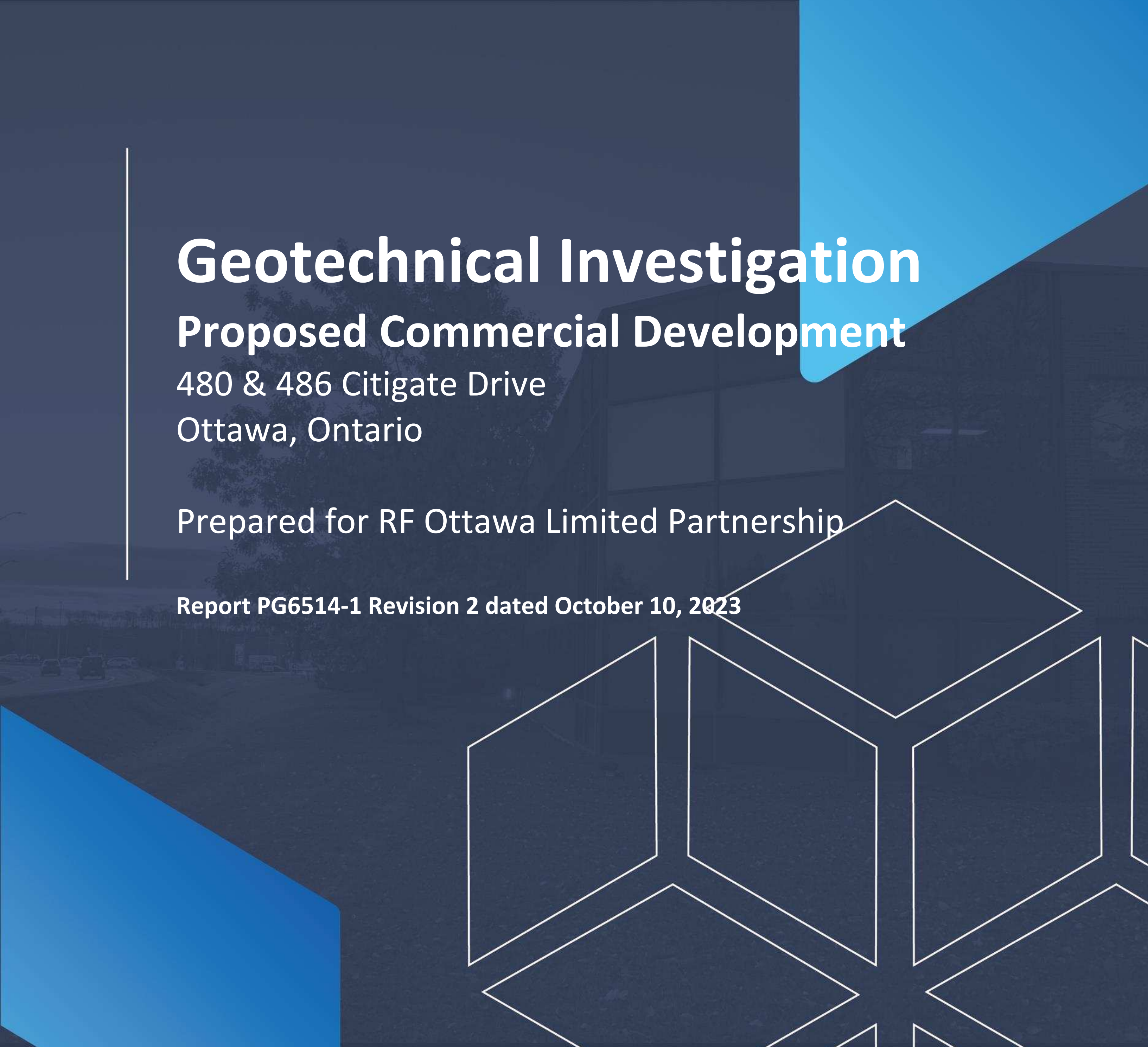


Geotechnical Investigation

Proposed Commercial Development

480 & 486 Citigate Drive
Ottawa, Ontario

Prepared for RF Ottawa Limited Partnership

Report PG6514-1 Revision 2 dated October 10, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by RF Ottawa Limited Partnership to complete a geotechnical investigation for the proposed commercial development to be located at 480 & 486 Citigate Drive, Ottawa, Ontario (refer to Drawing -1 - Key Plan presented in Appendix 2).

The objective of the geotechnical investigation was to:

☐ determine the subsoil and groundwater conditions at the site by means of test holes

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

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

2.0 Proposed Development

Based on the latest grading plans, it is understood that **two** industrial buildings are being proposed at 480 & 486 Citigate Drive. It is anticipated that the buildings will be one story with slab on grade construction. Access lanes, driveways, retaining walls parking garages, and landscaped areas are also anticipated as part of the proposed development. It is further understood that the subject site will have two main platforms, an upper western and a lower eastern platform and that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation at 480 & 486 Citigate Drive was carried out between December 1, 2022, and December 15, 2022. At that time, a total of **seventeen (17)** boreholes were advanced down to a maximum depth of 8.23m below existing ground surface. The test holes were placed in a manner to provide general coverage of the subject site taking into consideration site features and underground utilities. The test hole locations for the current investigation are presented on Drawing PG6514-1 - Test Hole Location Plan included in Appendix 2.

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

Sampling and In Situ Testing

Soil samples were recovered during drilling from the auger flights or a 50 mm diameter split-spoon sampler. The split-spoon samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory for further examination and classification. The split-spoon samples and auger grab-samples recovered from the boreholes are shown as SS and AU, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

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

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

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

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

Groundwater

Flexible polyethylene standpipes were installed in the boreholes to permit monitoring of the groundwater levels subsequent to the completion of the field investigations.

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the subject site. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a high-precision GPS and referenced to a geodetic datum. The location of the test holes is presented in Appendix 2.

3.3 Laboratory Review

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. Two (2) samples were submitted for Atterberg Limits testing, one (1) sample for shrinkage limit testing, and one (1) sample for grain size distribution testing.

All test results are included in Appendix 1 and further discussed in Subsection 4.2 of the current report.

3.4 Analytical Testing

One 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 others. The sample was 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 discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site on 480 & 486 Citigate Drive is currently undeveloped. The site slopes gradually upwards from east to west from an approximate geodetic elevation of 97 to 109 m. An approximately 3 to 4 m high slope runs along the west property boundary down to a drainage ditch running along the Highway 416 northbound lane.

The subject site is bordered by Citigate Drive followed by a commercial property to the east, Highway 416 to the west, and vacant treed lands to the north and south.

4.2 Subsurface Profile

Generally, the subsurface profile at the test hole locations consisted of a thin layer of topsoil underlain by a fill layer of silty sand to sandy silt with gravel, cobbles and boulders throughout most of the subject site. The fill throughout the eastern portion of the site was observed to be underlain by a very stiff deposit of silty clay at most of the borehole locations. Practical refusal to DCPT was encountered at the location of BH 1-22, BH 3A-22, BH 4-22, BH 5-22, BH 6-22, BH 7-22, BH 8-22, BH 9-22, BH 10-22, BH 11-22, BH 12-22, BH 13-22, BH 14-22, BH 15-22, BH 16-22 and BH 17-22 at depths ranging between 1.26 and 9.14m below existing ground surface.

The silty clay deposit was observed to be hard, **brown,** and underlain by a compact to very dense glacial till deposit. The fine matrix of the glacial till consisted of either a silty clay or silty sand with gravel, cobbles and boulders, throughout the east portions of the subject site. Additionally, a very stiff **grey** silty clay deposit was observed at the northwest side of the project at BH 6-22. the fine matrix of the glacial till was observed to consist of silty sand to sandy silt with gravel, cobbles and boulders.

Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets in Appendix 1.

Bedrock

Based on available geological mapping, the subject site is located in an area where the bedrock consists of interbedded limestone and dolomite of the Gull River formation with an overburden drift thickness between 1 to 15 m.

Grain Size Distribution and Hydrometer Test

A sieve analysis was completed to classify selected soil sample according to the Unified Soil Classification System (USCS). The results are summarized in Table 1 and presented in Appendix 1.

Table 1 - Grain Size Distribution and Hydrometer Testing

Test Hole	Sample	Gravel (%)	Sand (%)	Silt and Clay (%)
BH 1-22	SS4	0	4.6	95.4

Atterberg Limit Tests

Two selected silty clay samples were submitted for Atterberg Limit testing. The test results indicate that both low and high plasticity silty clays are anticipated at the subject site. The results are summarized in Table 2 and presented in Appendix 1.

Table 2 - Summary of Atterberg Limits Test Results

Test Hole	Sample No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH 8-22	SS4	44	27	17
BH9-22	SS4	51	27	24

4.3 Groundwater

Groundwater levels were measured in the installed piezometers during the current investigation. The measured groundwater level (GWL) readings are presented in Table 3 below and are shown on the Soil Profile and Test Data sheets in Appendix 1.

Table 3 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Date
BH 1-22	99.57	4.27	95.3	December 9, 2022
BH 2-22	103.68	4.58	99.1	
BH 3A-22	106.26	Dry	Dry	
BH 4-22	106.66	2.9	103.76	
BH 5-22	105.58	3.94	101.64	
BH 6-22	108.02	1.05	106.97	
BH7-22	104.82	2.17	102.65	
BH 8-22	102.11	4.25	97.86	
BH 9-22	100.87	Dry	Dry	
BH 10-22	97.12	3.53	93.59	
BH 11-22	97.75	2.45	95.3	
BH 12-22	98.85	2.65	96.2	

Note: Ground surface elevations at all test hole locations were surveyed by Paterson and are referenced to a geodetic datum.

It should be noted that groundwater levels could be influenced by surface water infiltrating the backfilled boreholes. Long-term groundwater levels can also be estimated based on the observed color and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level can be expected to be approximately **2 to 4 m** below ground surface. The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheets 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 anticipated that the proposed slab-on-grade industrial buildings will be founded on conventional shallow footings bearing on an undisturbed, compact to very dense glacial till, stiff to very stiff brown silty clay bearing surface, or on approved engineered fill pad placed upon an approved subgrade soil.

Due to the presence of silty clay within the eastern portion of the subject site, a permissible grade raise restriction will be required where the buildings and settlement sensitive structures are to be founded over the silty clay layer. The recommended permissible grade raise areas for the proposed development are defined in Drawing PG6514-2 - Permissible Grade Raise Plan enclosed in Appendix 2. Paterson completed a review from a geotechnical perspective for the proposed grades at the subject site, based on the latest grading plans prepared by Novatech for the proposed development. Based on our review, the proposed grades are within the recommended permissible grades and are therefore considered acceptable from a geotechnical perspective.

It is understood that retaining walls are anticipated at several locations along the property boundaries and within the subject site. Based on discussions with Rosefellow, it is understood that precast type retaining walls will be used at these locations. Upon request, Paterson can review/complete the design of these retaining walls during the detailed design stage of the project.

Based on the anticipated grading, and where excavation is anticipated to be completed in close proximity to the property boundaries (i.e. northwest and south west), a temporary shoring system may be required to protect the adjacent vacant properties. Alternatively, permission to encroach on neighbouring property can be obtained to enable an open cut excavation along these sides.

Recommendations are provided herein for the re-use of the site generated fill material in consideration of the cut and fill operation that will be required to accommodate the proposed grades.

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

5.2 Site Grading and Preparation

Stripping Depth

The upper topsoil layer and any fill containing significant amounts of deleterious or organic materials should be stripped from under buildings' footprints. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Any soft areas should be removed and replaced in accordance with the following fill placement recommendations.

Fill Placement

It is anticipated that the site will require notable soil excavation within the west and central portions of the site and in-filling within the east portion of the site. Therefore, in-filling operations are anticipated to be completed using approved fill generated from the cut operations.

Boulders larger than 300 mm in their longest dimensions should be removed from the glacial till prior to being reused. All fill used for grading below settlement sensitive structures should be placed in loose lifts no greater than 300 mm thick and compacted using suitable heavy sheepsfoot or smooth drum vibratory compaction equipment as deemed appropriate. Fill placed beneath the building area should be compacted, **under dry conditions, and above freezing temperatures**, to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

If site excavated cobbles and boulders are to be used as fill to build up the subgrade for roadways or the bearing mediums, it should be suitably fragmented to produce a well-graded material with a maximum particle size of 300 mm. Any crushed site-generated material greater than 300 mm in diameter should be segregated and hoe rammed into acceptable fragments. Where the fill is open-graded, a blinding layer of finer granular fill, such as OPSS Granular A, well-graded sand, crushed stone dust or a geotextile liner may be required to prevent adjacent finer materials from migrating into the voids, with associated loss of ground and settlements.

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids.

Placement of site-generated soil fill material during winter months increases the risk of placing frozen material which may result in poor-performing areas that may require sub-excavation of the material and subsequent reinstatement.

Alternatively, fill used for grading beneath the building areas could consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Granular material should be tested and approved prior to delivery to the site. The fill should be placed in loose lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD.

Footprint Bearing Medium Preparation

Consideration could be given to placing the proposed footings and floor slab over site-generated glacial till fill provided the placement of the fill is reviewed and approved by Paterson at the time of construction. The approved grade raise fill material should be proof rolled using suitable compaction equipment under dry conditions, above freezing temperatures, tested and approved by Paterson personnel. A minimum 300 mm thick granular pad, consisting of an OPSS Granular A crushed stone, compacted to 98% of its SPMDD is recommended to be placed at footing level over the approved grade raise fill subgrade. The sub-footing fill should be extended a minimum 300 mm horizontally beyond the footing face in all directions and throughout the lateral support zone of the footings.

5.3 Foundation Design

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, very stiff to stiff brown silty clay bearing surface or on engineered fill pad over a very stiff to stiff brown silty clay can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**.

Conventional spread footings placed on an undisturbed, compact glacial till bearing surface can be designed using bearing resistance values at serviceability limit states (SLS) of **250 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **400 kPa**.

Footings placed directly on clean, surface-sounded bedrock, or on lean concrete filled trenches placed directly over clean, surface sounded bedrock, can be designed using a factored bearing resistance value at ULS value of **1,000 kPa**, incorporating a geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

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.

Lateral Support

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

Modulus of Subgrade Reaction

Table 4 below presents the modulus of subgrade reaction for the undisturbed, silty clay, glacial till, and bedrock or engineering fill placed over an undisturbed subgrade layer and can be taken as per table 4 below.

Table 4 – Subgrade Reaction Modulus Values

Material	contact pressure (kPa)	K value (MPa/m)
silty clay	**150**	**12**
glacial till	**250**	**30**
bedrock	**1000**	**60**

Permissible Grade Raise and Settlements

Based on the undrained shear strength values of the silty clay deposit encountered at the eastern portion of the subject site and within an area along the western property boundary, our recommendations for the permissible grade raise restrictions are provided in Drawing PG6514-2 - Permissible Grade Raise Plan in Appendix 2.

A post-development groundwater lowering of 0.5 m was considered in our permissible grade raise calculations. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

It should be noted that Paterson completed a review of the latest grading plans for the proposed development at the subject site, from a geotechnical perspective. Based on our review, no grade raise exceedances were noted and the proposed grading is considered acceptable from a geotechnical perspective.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for foundations constructed at the subject site, according to Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC 2012). The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and fill, containing deleterious or significant amounts of organic materials, within the footprint of the proposed buildings, the native soil and/or approved fill pad will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 300 mm of sub-slab fill should consist of an OPSS Granular A crushed stone.

All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD.

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

5.6 Pavement Design

Car only parking areas, heavy truck roadways and parking areas and access lanes are anticipated at this site. The proposed pavement structures are presented in Tables 5 and 6.

Table 5 – Recommended Pavement Structure – Driveways and car only parking areas

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

Table 6 - Recommended Pavement Structure – Access Lanes and Heavy Vehicle Roadway and Parking Areas

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

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

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

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

Pavement Structure Drainage

The pavement structure performance is dependent on the moisture condition at the contact zone between the subgrade material and granular base. Failure to provide adequate drainage under conditions of heavy wheel loading could result in the subgrade fines pumped into the stone subbase voids, thereby reducing the load bearing capacity.

Due to the impervious nature of the subgrade and fill materials and transitions between various pavement structures, consideration should be provided to installing subdrains during the pavement construction. At transition zones between various pavement structures, subdrains should be installed longitudinally to drain any potential water trapped in the granular layers. The subdrains at catch basins should extend in four orthogonal directions and longitudinally when placed along a curb.

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 structure. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated and corrugated plastic pipe surrounded on all sides by 150 mm of 19 mm clear crushed stone, placed at the footing level round the exterior perimeter of the structures. The pipe should have a positive outlet, such as a gravity connection to the storm sewer or ditch.

Foundation Backfill

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 Miradrain G100N. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

Backfill material below sidewalk subgrade areas or other settlement sensitive structures should consist of free draining, non-frost susceptible material placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD under dry and above freezing conditions.

6.2 Protection Against Frost Action

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

Exterior unheated footings, such as those for isolated exterior piers, footings located below loading docks and loading dock ramp wing-walls are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure. These unheated structures require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation. It is recommended that Paterson review the proposed footing and/or insulation details for the above-noted items prior to construction to ensure the effects of frost action are mitigated appropriately.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should be either cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled or a permanent retaining wall is installed. Where the proposed building within the western portion of the site is anticipated to extend close to the property lines, it is expected that a temporary shoring may be required to support the excavation on the north and south sides. Alternatively, open cut excavation can be completed along these sides if a permission to encroach onto private property is obtained from the owners of the neighbouring properties. This is discussed further below.

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. Services are expected to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

It is good to note that the subject site has a high content of boulders which may require heavy machinery for the removal of these large boulders, also that might end up with potential sub excavation due to the removal of these boulders.

Temporary Shoring

As noted above, a temporary shoring system may be required to support the overburden soils where insufficient room is available to complete open cut excavation, and where a permission to encroach onto neighbouring property can not be obtained from the owners of the neighbouring properties.

The design and approval of the temporary shoring system will be the responsibility of the shoring contractor and the shoring designer who is a licensed professional engineer. It is the responsibility of the shoring contractor to ensure that the temporary shoring is in compliance with safety requirements, designed to avoid any impact to the adjacent properties and include dewatering control measures.

The designer should also take into account the impact of a significant precipitation event and designate design measures to ensure that precipitation will not negatively impact the shoring system or soils supported by the system.

