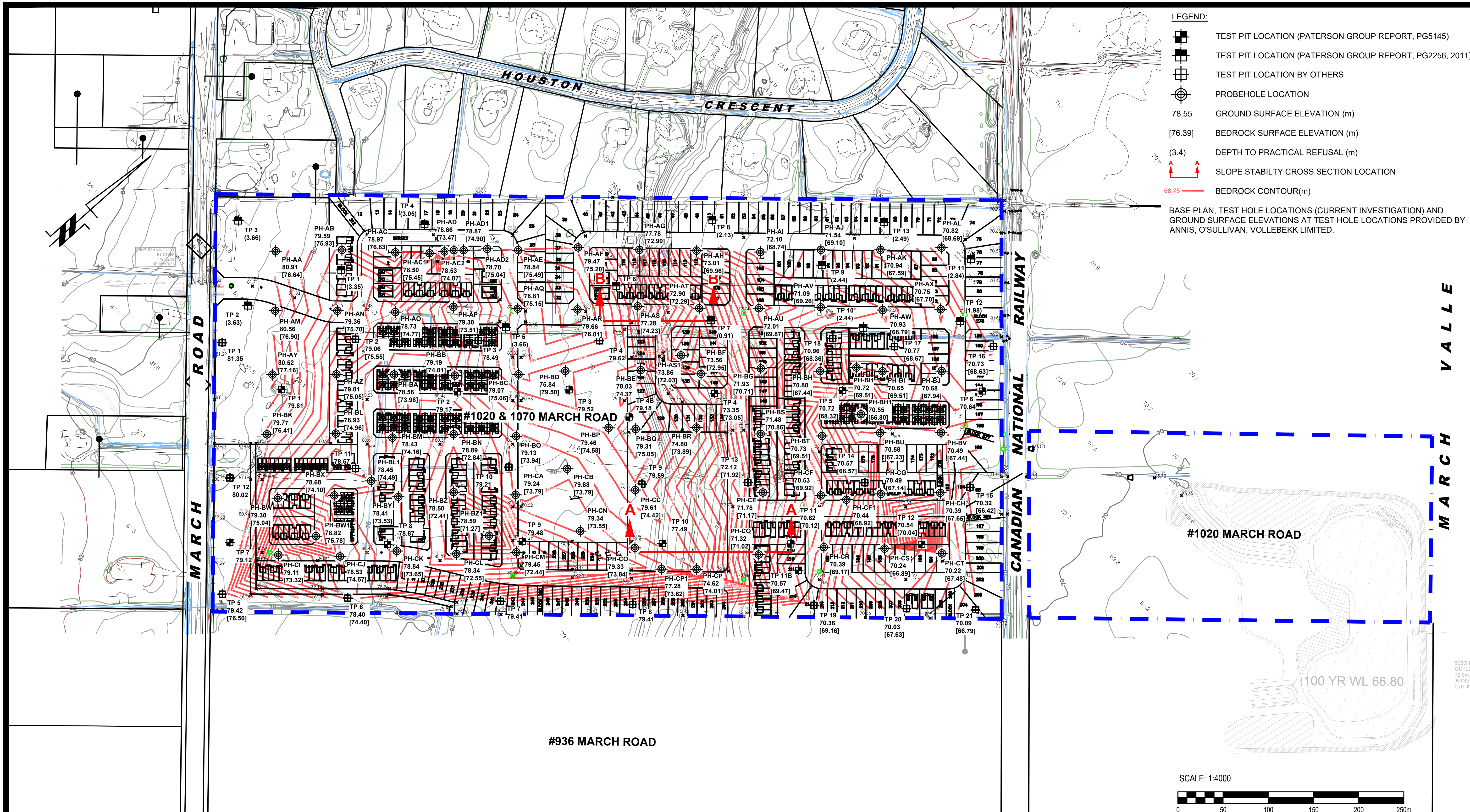

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CAVANAGH CONSTRUCTION
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
PART OF LOT 13 CONCESSION 4

OTTAWA, ONTARIO

Title:

BEDROCK CONTOUR PLAN

Scale: 1:4000	Date: 10/2021
Drawn by: RG	Report No.: P6009-1
Checked by: OC	Dwg. No.: PG6009-4
Approved by: DJG	Revision No.:

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