The temporary shoring system may consist of a soldier pile and lagging system or steel sheet piles which could be cantilevered, anchored, or braced.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

Once the substantial landscape and structural drawings for the proposed buildings are available, other engineering solutions may be applicable.

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. A minimum of a 150 mm layer of OPSS Granular A crushed stone should be placed for pipe bedding for sewer and water pipes for a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 99% of the SPMDD.

It should generally be possible to re-use the site materials above the cover material if the operations are carried out in dry weather conditions. The site excavated material may be placed above cover material if the excavation operations are completed in dry weather conditions and the site excavated material is approved by the geotechnical consultant. All cobbles greater than 200 mm in the longest dimension should be removed prior to the site materials being reused.

Glacial till with cobbles less than 250 mm in the longest dimension can be reused in the subgrade below parkway. However, no greater that 100 mm cobbles can be reused in the granular layers.

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) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material standard Proctor maximum dry density.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to medium and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) Category 3 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 of 4 to 5 months should be allowed for completion of the PTTW Category 3 application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it’s 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.

Impacts on Neighboring Properties

It is understood that a notable cut of native material will be sub-excavated to accommodate the proposed buildings throughout the subject site. It is anticipated that the neighboring portion of Highway 416 and the commercial building located to the east of the site are founded within the dense glacial till and very stiff silty clay deposit, respectively. The glacial till deposit encountered was observed to be sufficiently dense and have a relatively high content of fine-grained soils such that the groundwater table will be lowered marginally within the vicinity of the subject site at the time of construction and as is typically experienced by temporary short-term dewatering for construction.

It should be noted that no issues are expected with respect to groundwater lowering that would long term damage to adjacent structures surrounding the proposed development.

6.6 Winter Construction

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

The subsoil conditions at this site mostly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

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

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

6.7 Corrosion Potential and Sulphate

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

6.8 Landscaping Considerations

Tree Planting Considerations

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 for the portion of the building founded over the silty clay deposit within the ***east portion of the site***. Atterberg limits testing was completed for the recovered silty clay samples at selected locations.

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.

High Sensitivity Area

Based on the results of our review, a high-sensitivity clay soil as per City Guidelines was encountered only within the east portion of the site and a small area along the western portion of the site. Based on our Atterberg Limits test results, the plasticity index limit generally exceeds 40%. The following tree-planting setbacks are recommended for these high-sensitivity areas.

The following tree planting setbacks are recommended for the low to medium sensitivity silty clay deposit throughout the subject site.

- ☐ Large trees (mature height over 14 m) can be planted within these areas provided that a tree to foundation setback equal to the full mature height of the tree can be provided.

- ☐ Tree planting setback limits may be reduced to 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 conditions noted below are met.

- ☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade for footings within 10 m from the tree, as measured from the center of the tree trunk.

- ☐ A small tree must be provided with a minimum of 25 m3 of available soils volume while a medium tree must be provided with a minimum of 30 m3 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 surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree)

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

6.9 Slope Stability Analysis/Retaining Wall Design

It is understood that retaining walls are anticipated at several locations along the property boundaries. Therefore, Paterson requests permission to review the design of the retaining walls from a geotechnical perspective, at detailed design stage.

In addition, a relatively high cut slope is anticipated along the western property boundary. Paterson completed a slope stability analysis for the proposed cut slope at that location and provided geotechnical recommendations for relatively steep slope. Reference should be made to Paterson group memorandum PG6514-MEMO.01 Revision 1 dated October 10, 2023, for the result of our analysis and our recommendations from a geotechnical perspective for the various cut slope options considered.

7.0 Recommendations

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

☐ Review detailed grading plan from a geotechnical perspective.

☐ Review/Complete retaining wall design from a geotechnical perspective.

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

☐ Observation of placement of rigid insulation, where required.

☐ Sampling and testing of the concrete and fill materials.

☐ Review and inspections of the cut and fill operations carried out to build up the subgrade.

☐ 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 ensure that the specified level of compaction has been achieved.

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

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should be handled as per ***Ontario Regulation 406/19: On-Site and Excess Soil Management*.**

8.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

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

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than RF Ottawa Limited Partnership or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Yashar Ziaeimehr, M.A.Sc.

Maha K. Saleh, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Oct.10, 2023
M. SALEH
100507739
PROVINCE OF ONTARIO

Report Distribution:

- ☐ RF Ottawa Limited Partnership (email copy)
- ☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 1, 2022

FILE NO. **PG6514**

HOLE NO. **BH 1-22**

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.25
FILL: Brown silty clay with sand, trace gravel and rock fragments	1.60
Hard, brown **SILTY CLAY**	2.97
GLACIAL TILL: Comapct, brown silty sand to sandy silt, trace to some clay, gravel, cobbles, boulders	5.94
Dynamic Cone Penetration Test commenced at 5.94m depth.	6.99

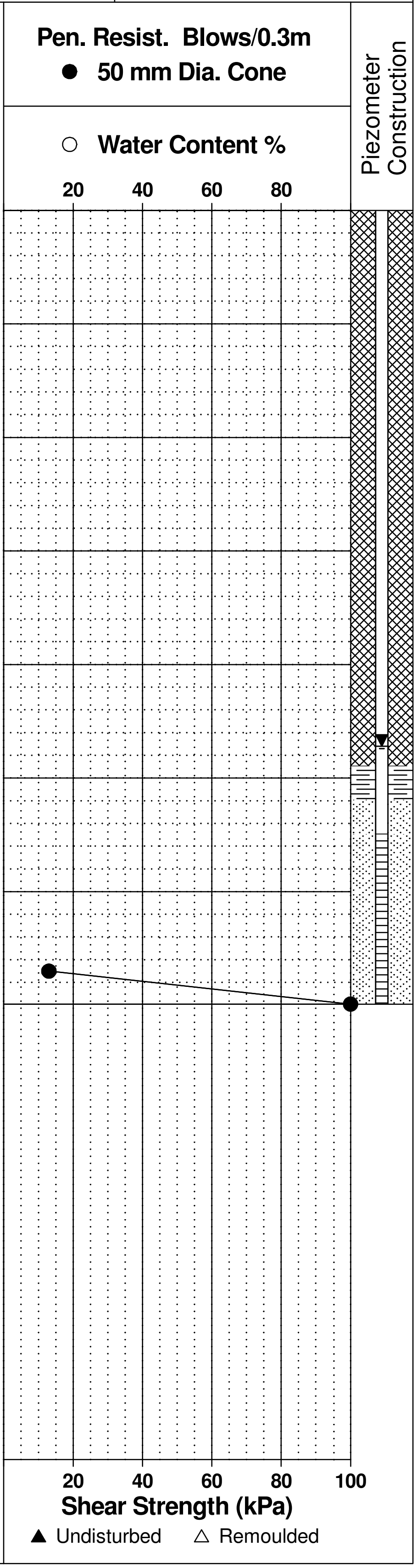
End of Borehole

Practical DCPT refusal at 6.99m depth.

(GWL @ 4.72m - Dec. 9, 2022)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	29	15
SS	3	50	7
SS	4	100	10
SS	5	71	11
SS	6	92	10
SS	7	75	14
SS	8	71	8

DEPTH (m)	ELEV. (m)
0	99.57
1	98.57
2	97.57
3	96.57
4	95.57
5	94.57
6	93.57



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 1, 2022

FILE NO. PG6514

HOLE NO. BH 2-22

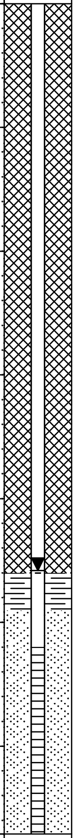
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.68
TOPSOIL 0.05						
FILL: Brown silty sand to sandy silt, some clay, gravel, occasional cobbles, trace topsoil	AU	1				
	SS	2	42	4	1	102.68
1.62						
Brown **SILTY SAND** with gravel and topsoil 1.88	SS	3	75	13	2	101.68
	SS	4	83	8	3	100.68
GLACIAL TILL: Compact to dense, brown silty sand to sandy silt with gravel, cobbles and boulders, some to trace clay	SS	5	100	10		
	SS	6	92	29	4	99.68
- increasing boulder content below 4.5m depth	SS	7	8	50+	5	98.68
	SS	8	83	36	6	97.68
	SS	9	100	48		
6.71						
End of Borehole						
(GWL @ 4.58m - Dec. 9, 2022)						

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



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 1, 2022

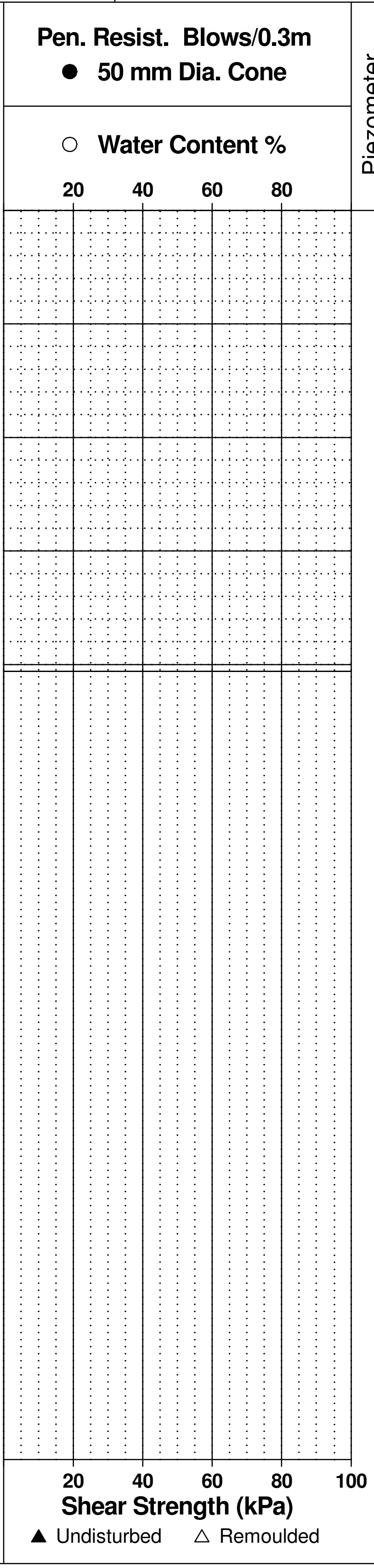
FILE NO. PG6514

HOLE NO. BH 3-22

SOIL DESCRIPTION					
GROUND SURFACE					
TOPSOIL	0.05				
FILL: Brown silty clay, trace sand and gravel	0.69				
GLACIAL TILL: Very dense to dense, brown silty sand to sandy silt with gravel, cobbles and boudlers, trace clay - 300mm long section of boulder cored starting at 2.26m depth - 375mm long section of boulder cored starting at 2.6m depth.	4.06				
End of Borehole					

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	71	50+
SS	3	71	38
RC	1	100	
RC	2	25	

DEPTH (m)	ELEV. (m)
0	106.08
1	105.08
2	104.08
3	103.08
4	102.08



Piezometer Construction

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

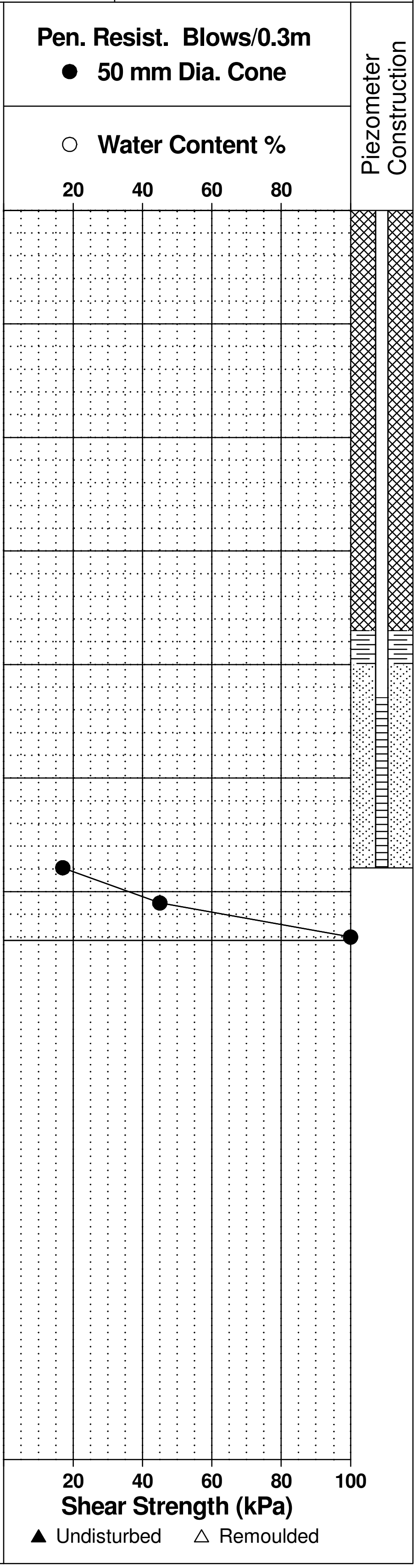
BORINGS BY Track-Mount Power Auger

DATE December 1, 2022

FILE NO. **PG6514**

HOLE NO. **BH 3A-22**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	106.26
TOPSOIL 0.05						
FILL: Brown silty clay, trace sand and gravel 0.69						
					1	105.26
					2	104.26
GLACIAL TILL: Very dense to compact, brown silty sand to sandy silt with gravel, cobbles and boulders, trace clay - increasing boulder content below 2.5m depth - 300mm section of boulder cored starting at 2.7m depth	SS	1	87	50+		
					3	103.26
	RC	1	27			
					4	102.26
	SS	2	100	50+		
					5	101.26
	SS	3	58	29		
5.79						
Dynamic Cone Penetration Test commenced at 5.79m depth. 6.43					6	100.26
End of Borehole Practical DCPT refusal at 6.43m depth. (BH dry - December 9, 2022)						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 2, 2022

FILE NO. PG6514

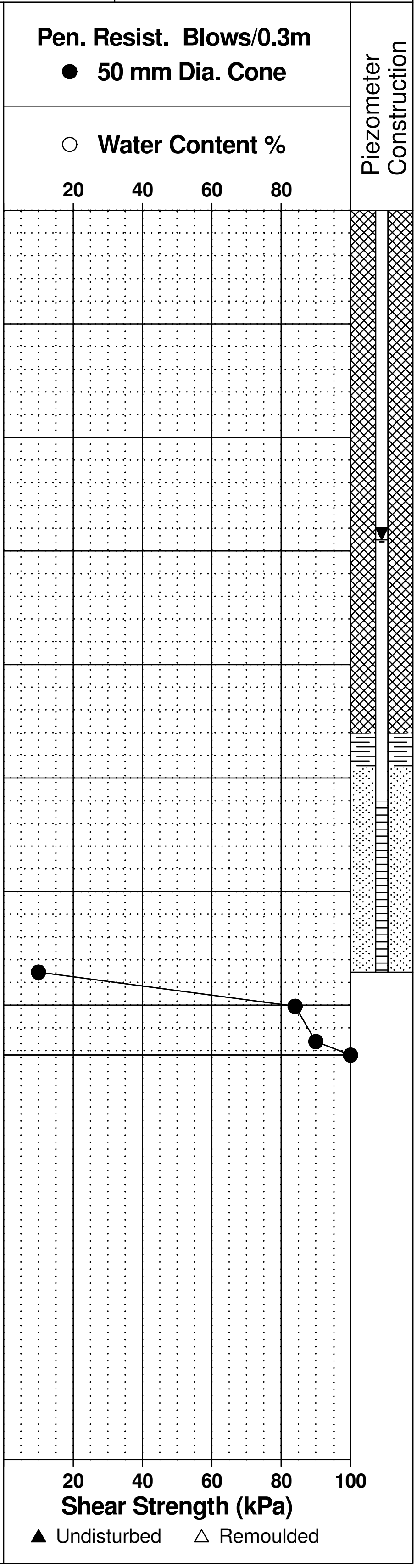
HOLE NO. BH 4-22

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	106.67
TOPSOIL 0.08						
FILL: Brown silty clay with gravel, trace sand 0.69	AU	1				
GLACIAL TILL: Very dense to dense, brown silty sand to sandy silt with gravel, cobbles and boulders	SS	2	83	15	1	105.67
	SS	3	92	50+	2	104.67
	SS	4	100	50+		
- increasing boulder content below 1.5m depth	SS	5	100	50+	3	103.67
	SS	6	100	50+	4	102.67
- grey by 4.5m depth	SS	7	100	45	5	101.67
	SS	8	79	34		
6.71	SS	9	83	50+	6	100.67
Dynamic Cone Penetration Test commenced at 6.71m depth. 7.44					7	99.67

End of Borehole

Practical DCPT refusal at 7.44m depth.

(GWL @ 2.90m - Dec. 9, 2022)



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

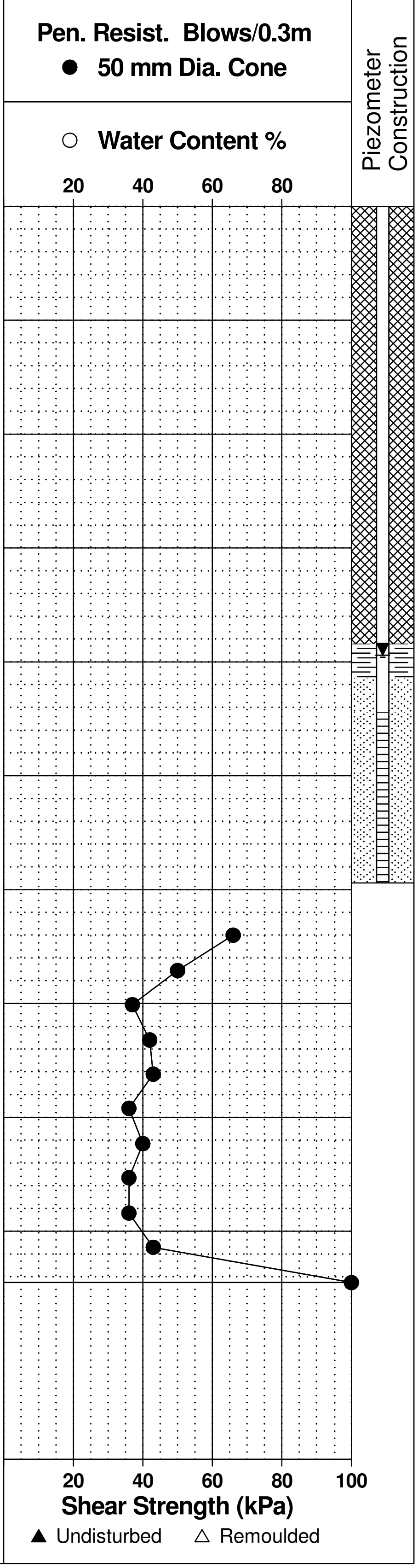
BORINGS BY Track-Mount Power Auger

DATE December 2, 2022

FILE NO. PG6514

HOLE NO. BH 5-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.58
TOPSOIL 0.05							
FILL: Brown silty sand to sandy silt with gravel, cobbles and boulders 0.80		AU SS SS	1 4 2	 100 0	 50+ 50+		
						1	104.58
		SS	3	100	31		
						2	103.58
GLACIAL TILL: Very dense to dense, brown silty sand to sandy silt with gravel, cobbles and boulders - high boulder and cobble content below 3.5m depth						3	102.58
		SS	5	100	49		
		SS	6	100	50+	4	101.58
		SS	7	100	50+		
						5	100.58
		SS	8	100	39		
6.10						6	99.58
Dynamic Cone Penetration commenced at 6.10m depth.							
						7	98.58
						8	97.58
						9	96.58
9.45							
End of Borehole Practical DCPT refusal at 9.45m depth. (GWL @ 3.94m - Dec. 9, 2022)							



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

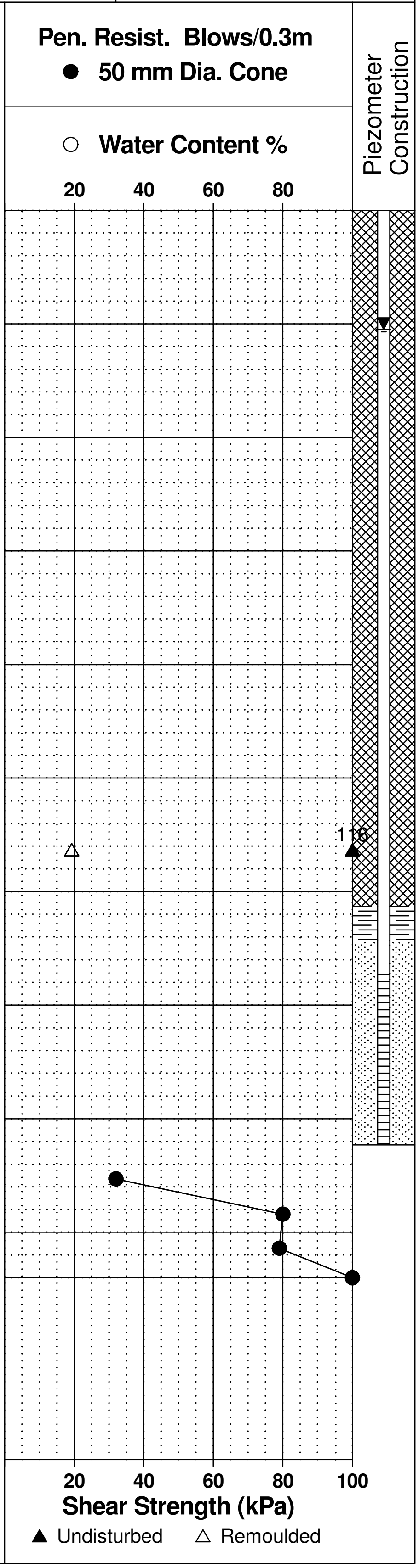
DATE December 2, 2022

FILE NO. PG6514

HOLE NO. BH 6-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.05					
FILL: Brown silty sand to sandy silt with gravel, trace clay and organics, occasional cobbles and boulders 0.50		AU	1		
GLACIAL TILL: Compact to dense, brown silty sand with gravel, cobbles and boulders		SS	2	83	18
		SS	.3	58	26
3.20		SS	4	75	49
Very stiff, grey **SILTY CLAY,** trace sand and gravel		SS	5	75	22
		SS	6	100	2
		SS	7	100	3
5.94		SS	8		P
GLACIAL TILL: Compact to dense, grey silty sand to sandy silt with gravel, cobbles and boulders, trace to some clay		SS	9	79	24
		SS	10	62	6
8.23		SS	11	50	31
Dynamic Cone Penetration Test commenced at 8.23m depth. - increasing boulder content below 9.0m depth 9.40					
End of Borehole Practical DCPT refusal at 9.40m depth. (GWL @ 1.05m - Dec. 9, 2022)					

DEPTH (m)	ELEV. (m)
0	108.02
1	107.02
2	106.02
3	105.02
4	104.02
5	103.02
6	102.02
7	101.02
8	100.02
9	99.02



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

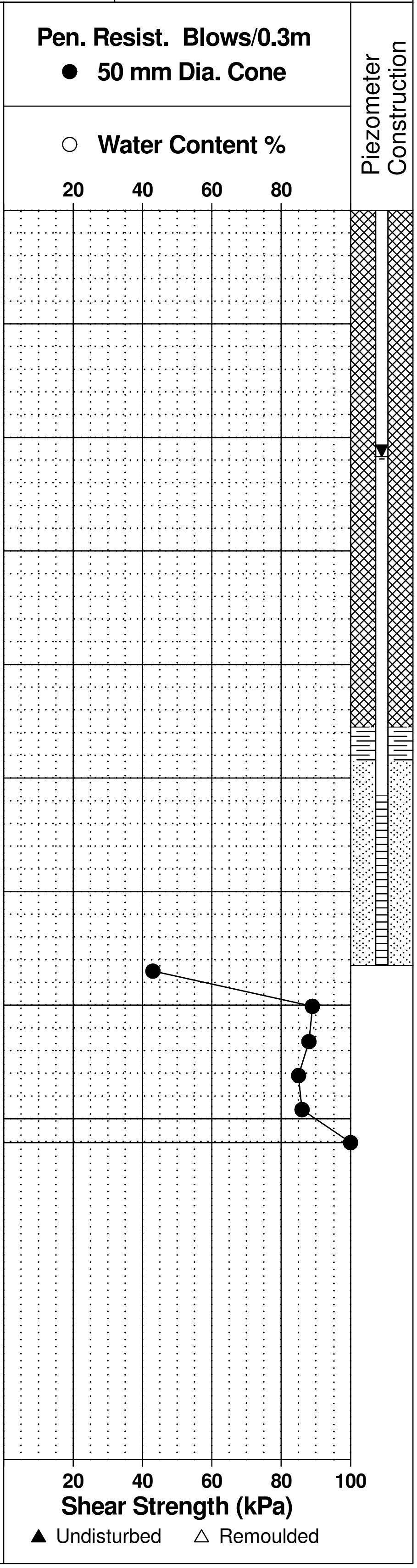
BORINGS BY Track-Mount Power Auger

DATE December 5, 2022

FILE NO. PG6514

HOLE NO. BH 7-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	104.82
TOPSOIL 0.05							
FILL: Grey to brown silty sand to sandy silt, trace clay and gravel, occasional cobbles and boulders		AU	1				
		SS	2	54	10	1	103.82
1.45							
GLACIAL TILL: Very dense to dense, brown silty sand to sandy silt with gravel, cobbles and boulders		SS	3	33	9	2	102.82
		SS	4	84	50+		
- increasing boulder content below 2.5m depth		SS	5	100	50+	3	101.82
		SS	6	50	50+	4	100.82
- 300mm long section of boulder cored starting at 5.0m depth		SS	7	80	50+	5	99.82
		RC	1	100			
		SS	8	71	40	6	98.82
6.65							
Dynamic Cone Penetration Test commenced at 6.65m depth.						7	97.82
						8	96.82
8.21							
End of Borehole Practical DCPT refusal at 8.21m depth. (GWL @ 2.17m - Dec. 9, 2022)							



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 5, 2022

FILE NO. **PG6514**

HOLE NO. **BH 8-22**

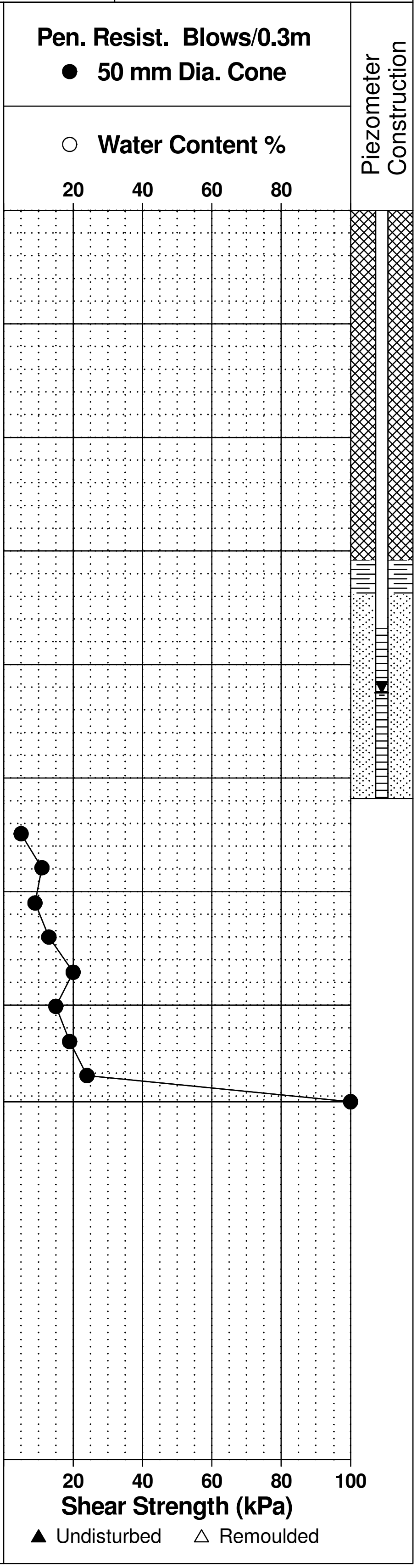
SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.05				
FILL: Brown silty sand with clay, gravel, crushed stone, occasional cobbles and boulders	0.69	AU	1		
FILL: Brown silty clay with sand, gravel, occasional cobbles and boulders	1.68	SS	2	75	9
FILL: Brown to grey silty sand to sandy silt with gravel, cobbles and boudlers	2.03	SS	3	50	23
Very stiff, brown **SILTY CLAY,** trace sand		SS	4	100	12
	3.73	SS	5	100	12
GLACIAL TILL: Compact, brown siltys and to sandy silt with gravel, cobbles and boulders, trace to some clay		SS	6	71	13
	5.18	SS	7	83	10
Dynamic Cone Penetration Test commenced at 5.18m depth.	7.85				

End of Borehole

Practical DCPT refusal at 7.85m depth.

(GWL @ 4.25m - Dec. 9, 2022)

DEPTH (m)	ELEV. (m)
0	102.11
1	101.11
2	100.11
3	99.11
4	98.11
5	97.11
6	96.11
7	95.11



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate DriveProp. C
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Track-Mount Power Auger
DATE December 5, 2022
FILE NO. PG6514
HOLE NO. BH 9-22

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.25
FILL: Brown silty clay with sand, trace to some gravel	2.44
Hard, brown **SILTY CLAY,** trace sand	4.06
GLACIAL TILL: Loose, brown silty sand to sandy silt with gravel, occasional cobbles and boulders, trace to some clay	5.18
Dynamic Cone Penetration Test commenced at 5.18m depth.	9.35

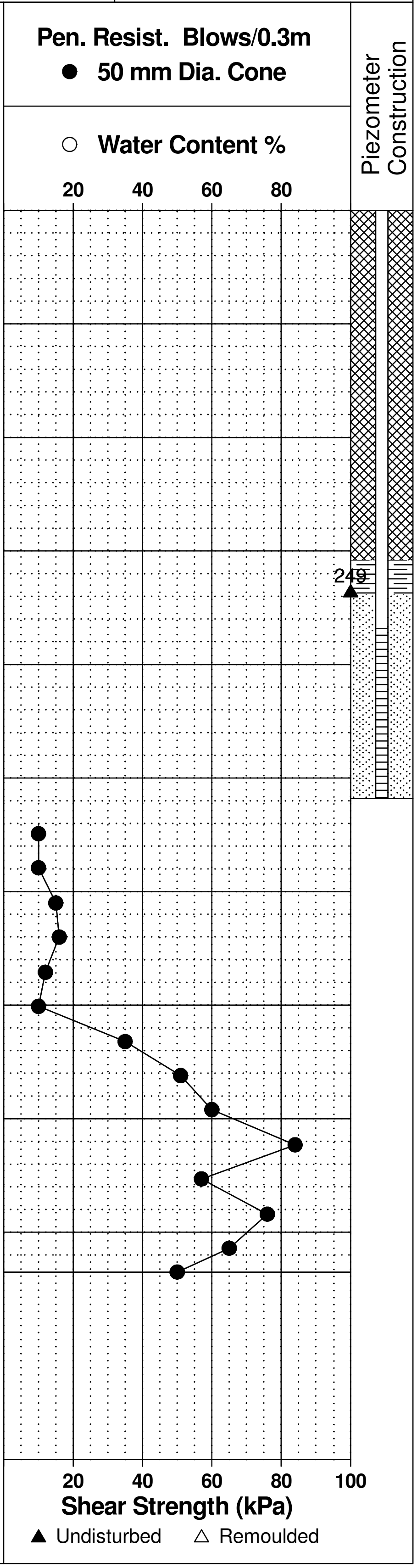
End of Borehole

Practical DCPT refusal at 9.35m depth.

(BH dry - December 9, 2022)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	8
SS	3	100	4
SS	4	100	11
SS	5	100	P
SS	6	83	6
SS	7	67	7

DEPTH (m)	ELEV. (m)
0	100.87
1	99.87
2	98.87
3	97.87
4	96.87
5	95.87
6	94.87
7	93.87
8	92.87
9	91.87



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

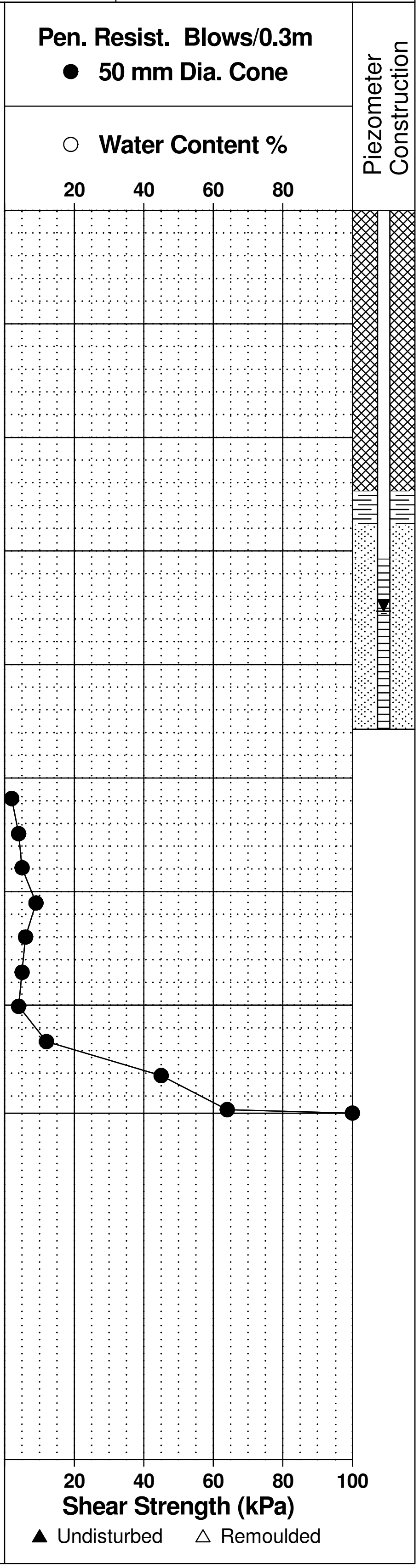
DATE December 6, 2022

FILE NO. **PG6514**

HOLE NO. **BH10-22**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.05				
FILL: Brown silty sand with gravel, trace to some clay	AU	1		
	SS	2	50	5
1.45				
Hard, brown **SILTY CLAY**	SS	3	100	10
2.21				
GLACIAL TILL: Compact to loose, brown silty sand with gravel, some clay, occasional cobbles	SS	4	67	10
	SS	5	54	14
	SS	6	71	5
4.57				
Dynamic Cone Penetration Test commenced at 4.57m depth.				
7.95				
End of Borehole Practical DCPT refusal at 7.95m depth. (GWL @ 3.53m - Dec. 9, 2022)				

DEPTH (m)	ELEV. (m)
0	97.12
1	96.12
2	95.12
3	94.12
4	93.12
5	92.12
6	91.12
7	90.12



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 6, 2022

FILE NO. **PG6514**

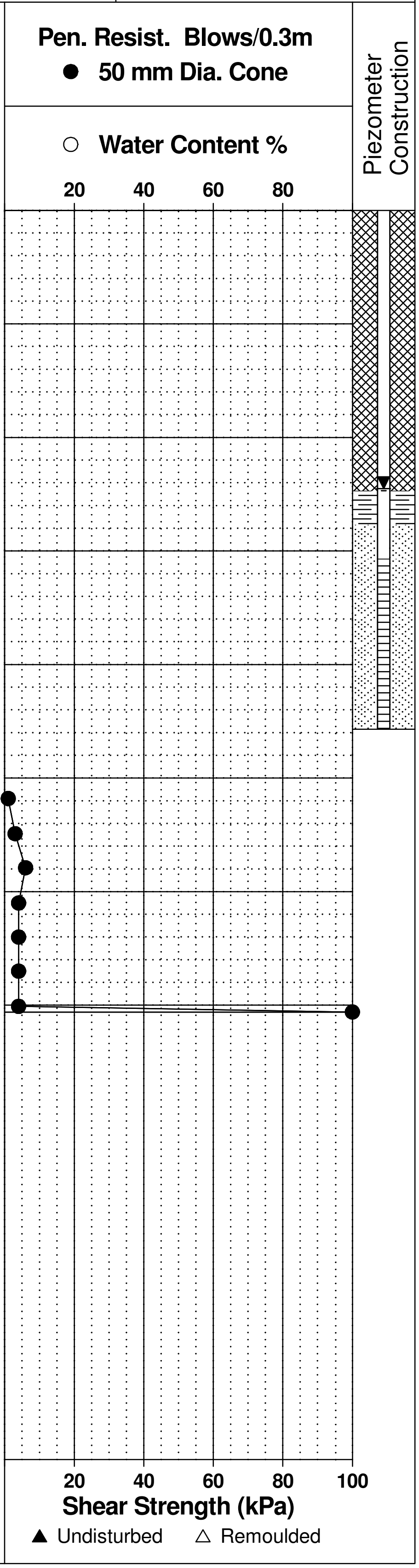
HOLE NO. **BH11-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.75
TOPSOIL 0.05							
FILL: Grey to brown silty sand to sandy silt with gravel, trace clay, occasional cobbles and boulders - high boulder contetn at 1.0m depth		AU	1				
		SS	2	89	50+		
1.45						1	96.75
Hard, brown **SILTY CLAY**		SS	3	100	10	2	95.75
2.64		SS	4	100	6		
GLACIAL TILL: Loose, brown silty sand to sandy silt with clay and gravel, occasional cobbles and boulders		SS	5	62	8	3	94.75
		SS	6	100	9	4	93.75
4.57							
Dynamic Cone Penetration Test commenced at 4.57m depth.						5	92.75
						6	91.75
7.06						7	90.75

End of Borehole

Practical DCPT refusal at 7.06m depth.

(GWL @ 2.45m - Dec. 9, 2022)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 6, 2022

FILE NO. **PG6514**

HOLE NO. **BH12-22**

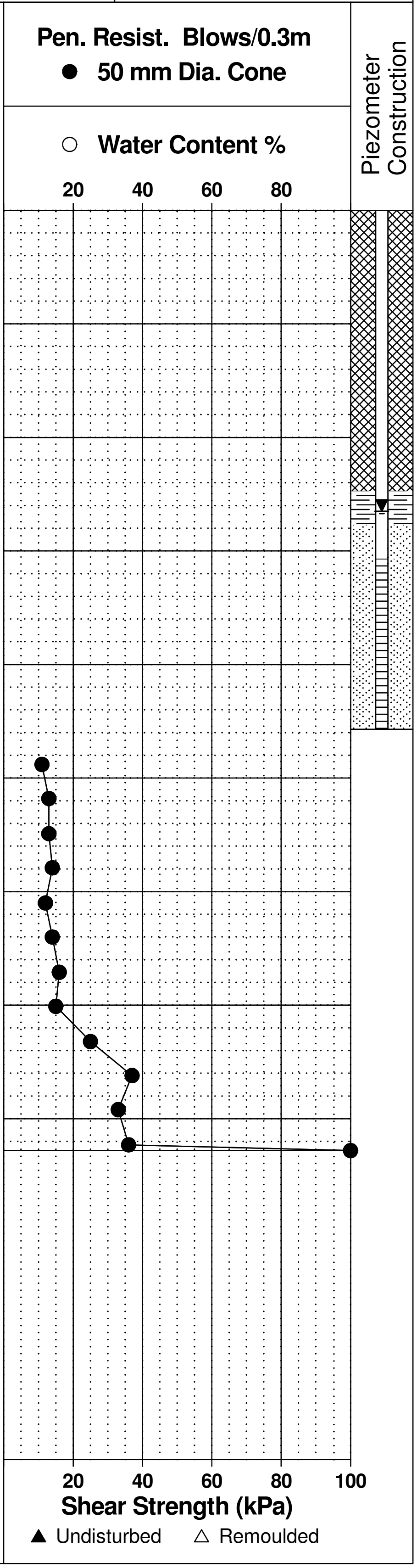
SOIL DESCRIPTION	Bottom depth (m)	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.05				
FILL: Brown silty clay with sand, trace gravel	1.45	AU SS	1 2	 50	 5
Hard, brown **SILTY CLAY**	2.39	SS	3	100	11
GLACIAL TILL: Compact, brown sitly sand to sandy silt with gravel, cobbles and boulders, trace clay	4.57	SS SS SS	4 5 6	71 75 54	18 21 10
Dynamic Cone Penentration Test commenced at 4.57m depth.	8.28				

End of Borehole

Practical DCPT refusal at 8.28m depth.

(GWL @ 2.65m - Dec. 9, 2022)

DEPTH (m)	ELEV. (m)
0	98.85
1	97.85
2	96.85
3	95.85
4	94.85
5	93.85
6	92.85
7	91.85
8	90.85



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH13-22

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	108.66		
OVERBURDEN						1	107.66		
1.62									
End of Borehole Practical refusal to augering at 1.62m depth.									

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH13A-22

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	108.66		
						1	107.66		
						2	106.66		
OVERBURDEN						3	105.66		
						4	104.66		
5.18						5	103.66		
End of Borehole Practical refusal to augering at 5.18m depth.									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH13B-22

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	108.66		
						1	107.66		
						2	106.66		
						3	105.66		
OVERBURDEN						4	104.66		
						5	103.66		
						6	102.66		
						7	101.66		
8.15						8	100.66		
End of Borehole Practical refusal to augering at 8.15m depth.									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH14-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	108.89		
						1	107.89		
						2	106.89		
OVERBURDEN									
						3	105.89		
						4	104.89		
						5	103.89		
5.66									
End of Borehole Practical refusal to augering at 5.66m depth.									

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH14A-22

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	108.89		
						1	107.89		
OVERBURDEN						2	106.89		
						3	105.89		
						4	104.89		
5.23						5	103.89		

End of Borehole

Practical refusal to augering at 5.23m depth.

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH15-22

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	103.63		
						1	102.63		
						2	101.63		
OVERBURDEN						3	100.63		
						4	99.63		
						5	98.63		
6.10						6	97.63		
End of Borehole									

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

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH16-22

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	107.32		
						1	106.32		
						2	105.32		
						3	104.32		
						4	103.32		
OVERBURDEN						5	102.32		
						6	101.32		
						7	100.32		
						8	99.32		
9.14						9	98.32		
End of Borehole									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Com. Development - 480 & 486 Citigate Drive
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE December 15, 2022

FILE NO. PG6514

HOLE NO. BH17-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	109.38
						1	108.38
						2	107.38
						3	106.38
						4	105.38
OVERBURDEN							
						5	104.38
						6	103.38
						7	102.38
						8	101.38
						9	100.38
9.14							
End of Borehole							

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

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

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

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

Cc - Concavity coefficient = $(D30)^2 / (D10 \text{ x } D60)$
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)

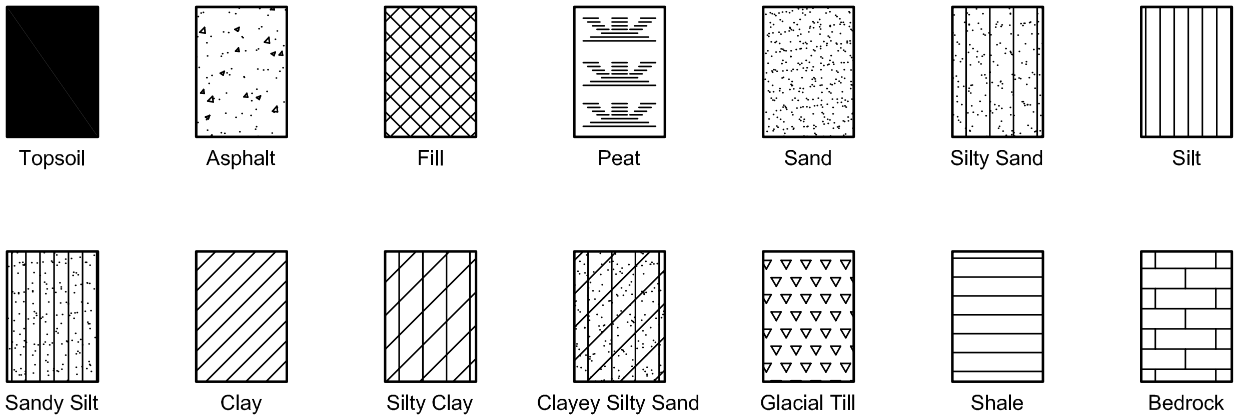
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

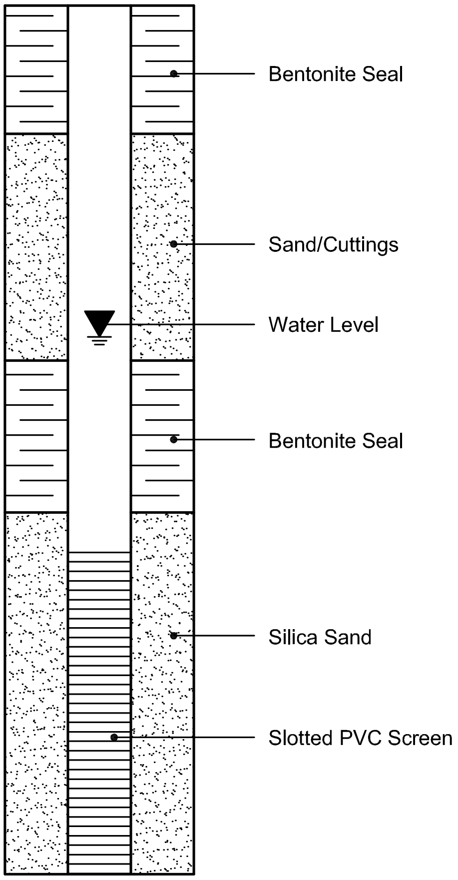
SYMBOLS AND TERMS (continued)

STRATA PLOT

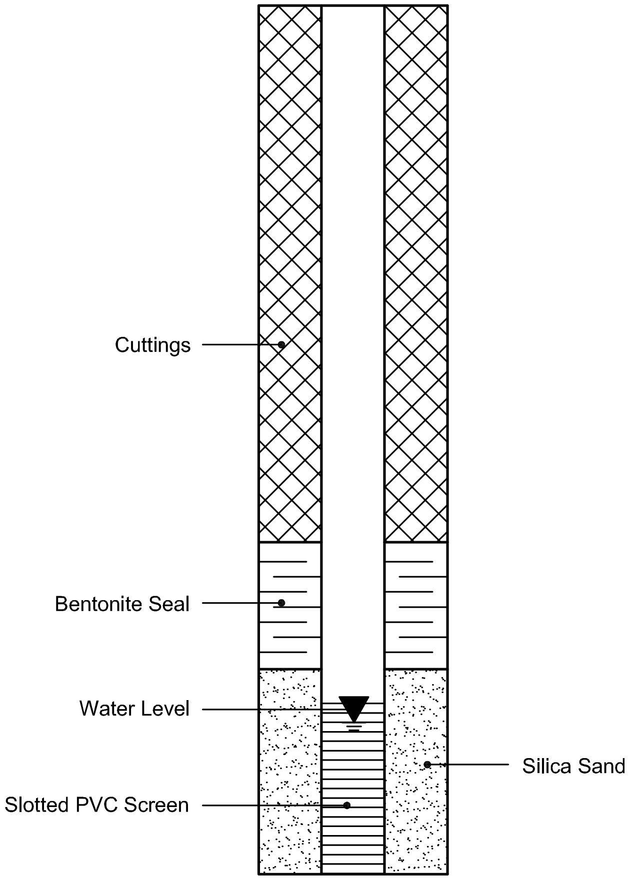


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 14-Dec-2022

Client: Paterson Group Consulting Engineers

Order Date: 7-Dec-2022

Client PO: 56396

Project Description: PG6514

	Client ID:	BH7 - 22 (BHF) SS5	-	-	-	-	-
	Sample Date:	06-Dec-22 09:00	-	-	-		
	Sample ID:	2250361-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	92.3	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.69	-	-	-	-	-
Resistivity	0.1 Ohm.m	88.1	-	-	-	-	-
Anions							
Chloride	5 ug/g	<5	-	-	-	-	-
Sulphate	5 ug/g	12	-	-	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

DRAWING PG6514-1 – TEST HOLE LOCATION PLAN

DRAWING PG6514-2 – PERMISSIBLE GRADE RAISE PLAN

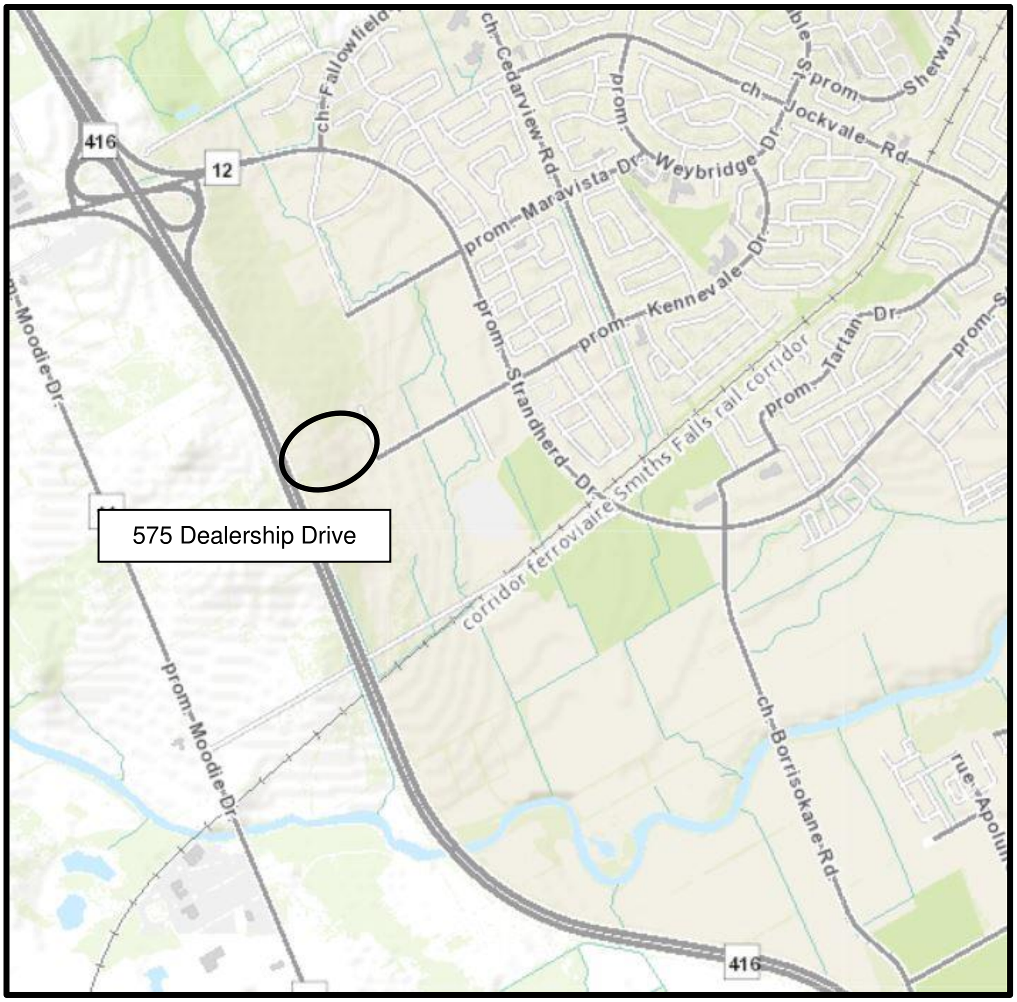
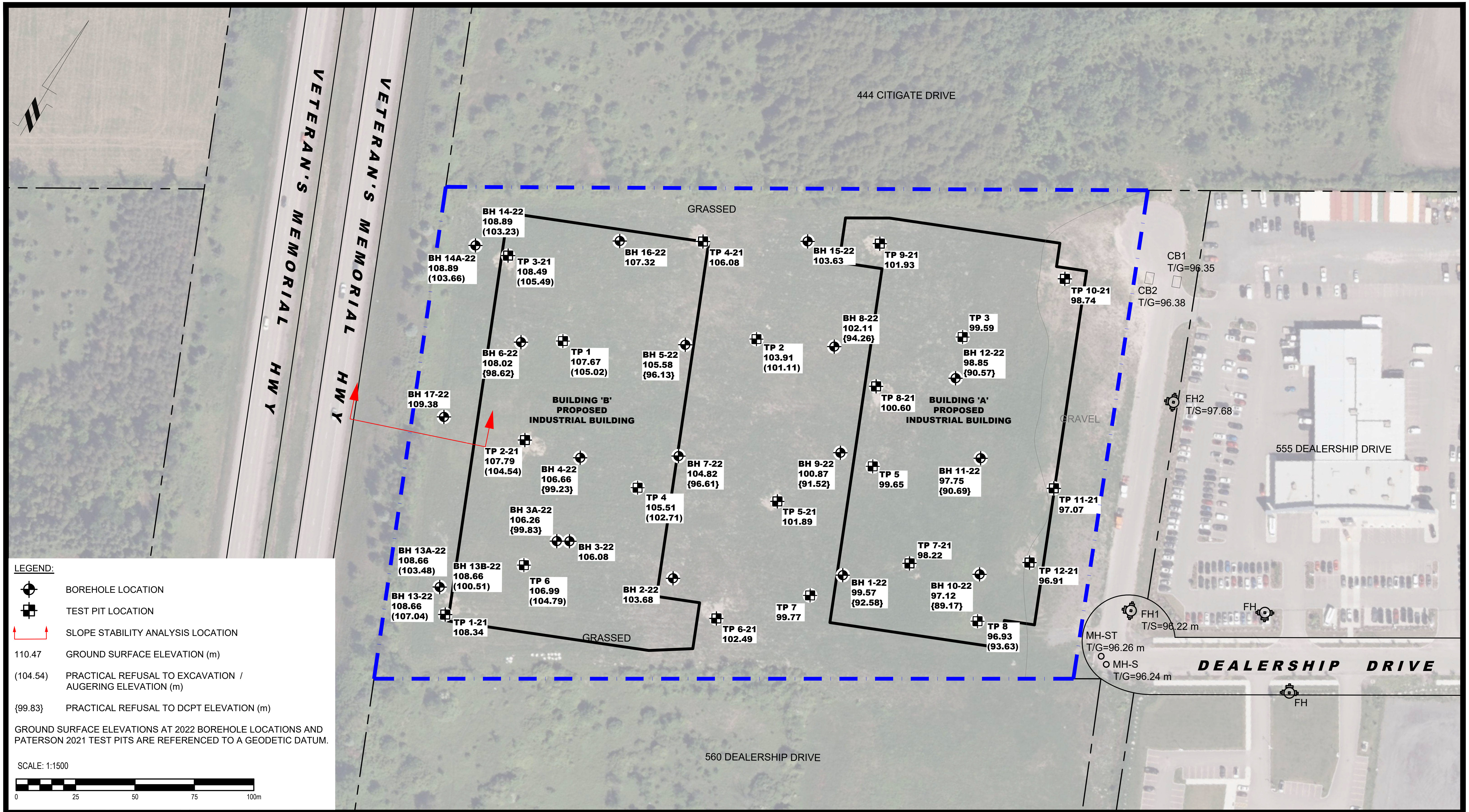


FIGURE 1

KEY PLAN

PATERSON GROUP



LEGEND:

⊕	BOREHOLE LOCATION
⊞	TEST PIT LOCATION
↑ ↑	SLOPE STABILITY ANALYSIS LOCATION
110.47	GROUND SURFACE ELEVATION (m)
(104.54)	PRACTICAL REFUSAL TO EXCAVATION / AUGERING ELEVATION (m)
{99.83}	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

GROUND SURFACE ELEVATIONS AT 2022 BOREHOLE LOCATIONS AND PATERSON 2021 TEST PITS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1500

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
2	UPDATED BUILDING FOOTPRINT	10/10/2023	YZ
1	BH 13-22 - BH 17-22 ADDED TO PLAN	05/01/2023	MS

RF OTTAWA LIMITED PARTNERSHIP C/O ROSEFELLOW DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
480 AND 486 CITIGATE DRIVE

OTTAWA, ONTARIO

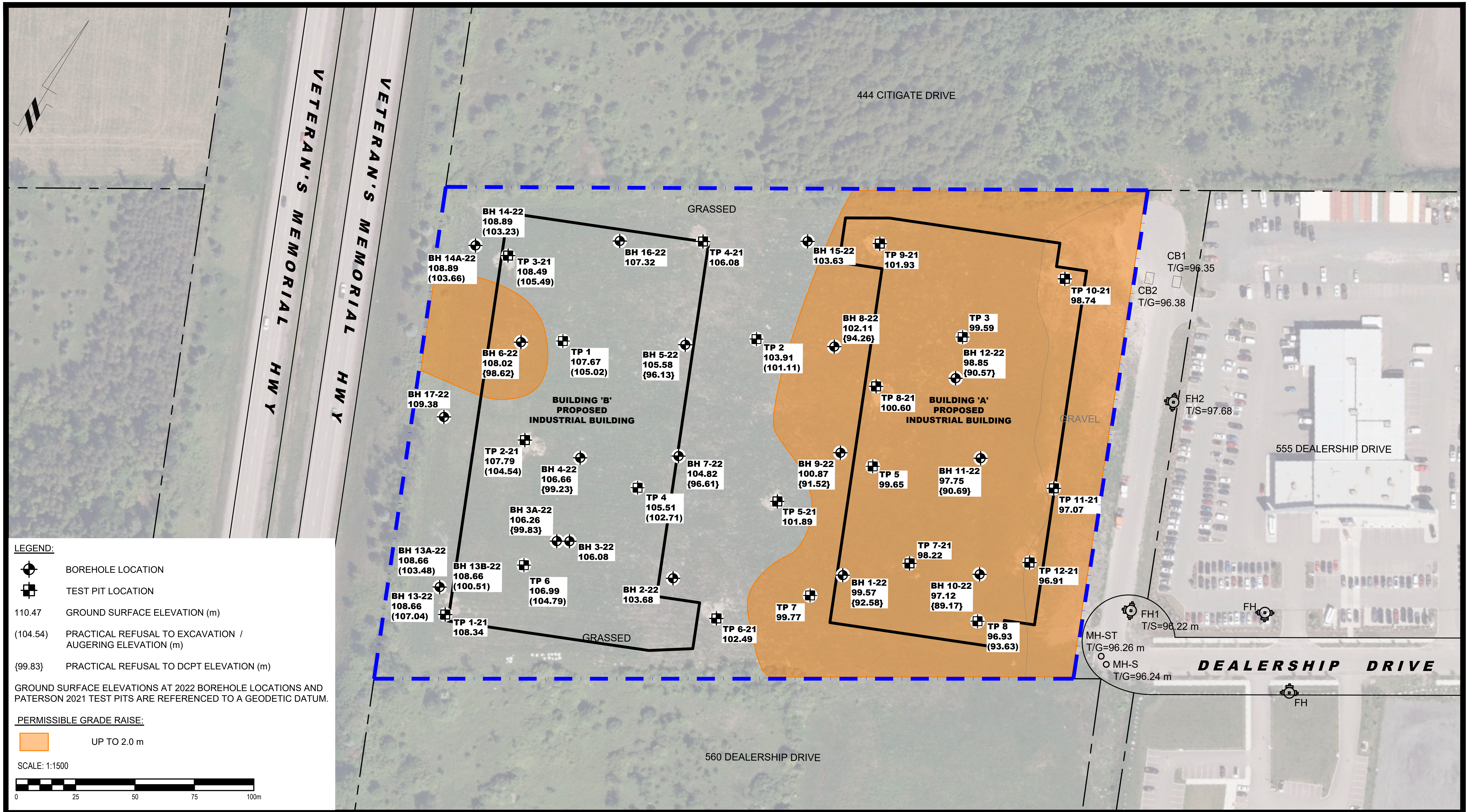
Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500
Date: 12/2022
Drawn by: YA
Report No.: PG6514-1
Checked by: MS
Dwg. No.: PG6514-1
Approved by: DJG
Revision No.: 2

p:\autocad drawings\geotechnical\pg65xx\pg6514\pg6514-1 test hole location plan rev 2.dwg

11x17



LEGEND:

⊕	BOREHOLE LOCATION
⊞	TEST PIT LOCATION
110.47	GROUND SURFACE ELEVATION (m)
(104.54)	PRACTICAL REFUSAL TO EXCAVATION / AUGERING ELEVATION (m)
{99.83}	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

GROUND SURFACE ELEVATIONS AT 2022 BOREHOLE LOCATIONS AND PATERSON 2021 TEST PITS ARE REFERENCED TO A GEODETIC DATUM.

PERMISSIBLE GRADE RAISE:

🟧	UP TO 2.0 m

SCALE: 1:1500

0 25 50 75 100m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

RF OTTAWA LIMITED PARTNERSHIP C/O ROSEFELLOW DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
480 AND 486 CITIGATE DRIVE

OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:1500
Date: 10/2023
Drawn by: ZS
Report No.: PG6514-1
Checked by: YZ
Dwg. No.: PG6514-2
Approved by: MS
Revision No.:

11x17

p:\autocad drawings\geotechnical\pg65xx\pg6514\pg6514-1 test hole location plan rev 2.dwg

APPENDIX 3

RELEVANT MEMORANDUMS

PATERSON GROUP

memorandum

re: **Slope Stability Analysis – Western Property Boundary**
Proposed Commercial Building
480 & 486 Citigate Drive – Ottawa, Ontario
to: RF Ottawa Limited Partnership – Mr. Julian Nini – juliann@rosefellow.com
date: October 10, 2023
file: PG6514-MEMO.01 Revision 1

As requested, Paterson Group (Paterson) prepared the current memorandum to provide geotechnical recommendations for the proposed steep slopes to be located along the western property boundary at the aforementioned site. It should be noted that the slope stability analysis for the retaining walls at the remaining locations and within the property will be completed at detailed design stage. This memorandum should be read in conjunction with Paterson's geotechnical Report PG6514-1 Revision 2 dated October 10, 2023.

1.0 Background Information

It is our understanding that due to the proposed parking area along the west property line, a steep slope is proposed to be excavated (steeper than the recommended 3H:1V). Therefore, Paterson was approached by Rosefellow to analyze the ***potential*** to build slopes with a maximum inclination of 1H:1V or 2H:1V and provide recommendations to ensure that the slope is achieved while maintaining slope stability in the long term.

As part of our assessment of the subject slope, the following drawings were reviewed to retrieve proposed grading and the existing topography of the area:

- ☐ Grading Plan – Project No. 119123 – Drawing No. 119123-GR1 – Revision 2 dated October 6, 2023.
- ☐ Grading Plan – Project No. 119123 – Drawing No. 119123-GR2 – Revision 2 dated October 6, 2023.

The following provides our assessment of the proposed slope and our recommendations during and post construction.

2.0 Slope Stability Assessment

Subsurface Conditions

Based on our geotechnical investigation findings, the subsurface profile across the western side of the subject site generally consists of topsoil underlain by a thin layer of silty sand fill.

The above noted layers are followed by dense to very dense glacial till or a stiff to very stiff grey silty clay and followed by a layer of glacial till. The glacial till layer consists of brown to grey silty sand with gravel, cobbles, and boulders with some clay which are underlain by bedrock.

Generally, based on the measured groundwater levels at each borehole location along with the colouring, consistency and moisture levels of the recovered samples, the groundwater table is expected to range between 2 to 4 m below existing grade. Reference should be made to the latest revision of the geotechnical Report PG6514-1 Revision 1 dated March 8, 2023.

Slope Stability Analysis methodology

The slope stability analysis for the ***"proposed sloping scenarios"*** was modeled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several limit equilibrium analysis methods, including but not limited, the Bishop's and Morgenstern-Price methods, which are widely accepted slope analyses methods. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. The factor of safety displayed represents the lowest value calculated from the analysis results. 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. It should be noted that only the figures with the lowest factor of safety are presented and considered the governing factors.

Two (2) slope scenarios (Sections A and B) were studied with the potential proposed inclination of 1H:1V or 2H:1V, respectively, for the proposed slopes to be located along the west side of the site. Conservatively, the subsurface layers were assumed to be fully saturated in order to achieve a factor of safety of 1.5 or higher while in the worst case scenario.

The cross-section locations are presented on Drawing PG6514-1 - Test Hole Location Plan attached to the end of this memorandum. It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 1A through 3B attached to the end of this report based on the proposed grading.

The parameters in Table 1 and 2 were used for the slope stability analysis under static and seismic conditions:

Table 1 - Soil Parameters – Static Conditions

Soil Layer	Unit Weight (kN/m³)	Friction Angle (degrees)	Cohesion (kPa)
Silty Sand Fill	19	35	
Silty Clay with Sand and Gravel	18	33	10
Glacial Till	20	38	5
Bedrock	24	-	-

Table 2 - Soil Parameters – Seismic Loading

Soil Layer	Unit Weight (kN/m³)	Friction Angle (degrees)	Cohesion (kPa)
Silty Sand Fill	19	35	
Silty Clay with Sand and Gravel	18	33	80
Glacial Till	20	38	5
Bedrock	24	-	-

Slope Stability Sections

Section A

Section A was drawn to form a slope with a maximum slope inclination of 1H:1V and an approximate horizontal distance of 6.5 m between the toe of the slope and the edge of the proposed curb. A 1 m wide swale was assumed to be located along the bottom of the slope at a depth of approximately 1 m below finished grade.

Two separate scenarios were analyzed to determine whether a 1H:1V slope is achievable given the available tight spacing present on site and are summarized as follows:

- ☐ The first Scenario (Figures 1A and 1B) assumed that the slope face will be covered by a geosynthetic system that would provide erosion control along the slope face.
- ☐ The second Scenario (Figures 2A and 2B) assumed that a 3.8 m deep geogrid wrapped, compacted granular fill layers placed in a tapered fashion along the face of the slope and separated vertically at 750 mm vertical spacing, would be built to support the 1H:1V slope face. The geogrid wrapped granular fill will contain a biaxial geogrid liner such as Terrafix TBX2500 or equivalent, wrapped around a minimum 750 mm thick layers of OPSS Granular B Type II compacted to 98% of the material's SPMDD. Reference should be made to the sketch presented below for this system.

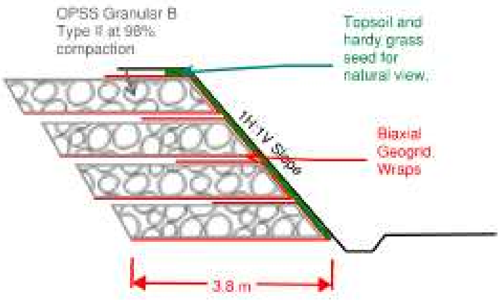


Figure 1- Sketch of the proposed geogrid reinforced slope face

Section B

Section B was drawn with a maximum slope inclination of 2H:1V with an approximate horizontal distance of 3 m between the toe of the slope to the edge of the proposed curb. A 1 m wide swale was assumed to be located along the bottom of the slope at a depth of approximately 1 m below finished grade.

The analysis was completed with the assumption that the slope face will be supported by an erosion control system such as the use of GeoWeb cells penetrated into the slope face by a minimum of 150 mm below the slope face and backfilled with topsoil and hardy grass seed.

The results of the slope stability sections are summarized in the following section.

Slope Stability Analysis Results

The static analysis results for slope sections A and B are presented in Figures 1A, 2A, and 3A and attached to the end of this report. The factor of safety for both slope scenarios of Section A was less than the minimum acceptable factor of safety of 1.5 (Figures 1A and 2A). Whereas the factor of safety for Section B (Figure 3A) was found to be greater than 1.5 without the need to complete excessive work on the slope face beyond providing an erosion control system along the slope face.

Similarly, the slope stability analysis under seismic loading for Section A were less than the desired factor of safety of 1.1 while the analysis results for Section B indicate a safe slope under seismic conditions. Reference should be made to Figures 1B, 2B and 3B showing the results of the slope stability under seismic loading.

3.0 Conclusion and Recommendations

Based on the above analysis results, it is recommended that the slope be shaped to a minimum of 2H:1V or shallower. If a shallower slope of 1H:1V is required, the extent of the geogrid will be required to encroach into the City property. Provided that the client receives a written approval from the City to encroach, this option will not be viable.

It is highly recommended that an erosion control system be installed along the 2H:1V slope face consisting of the following:

- ☐ The slope face should be shaped to a minimum 2H:1V with the top of slope at an approximate elevation of 109 m down to an approximate elevation of 104 m.
- ☐ A swale should be excavated along the slope face with a positive outlet to ensure that the accumulated surface water runoff is drained away from the bottom of the slope.
- ☐ The swale should be backfilled with granular material consisting of OPSS Granular B Type II or rip-rap with a maximum particle size of 150 mm to allow for drainage and provide a sufficient toe protection against active erosion.
- ☐ The slope face should be covered with GeoWeb system by Presto, or equivalent, with a minimum cell depth of 150 mm penetrated into the slope face.

☐ The GeoWeb Cells should be backfilled with a minimum of 300 mm thick layer of topsoil followed by applying hardy grass seed to establish vegetation. Reference should be made to the attached GeoWeb data sheets.

☐ It is important to note that the placement of the topsoil layer and the application of the hardy grass seed should be completed during the fall season or after the spring thaw, away from freezing temperatures, to ensure a fast growth of roots into the slope face.

☐ Any existing trees located within the proposed slope alignment should remain in place as tree roots reinforce the stability of the slope face.

☐ Based on the preliminary grading plan for the roads which was provided by the client, and on the current site topography, it is anticipated that the proposed development will include terracing and retaining walls within and along the site boundaries. Paterson will complete a slope stability review and a design for the retaining walls, as per City Guidelines, at the detailed design stage of the project.

4.0 Field Inspections

All slope related field work should be overseen and approved by Paterson at the time of construction. It is recommended to contact Paterson if different soils than described in this report are encountered along the slope faces to provide additional recommendations, where required.

We trust that this information satisfies your requirements.

Best Regards,

Paterson Group Inc.

Yashar Ziaeimehr, M.A.Sc.

LICENSED PROFESSIONAL ENGINEER
Oct.10, 2023
M. SALEH
100507739
PROVINCE OF ONTARIO

Maha Saleh, P.Eng.

Attachments:

☐ Presto Geoweb Data Sheets
☐ Slope Stability Analysis Figures 1A through 3B
☐ Drawing PG6514-1 – Test Hole Location Plan
☐ Grading Plan, Revision 2 dated October 6, 2023, prepared by Novatech.

PRESTO GEOSYSTEMS®

Perforated GEOWEB® System
Performance & Material Specification Summary

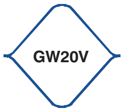
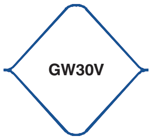
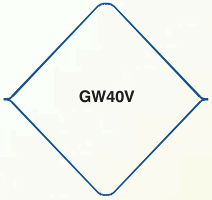
	Property	Value		Test Method
Base Material	**Material Composition**	Polymer – Polyethylene with density of 58.4 - 60.2 lb/ft^3 (0.935 – 0.965 g/cm^3)		ASTM D 1505
	Color	Black - from Carbon Black	Tan, Green, Other colors with no heavy metal content	N/A
	Stabilizer	Carbon black content 1.5% - 2% by weight	Hindered amine light stabilizer (HALS) 1.0% by weight of carrier	N/A
	Minimum ESCR	5000 hr		ASTM D 1693
Strip Properties	**Sheet Thickness**	50 mil –5% +10%(1.27 mm -5% +10%)		ASTM D 5199
	Surface Treatment	**Performance:** The polyethylene strips shall be textured and perforated such that the peak friction angle between the surface of the textured / perforated plastic and #40 silica sand at 100% relative density shall be no less than 85% of the peak friction angle of the silica sand in isolation when tested by the direct shear method per ASTM D 5321.	**Material:** The polyethylene strips shall be textured with a multitude of rhomboidal (diamond shape) indentations. The rhomboidal indentations shall have a surface density of 140 – 200 per in^2 (22 – 31 per cm^2). In addition, the strips shall be perforated with horizontal rows of 0.4 in (10 mm) diameter holes. Perforations within each row shall be 0.75 in (19 mm) on-center. Horizontal rows shall be staggered and separated 0.50 in (12 mm) relative to the hole centers. The edge of strip to the nearest edge of perforation shall be 0.3 in (8 mm) minimum and the centerline of the weld to the nearest edge of perforation shall be 0.7 in (18 mm) minimum. A slot with a dimension of 3/8 in x 1 3/8 in (10 mm x 35 mm) is standard in the center of the non-perforated areas and at the center of each weld.	

	Cell Details	Percent Cell Wall Open Area	Nominal Dimensions ±10%		Density per yd^2 (m^2)	Nominal Area ±1%
			Length	Width		
Cell & Seam Properties	**GW20V**	21.2% ± 1.0%	8.8 in (224 mm)	10.2 in (259 mm)	28.9 yd^2 (34.6 m^2)	44.8 in^2 (289 cm^2)
	GW30V	16.8% ± 1.0%	11.3 in (287 mm)	12.6 in (320 mm)	18.2 yd^2 (21.7 m^2)	71.3 in^2 (460 cm^2)
	GW40V	19.89% ± 1.0%	18.7 in (475 mm)	20.0 in (508 mm)	6.9 yd^2 (8.3 m^2)	187.0 in^2 (1,206 cm^2)

	Property	Cell Depth	Minimum Certified Cell Seam Strength
Cell & Seam Properties	**Short-term Seam Peel Strength**	3 in (75 mm)	240 lbf (1060 N)
		4 in (100 mm)	320 lbf (1420 N)
		6 in (150 mm)	480 lbf (2130 N)
		8 in (200 mm)	640 lbf (2840 N)
	Long-term Seam Peel Strength	Long term seam peel-strength test shall be performed on all resin or pre-manufactured sheet or strips. A 4.0 in (100 mm) wide seam sample shall support a 160 lb (72.5 kg) load for a period of 168 hours (7 days) minimum in a temperature-controlled environment undergoing a temperature change on a 1-hour cycle from ambient room to 130°F (54°C). Ambient room temperature is per ASTM E 41.	
	10,000 hour Seam Peel Strength Certification	Presto shall provide data showing that the high-density polyethylene resin used to produce the GEOWEB® sections has been tested using an appropriate number of seam samples and varying loads to generate data indicating that the seam peel strength shall survive a loading of at least 209 lbf (95 kg) for a minimum of 10,000 hours.	

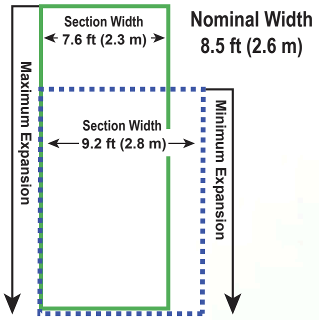
	Section Dimension	Section Width	Section Length Range (Cells Long: 18, 21, 25, 29, 34)	
		Variable	Minimum	Maximum
Section Properties	**GW20V**	7.7 ft (2.3 m) to 9.2 ft (2.8 m)	12.0 ft (3.7 m)	27.3 ft (8.3 m)
	GW30V		15.4 ft (4.7 m)	35.1 ft (10.7 m)
	GW40V		25.4 ft (7.7 m)	58.2 ft (17.8 m)

The GEOWEB® Cell Dimensions

Relative Size[1]				
Name	**GW20V (small cell)**	**GW30V (mid cell)** **For all other Applications**	**For Earth Retention**[4]	**GW40V (large cell)**
Nominal Length x Width[2]	8.8 x 10.2 in (224 x 259 mm)	11.3 x 12.6 in (287 x 320 mm)	10.5 x 13.0 in (267 x 330 mm)	18.7 x 20.0 in (475 x 508 mm)
Nominal Area[3]	44.8 in^2 (289 cm^2)	71.3 in^2 (460 cm^2)	68.3 in^2 (440 cm^2)	187.0 in^2 (1206 cm^2)
Cells per yd^2 (m^2)	28.9 (34.6)	18.2 (21.7)	NA	6.9 (8.3)
Nominal Depths	3 in (75 mm), 4 in (100 mm), 6 in (150 mm), and 8 in (200 mm) for all cells			

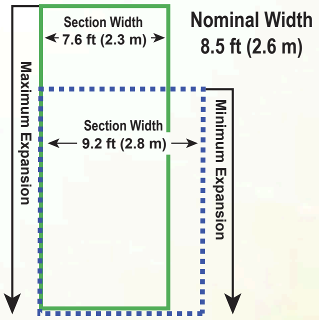
1 All details and dimensions are nominal and subject to manufacturing tolerances.
2 Cell length and width will vary approximately ±10% through the recommended expansion range.
3 Cell area will vary only ±1% through the recommended section expansion range.
4 Cell dimensions for Earth Retention sections are fixed and NOT variable or nominal.

The GW20V Section Dimensions



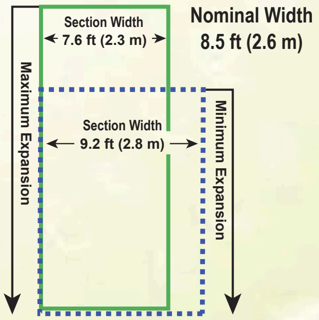
Cells Long	Length Minimum Expansion	Nominal Length	Length Maximum Expansion	Nominal Area
18	12.0 ft (3.7 m)	13 ft (4.0 m)	14.5 ft (4.4 m)	112 ft^2 (10.4 m^2)
21	4.0 ft (4.3 m)	15 ft (4.7 m)	16.9 ft (5.1 m)	131 ft^2 (12.1 m^2)
25	6.7 ft (5.1 m)	18 ft (5.6 m)	20.1 ft (6.1 m)	156 ft^2 (14.5 m^2)
29	9.4 ft (5.9 m)	21ft (6.5 m)	23.3 ft (7.1 m)	181 ft^2 (16.8 m^2)
34	22.7 ft (6.9 m)	25 ft (7.6 m)	27.3 ft (8.3 m)	212 ft^2 (19.7 m^2)

The GW30V Section Dimensions

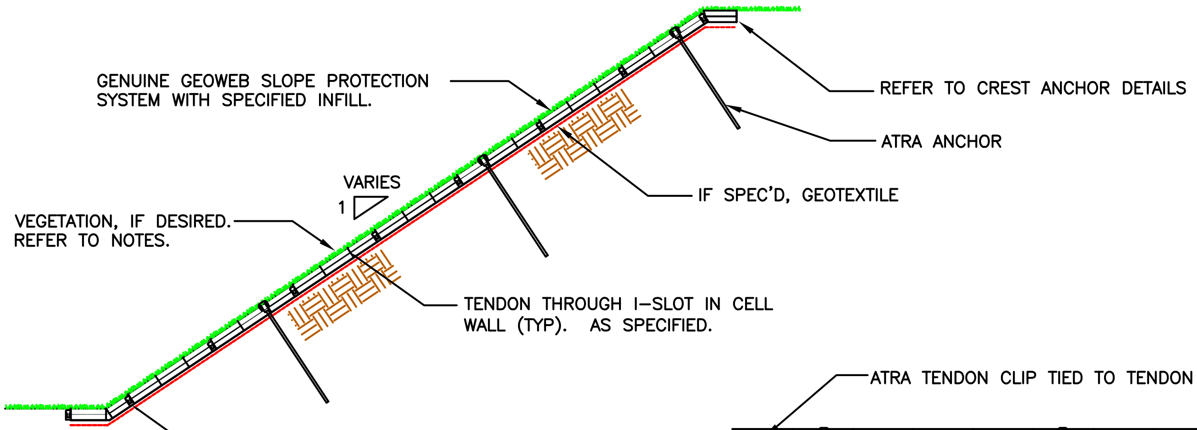


Cells Long	Length Minimum Expansion	Nominal Length	Length Maximum Expansion	Nominal Area
18	15.4 ft (4.7 m)	17 ft (5.1 m)	18.6 ft (5.7 m)	143 ft^2 (13.3 m^2)
21	18.0 ft (5.5 m)	20 ft (6.0 m)	21.7 ft (6.6 m)	167 ft^2 (15.5 m^2)
25	21.4 ft (6.5 m)	23 ft (7.1 m)	25.8 ft (7.9 m)	198 ft^2 (18.4 m^2)
29	24.8 ft (7.6 m)	27 ft (8.2 m)	30.0 ft (9.1 m)	230 ft^2 (21.4 m^2)
34	29.1 ft (8.9 m)	32 ft (9.6 m)	35.1 ft (10.7 m)	270 ft^2 (25.0 m^2)

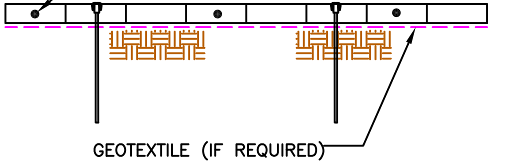
The GW40V Section Dimensions



Cells Long	Length Minimum Expansion	Nominal Length	Length Maximum Expansion	Nominal Area
18	25.4 ft (7.7 m)	28 ft (8.3 m)	30.8 ft (9.4 m)	234 ft^2 (21.7 m^2)
21	29.6 ft (9.0 m)	32 ft (9.7 m)	36.0 ft (11.0 m)	273 ft^2 (25.3 m^2)
25	35.2 ft (10.7 m)	38 ft (11.6 m)	42.8 ft (13.1 m)	325 ft^2 (30.2 m^2)
29	40.9 ft (12.5 m)	44 ft (13.5 m)	49.7 ft (15.1 m)	377 ft^2 (35.0 m^2)
34	47.9 ft (14.6 m)	52 ft (15.8 m)	58.2 ft (17.8 m)	441 ft^2 (41.0 m^2)



TYPICAL TENDON ANCHOR SYSTEM



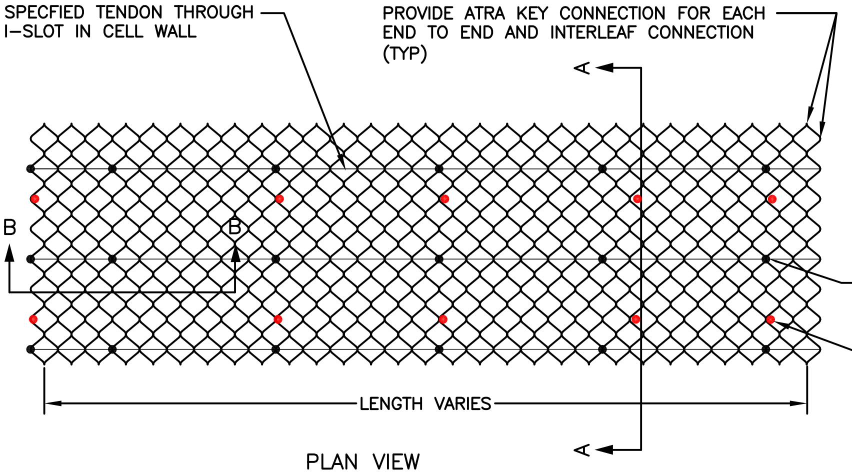
SECTION A – A

NOTES:

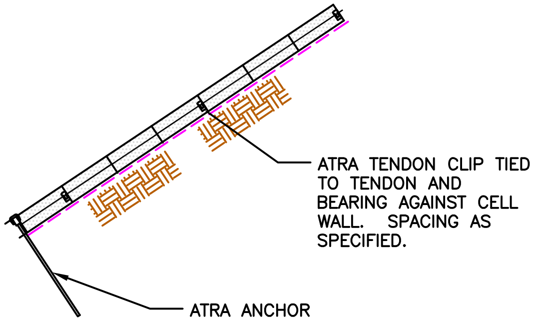
1. THE TYPE AND QUANTITY OF TENDONS AND ATRA ANCHORS SHALL BE AS SPECIFIED.
2. THE GEOWEB SHALL BE FILLED WITH THE SPECIFIED MATERIAL (TOPSOIL, STONE, OR CONCRETE) AND SHALL BE SUITABLE TO WITHSTAND THE APPLICABLE HYDRAULIC CONDITIONS.
3. THE GEOWEB SECTIONS SHALL BE ANCHORED TO RESIST SLIDING DUE TO DRIVING AND HYDRAULIC FORCES.
4. IF VEGETATION IS DESIRED, PROVIDE AN EROSION CONTROL BLANKET OR TURF REINFORCEMENT MAT IF THERE IS A POTENTIAL FOR WASH–OUT PRIOR TO ESTABLISHING VEGETATION.
5. THE GEOWEB PANELS SHALL BE CONNECTED WITH ATRA KEYS AT EACH INTERLEAF AND END TO END CONNECTION.
6. REFER TO THE GENERAL DETAIL DRAWINGS FOR ANCHOR DETAILS.

TENDON DATA

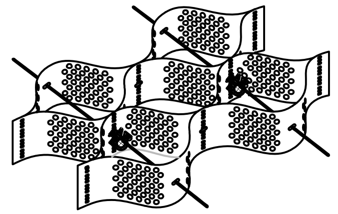
TENDON TYPE	WIDTH, IN(MM)	BREAK STRENGTH, LBF (KN)
POLYESTER		
TP-31	0.50 (13)	700 (3.11)
TP-67	0.75 (19)	1506 (6.70)
TP-93	0.75 (19)	2090 (9.30)
KEVLAR		
TK-89	0.375 (10)	2000 (8.90)
TK-133	0.625 (16)	3000 (13.34)
TK-189	0.75 (19)	4000 (17.8)



PLAN VIEW



SECTION B – B



THIS DRAWING IS COPYRIGHTED AND BASED UPON THE USE OF GENUINE GEOWEB MANUFACTURED BY PRESTO GEOSYSTEMS. ANY USE OF THIS DRAWING FOR ANY PRODUCT OTHER THAN THAT MANUFACTURED BY PRESTO GEOSYSTEMS IS STRICTLY PROHIBITED.

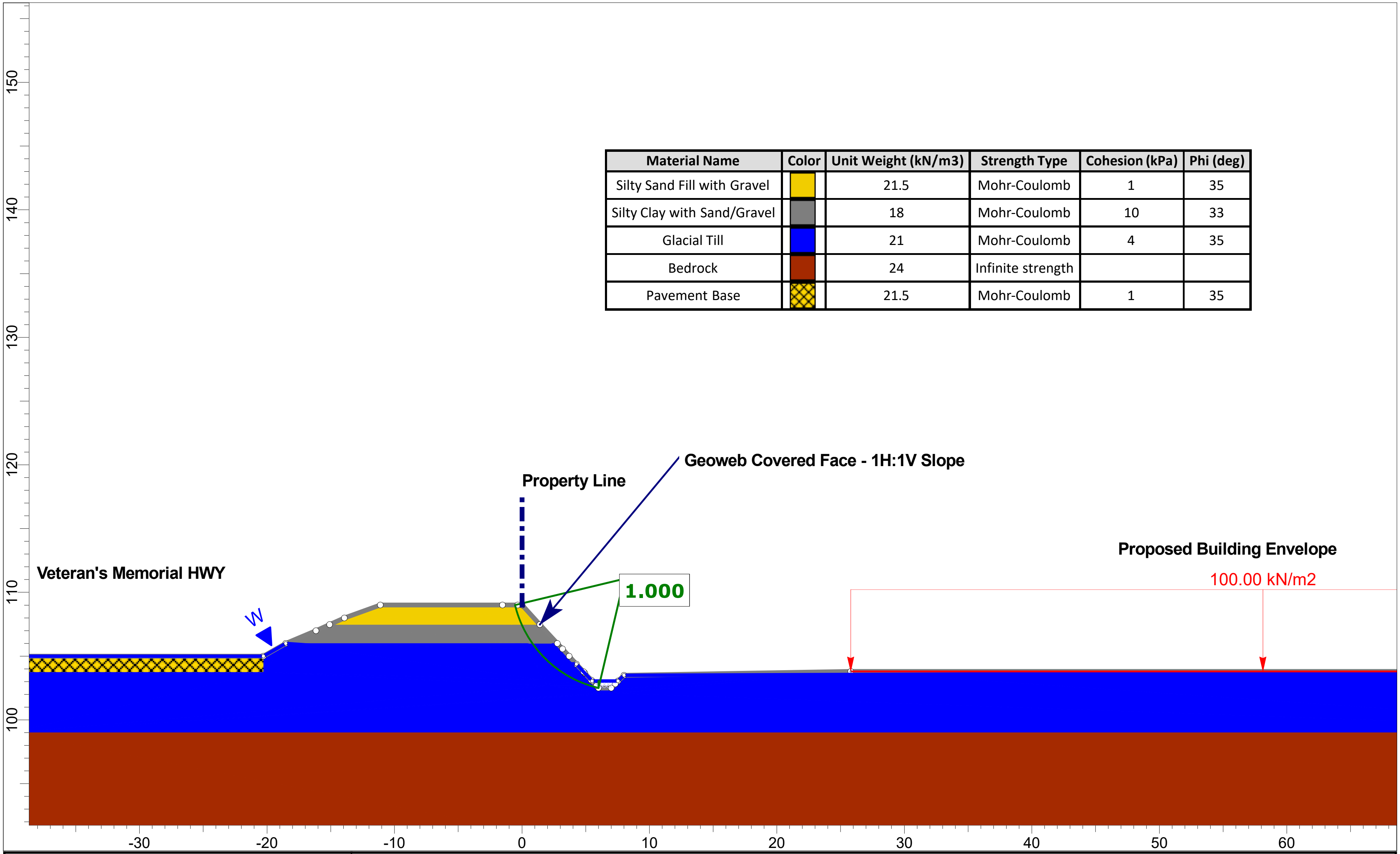
GEOSYSTEMS

PRESTO® PRODUCTS CO.
670 NORTH PERKINS STREET
APPLETON, WI 54914
920-738-1328
WWW.PRESTOGEO.COM

GENUINE GEOWEB®
SLOPE – TENDON/ATRA ANCHORAGE

PRESTO, GEOWEB, AND ATRA ARE REGISTERED TRADEMARKS® OF PRESTO PRODUCTS.

DATE JUNE 2013
FILE NAME GWSL6F.DWG
SCALE NTS
SHEET 1

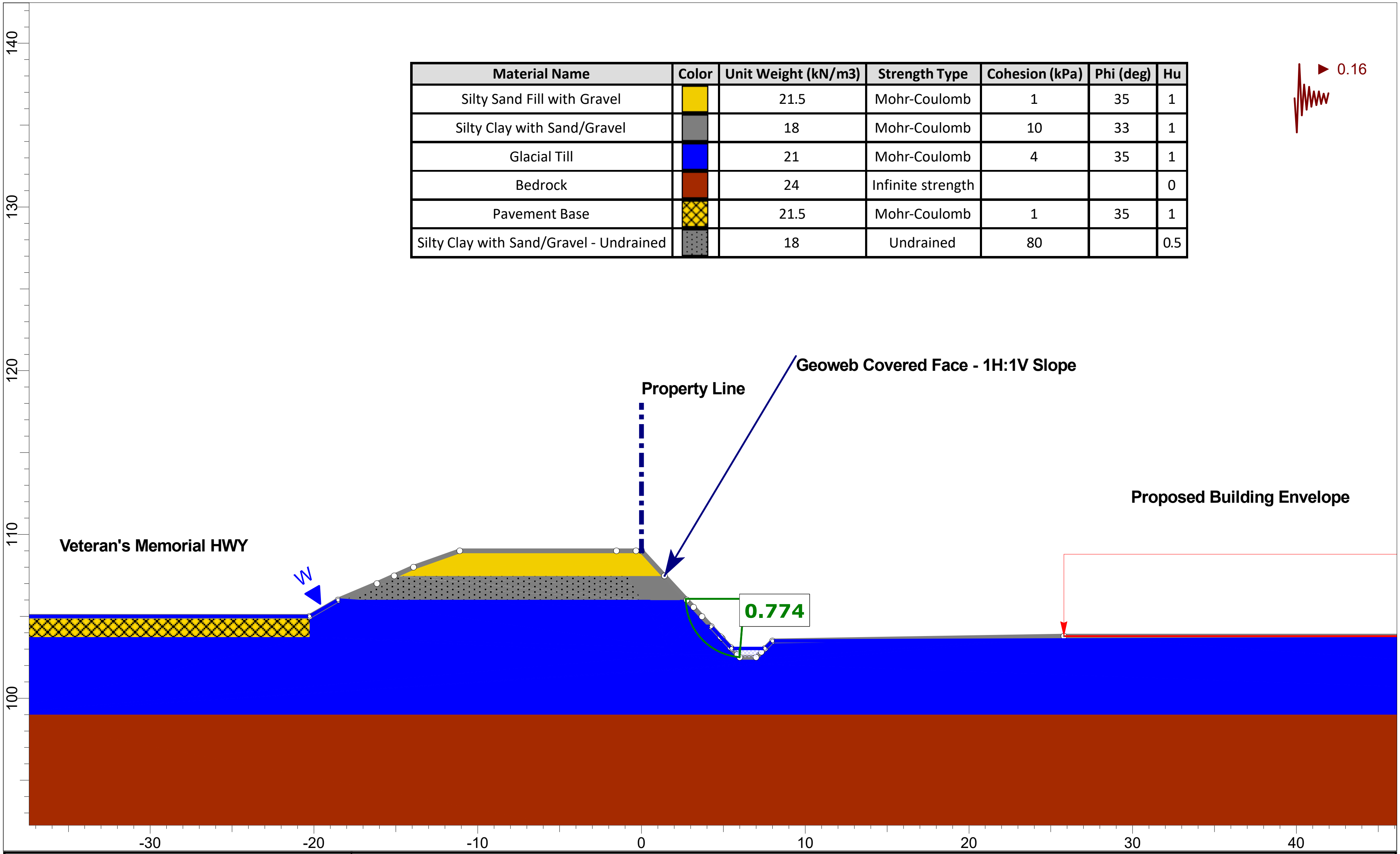


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35
Silty Clay with Sand/Gravel	◼	18	Mohr-Coulomb	10	33
Glacial Till	🟦	21	Mohr-Coulomb	4	35
Bedrock	🟫	24	Infinite strength		
Pavement Base	▨	21.5	Mohr-Coulomb	1	35

PATERSON GROUP

SLIDEINTERPRET 9.025

Project	**Proposed Commercial Development**
Figure No.	**Figure 1A - Section A - No Support - Static Conditions**
Drawn By	Faisal I. Abou-Seido, P.Eng.
Company	Paterson Group
Date	Thu, 2023-03-09, 12:34:08 PM
File Name	Section A - 1H to 1V Slopes.slmd



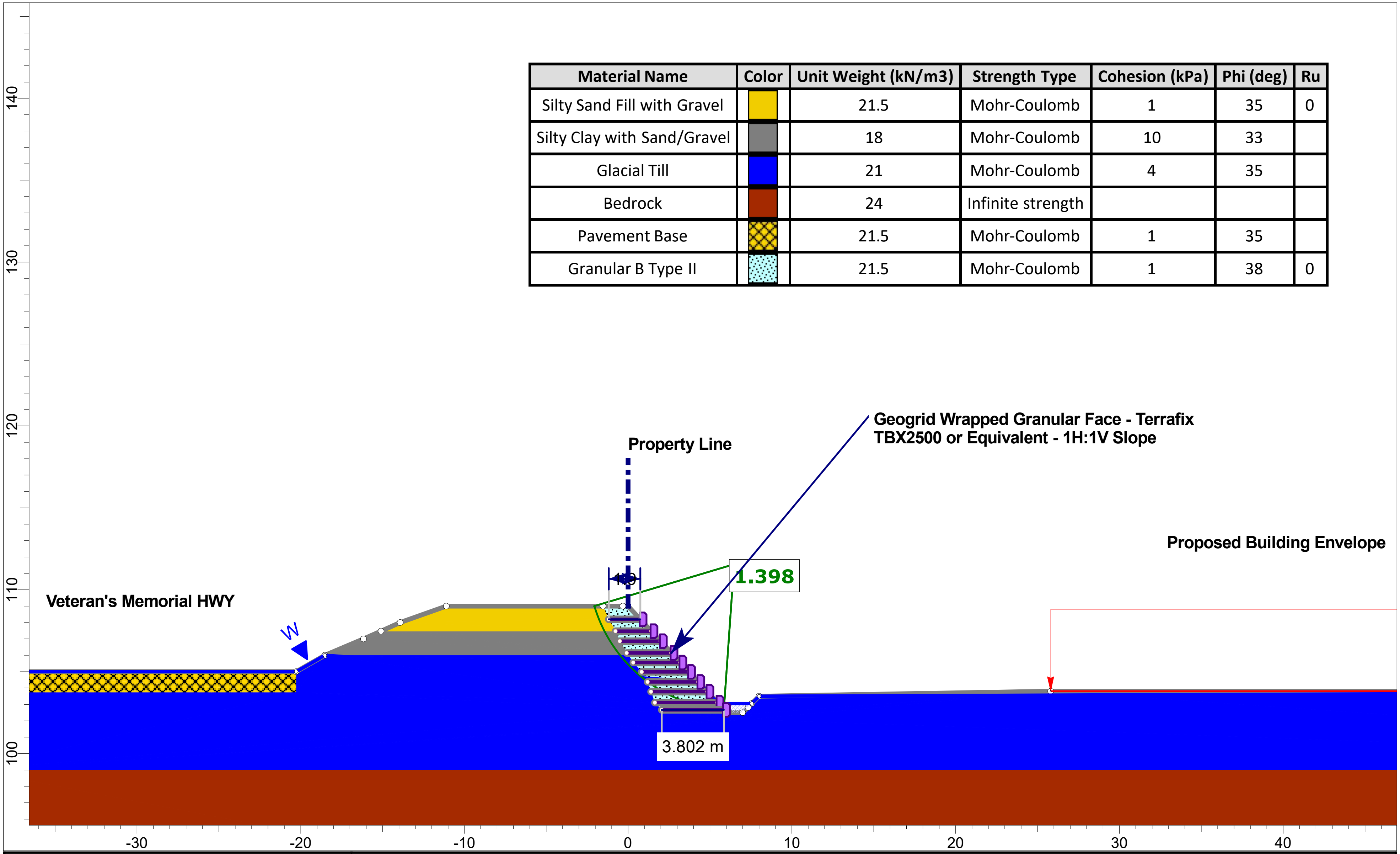
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Hu
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35	1
Silty Clay with Sand/Gravel	⬛	18	Mohr-Coulomb	10	33	1
Glacial Till	🟦	21	Mohr-Coulomb	4	35	1
Bedrock	🟫	24	Infinite strength			0
Pavement Base	▨	21.5	Mohr-Coulomb	1	35	1
Silty Clay with Sand/Gravel - Undrained	▩	18	Undrained	80		0.5

PATERSON GROUP

SLIDEINTERPRET 9.025

Project	**Proposed Commercial Development**
Figure No.	**Figure 1B - Section A - No Support - Seismic Loading**

Drawn By	Faisal I. Abou-Seido, P.Eng.	*Company*	Paterson Group
Date	Thu, 2023-03-09, 12:34:08 PM	*File Name*	Section A - 1H to 1V Slopes.slmd

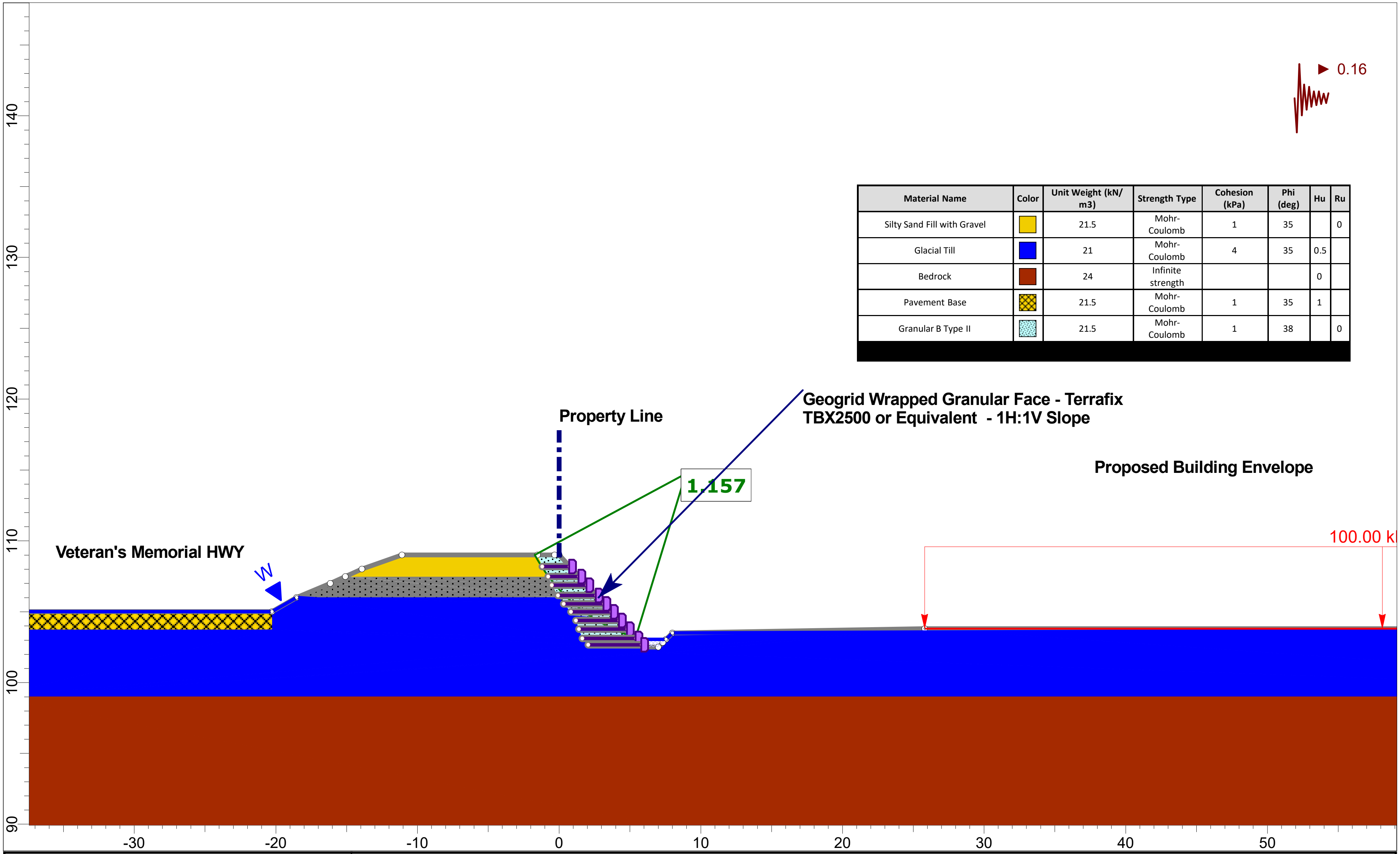


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Ru
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35	0
Silty Clay with Sand/Gravel	⬛	18	Mohr-Coulomb	10	33	
Glacial Till	🟦	21	Mohr-Coulomb	4	35	
Bedrock	🟫	24	Infinite strength			
Pavement Base	▨	21.5	Mohr-Coulomb	1	35	
Granular B Type II	░	21.5	Mohr-Coulomb	1	38	0

PATERSON GROUP

SLIDEINTERPRET 9.025

Project	**Proposed Commercial Development**		
Figure No.	**Figure 2A - Section A -Geogrid Raps Along Slope Face - Static Conditions**		
Drawn By	Faisal I. Abou-Seido, P.Eng.	*Company*	Paterson Group
Date	Thu, 2023-03-09, 12:34:08 PM	*File Name*	Section A - 1H to 1V Slopes.slmd



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Hu	Ru
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35		0
Glacial Till	🟦	21	Mohr-Coulomb	4	35	0.5	
Bedrock	🟫	24	Infinite strength			0	
Pavement Base	▨	21.5	Mohr-Coulomb	1	35	1	
Granular B Type II	▒	21.5	Mohr-Coulomb	1	38		0

PATERSON GROUP

SLIDEINTERPRET 9.025

Project
Proposed Commercial Development

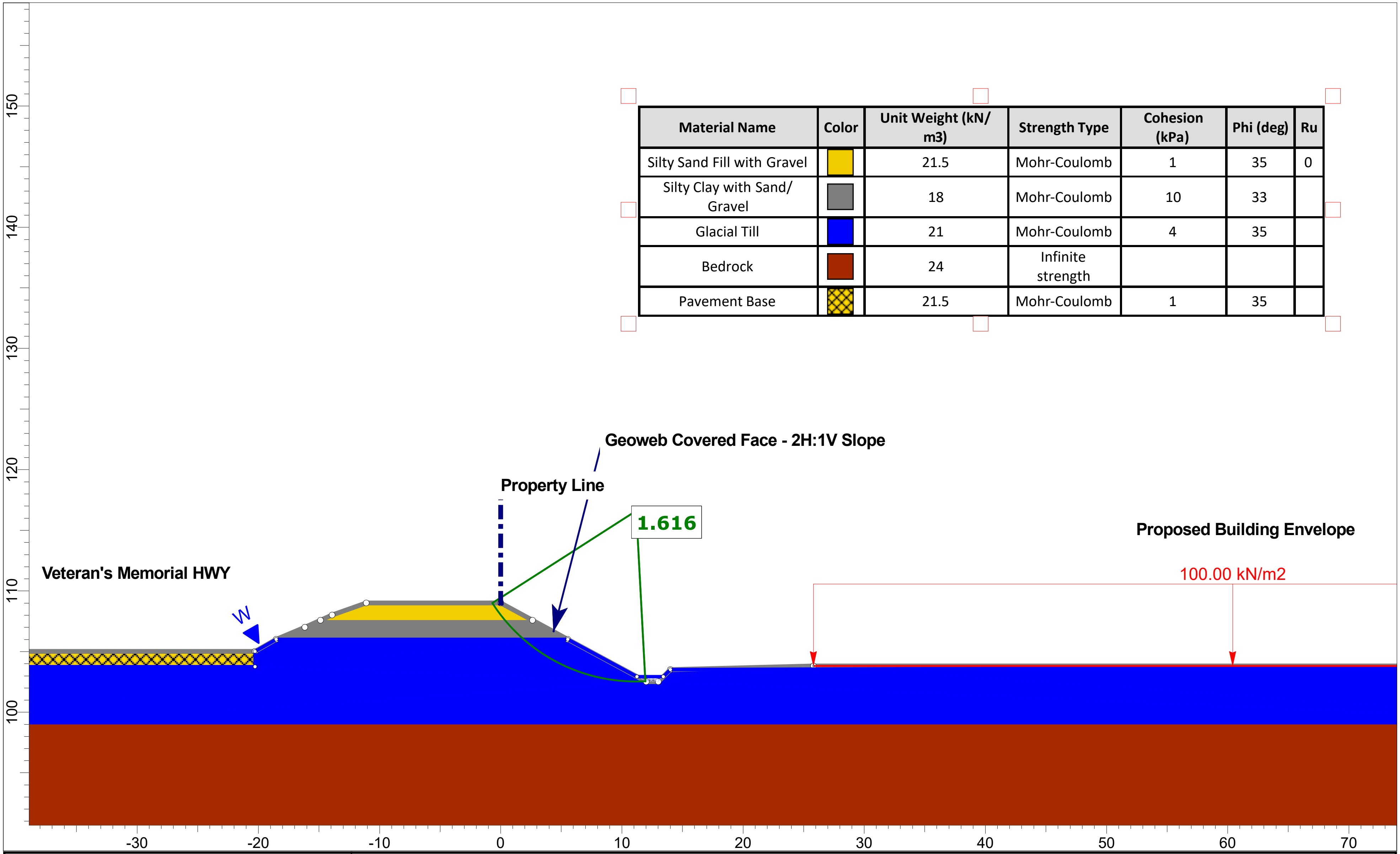
Figure No.
Figure 2B - Section A - Geogrid Raps Along Slope Face - Seismic Loading

Drawn By Faisal I. Abou-Seido, P.Eng.

Company Paterson Group

Date Thu, 2023-03-09, 12:34:08 PM

File Name Section A - 1H to 1V Slopes.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Ru
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35	0
Silty Clay with Sand/ Gravel	⬛	18	Mohr-Coulomb	10	33	
Glacial Till	🟦	21	Mohr-Coulomb	4	35	
Bedrock	🟫	24	Infinite strength			
Pavement Base	▩	21.5	Mohr-Coulomb	1	35	

PATERSON GROUP

SLIDEINTERPRET 9.025

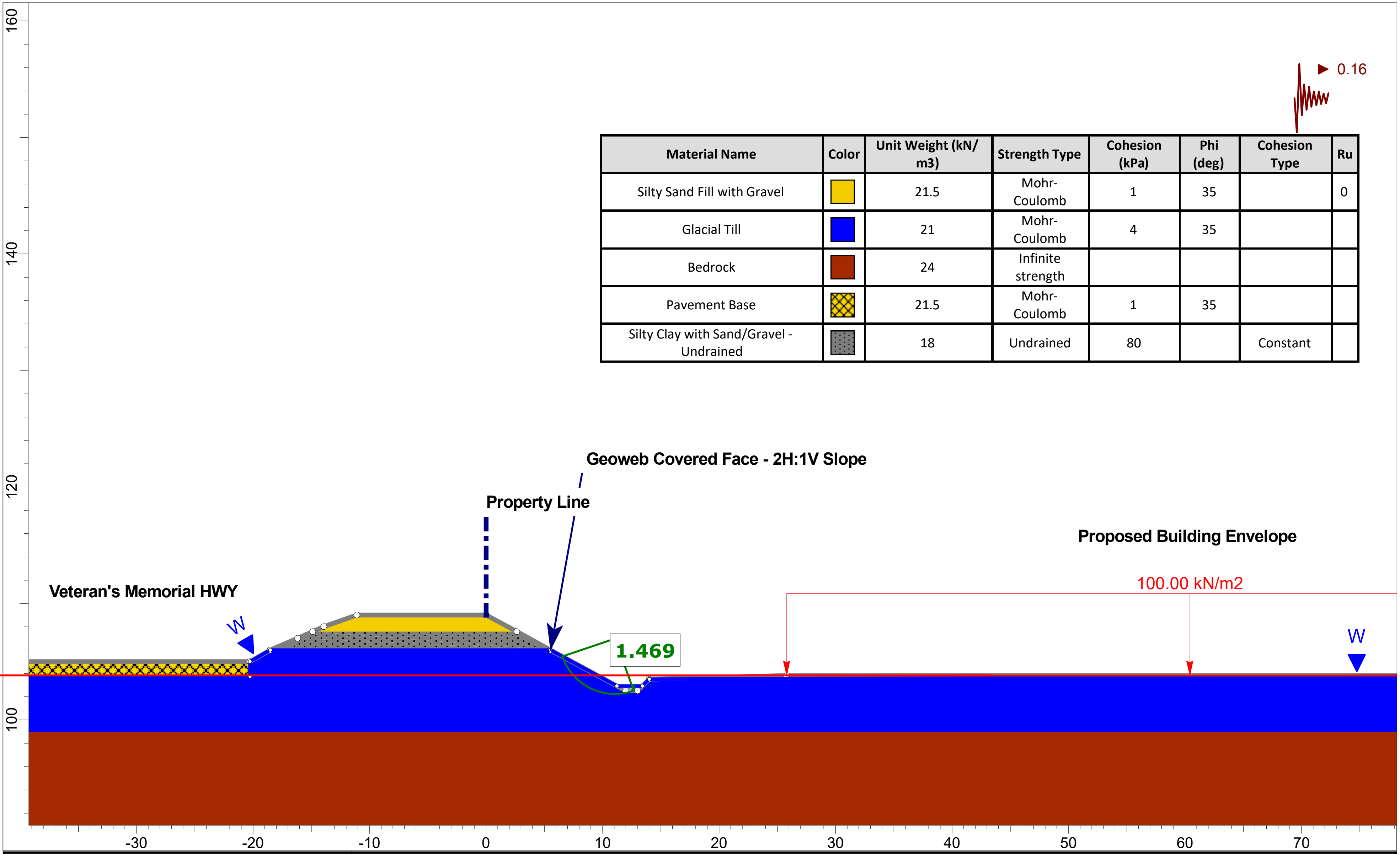
Project

Proposed Commercial Development

Figure No.

Figure 3A - Section B - GeoWeb on Slope Face - Static Conditions

Drawn By	Faisal I. Abou-Seido, P.Eng.	*Company*	Paterson Group
Date	Thu, 2023-03-09, 12:34:08 PM	*File Name*	Section A - 1H to 1V Slopes.slmd

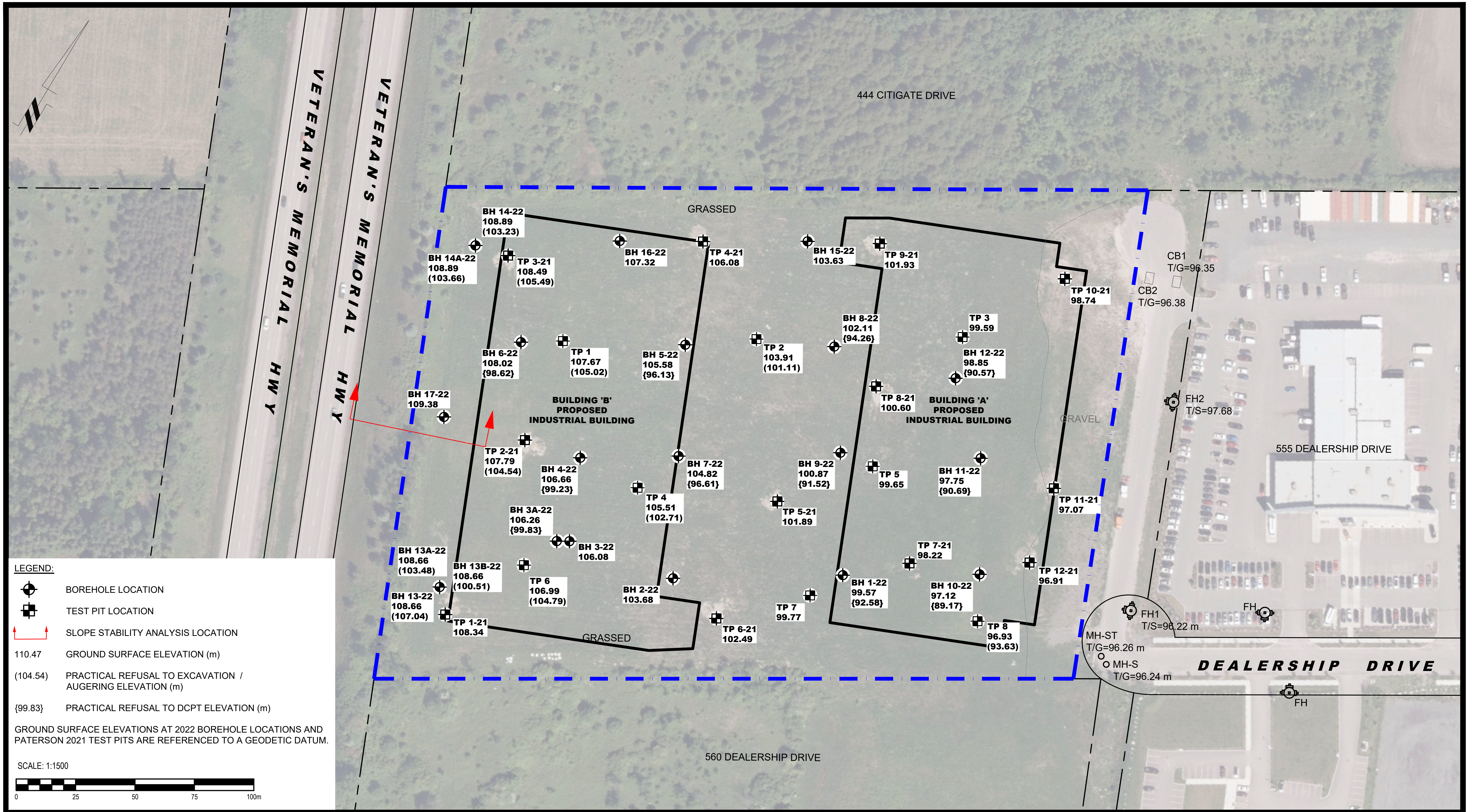


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Ru
Silty Sand Fill with Gravel	🟨	21.5	Mohr-Coulomb	1	35		0
Glacial Till	🟦	21	Mohr-Coulomb	4	35		
Bedrock	🟥	24	Infinite strength				
Pavement Base	▨	21.5	Mohr-Coulomb	1	35		
Silty Clay with Sand/Gravel - Undrained	▒	18	Undrained	80		Constant	

PATERSON GROUP

SLIDEINTERPRET 9.025

Project	**Proposed Commercial Development**
Figure No.	**Figure 3B - Section B - GeoWeb on Slope Face - Seismic Loading**
Drawn By	Faisal I. Abou-Seido, P.Eng.
Company	Paterson Group
Date	Thu, 2023-03-09, 12:34:08 PM
File Name	Section A - 1H to 1V Slopes.slmd



LEGEND:

⊕	BOREHOLE LOCATION
⊞	TEST PIT LOCATION
↑	SLOPE STABILITY ANALYSIS LOCATION
110.47	GROUND SURFACE ELEVATION (m)
(104.54)	PRACTICAL REFUSAL TO EXCAVATION / AUGERING ELEVATION (m)
{99.83}	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

GROUND SURFACE ELEVATIONS AT 2022 BOREHOLE LOCATIONS AND PATERSON 2021 TEST PITS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1500

0 25 50 75 100m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
2	UPDATED BUILDING FOOTPRINT	10/10/2023	YZ
1	BH 13-22 - BH 17-22 ADDED TO PLAN	05/01/2023	MS

RF OTTAWA LIMITED PARTNERSHIP C/O ROSEFELLOW DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
480 AND 486 CITIGATE DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500
Date: 12/2022
Drawn by: YA
Report No.: PG6514-1
Checked by: MS
Dwg. No.: PG6514-1
Approved by: DJG
Revision No.: 2

11x17

p:\autocad drawings\geotechnical\pg65xx\pg6514\pg6514-1 test hole location plan rev 2.dwg

THIS PLAN IS TO BE READ IN CONJUNCTION WITH
CIVIL PLANS 119123-NLD AND 119123-GP1&GP2

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
2	REVISED PER CITY COMMENTS	OCT 6/23	DDB
1	ISSUED FOR CITY OF OTTAWA REVIEW	MAY 3/23	DDB

SCALE
1:400

1:400
0 4 8 12 16

DESIGN
SM / BM / DDB
CHECKED
DDB
DRAWN
SM
CHECKED
BM / DDB
APPROVED
DDB

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY of OTTAWA
480 & 486 CITIGATE DRIVE - PROPOSED WAREHOUSES

DRAWING NAME
GRADING PLAN

PROJECT No.
119123
REV
REV # 2
DRAWING No.
119123-GR1

M:\2019\119123\CAD\Design\119123-GR.dwg, GR1, Oct 03, 2023 - 12:18pm, smatthews

PLAN24x36.DWG - 914.4mmx609.6mm

D07-12-23-0064

plan # __

THIS PLAN IS TO BE READ IN CONJUNCTION WITH
CIVIL PLANS 119123-NLD AND 119123-GP1&GP2

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
2	REVISED PER CITY COMMENTS	OCT 6/23	DDB
1	ISSUED FOR CITY OF OTTAWA REVIEW	MAY 3/23	DDB

SCALE
1:400

1:400
0 4 8 12 16

DESIGN SM / BM / DDB
CHECKED DDB
DRAWN SM
CHECKED BM / DDB
APPROVED DDB

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY of OTTAWA
480 & 486 CITIGATE DRIVE - PROPOSED WAREHOUSES

DRAWING NAME
GRADING PLAN

PROJECT No. 119123
REV REV # 2
DRAWING No. 119123-GR2

M:\2019\119123\CAD\Design\119123-GR.dwg, GR2, Oct 03, 2023 - 12:18pm, smatthews

PLAN24x36.DWG - 914.4mmx609.6mm

D07-12-23-0064

plan # __

PATERSON GROUP

memorandum

re: **Geotechnical Response to City Comments**
Proposed Commercial Development
480 & 486 Citigate Drive – Ottawa, Ontario
to: RF Ottawa Limited Partnership– **Mr. Julian Nini** – juliann@rosefellow.com
date: October 10, 2023
file: PG6514-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) prepared the following memorandum to provide geotechnical responses to the City of Ottawa comments provided via letter (Application No. D07-12-23-0054) on June 9, 2023. The following memorandum should be read in conjunction with Paterson Group Report PG6514-1 Revision 2 dated October 10, 2023, Paterson Group Memorandum PG6514-MEMO.01 Revision 1 dated October 10, 2023, and Paterson Group Memorandum PG6514-MEMO.03 dated October 10, 2023.

Geotechnical Response to City Comments

Comment A11: *Provide geotechnical sign-off on the latest revision of the grading plan.*

Response: Paterson reviewed the latest grading plans for the proposed commercial development at the subject site, from a geotechnical perspective. Based on our review, the proposed grading is generally acceptable from a geotechnical perspective. Details of our review and geotechnical recommendations can be found in Paterson Group Memorandum PG6514-MEMO.03 dated October 10, 2023.

Comment A16: *Pavement Structures: heavy duty concrete roadway design is not present in the submitted geotechnical report.*

Response: The pavement structure for heavy duty concrete roadway design is provided in Table 6, under section Subsection 5.6, in Paterson Group Report PG6514-1 Revision 2 dated October 10, 2023.

Comment B1: *Section 2.0 – Proposed Development: This section refers to one industrial building being proposed. Revise this description to reflect the current proposal for this site. Ensure the investigation performed is sufficient for the current proposal.*

Response: The proposed development section has been updated as noted in the above comment based on the latest conceptual plans received. Reference should be made to Section 2.0 in Paterson Group Report PG6514-1 Revision 2 dated October 10, 2023. The available borehole coverage is sufficient for the proposed development at the subject site.

Comment B2: *Section 5.1 – Geotechnical Assessment: Provide a schematic and identify where the grade raise restriction is applicable.*

Response: Paterson prepared a permissible grade raise (PGR) plan for the subject site to identify the areas where a PGR restriction will be applicable. Reference should be made to Drawing PG6514-2 – Permissible Grade Raise Plan attached to Paterson Group Report PG6514-1 Revision 2 dated October 10, 2023, for the grade raise restriction recommendations plan.

Comment B3: *Provide geotechnical sign-off on the latest revision of the Grading Plan.*

Response: Refer to our response to comment A11 above.

Comment B4: *The preamble for the memo references Paterson's geotechnical report PH6514-1 Revision 1, dated March 8th, 2023. The geotechnical investigation submitted as part of this application is titled and dated: Report PG6514-1 dated January 11, 2023. Please provide the latest revision of the geotechnical investigation for this subject property or revise the reference in the Memo to reference the appropriate report.*

Response: The reference in the abovementioned memorandum has been revised to refer to the latest geotechnical investigation report. Reference should be made to Paterson Group Report PG6514-1 Revision 2 dated October 10, 2023, and Paterson Group Memorandum PG6514-MEMO.01 Revision 1 dated October 10, 2023, for the last revision of the above noted report and memorandum.

Comment B5: *The slope stability analysis was performed on the drawing titled: "Conceptual Grading and Site Servicing" prepared by Novatech, dated January 25/23. A considerably different grading plan, listed above, was submitted as part of this application. The slope stability analysis should be performed and reference the grading plan that was submitted as part of this application.*

Response: Reference should be made to Paterson Group Memorandum PG6514-MEMO.01 Revision 1 dated October 10, 2023. It should be noted that the above noted memo has been updated based on the most recent grading plan prepared by Novatech, dated October 6, 2023.

Comment B6: *A slope stability analysis and retaining wall design drawings are required for any retaining walls greater than 1.0m in height (for both the walls bordering the property, and the wall that bisects the loading bays).*

Response: Based on our review of the latest grading plans for the proposed development at the subject site, and following our conversations with Rosefellow, it is understood that retaining walls will be required at several locations along the property boundaries and within the subject property. It is further understood that several options for the retaining walls are being considered at this stage. Once the final conceptual design for the retaining walls is available, Paterson will review/complete the design of the retaining walls from a geotechnical perspective and will complete a slope stability analysis for the walls as per City Guidelines, during the detailed design stage of the project.

Comment B7: *A cross section where there is a slope & retaining wall on the western site boundary should be analyzed for stability (see inline image below). This cross-sectional analysis can be included as part of the retaining wall analysis.*

Response: Reference should be made to our response to comment B6. In addition, it should be noted that the retaining walls are addressed in Paterson Group Memorandum PG6514-MEMO.01 Revision 1 dated October 10, 2023. However, Paterson will review/complete a detailed design for the retaining walls along the property boundaries and within the property at a later stage.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Oct. 10, 2023
M. SALEH
100507739
PROVINCE OF ONTARIO

Yashar Ziaeimehr, M.A.Sc.

Maha K. Saleh, P.Eng.

PATERSON GROUP

memorandum

re: **Grading Plan Review**
Proposed Commercial Development
480 & 486 Citigate Drive – Ottawa, Ontario
to: RF Ottawa Limited Partnership– **Mr. Julian Nini** – julIann@rosefellow.com
date: October 10, 2023
file: PG6514-MEMO.03

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide a review from a geotechnical perspective for the grading and site servicing plans for the proposed residential building at the aforementioned site. This memorandum should be read in conjunction with Paterson Geotechnical Report PG6514 -1 Revision 2 dated October 10, 2023.

Grading Plan Review

Paterson reviewed the following grading plans prepared by Novatech, regarding the aforementioned industrial buildings:

- ☐ Grading Plan – Project No. 119123 – Drawing No. 119123-GR1 – Revision 2 dated October 6, 2023.
- ☐ Grading Plan – Project No. 119123 – Drawing No. 119123-GR2 – Revision 2 dated October 6, 2023

Based on our review of the above noted grading plans, the proposed grade raises within the aforementioned site are within the recommended permissible grade raise of 2.0 m. No exceedances were noted for any area within the subject site. Therefore, the proposed grade raises are generally acceptable from a geotechnical perspective and will not require the use of lightweight fill at this time.

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

Other exterior unheated footings, such as those for isolated exterior piers, footings located below loading docks, and loading dock ramp wing-wall are more prone to deleterious movement associated with frost action than the exterior walls of the proper structure. These footings should be provided with a minimum 2.1 m thick soil cover (or insulation equivalent).

Where footings are founded directly on clean, surface-sounded bedrock with no near-surface cracks or fissures and are approved by Paterson personnel at the time of the excavation, the minimum soil cover, listed above, is not required.

It is recommended that Paterson review the proposed footing and/or insulation details once the final detail design drawings are available for the above noted items prior to construction to ensure the effects of frost action are mitigated appropriately.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Oct.10, 2023
M. SALEH
100507739
PROVINCE OF ONTARIO

Yashar Ziaeimehr, M.A.Sc.

Maha K. Saleh, P.Eng.