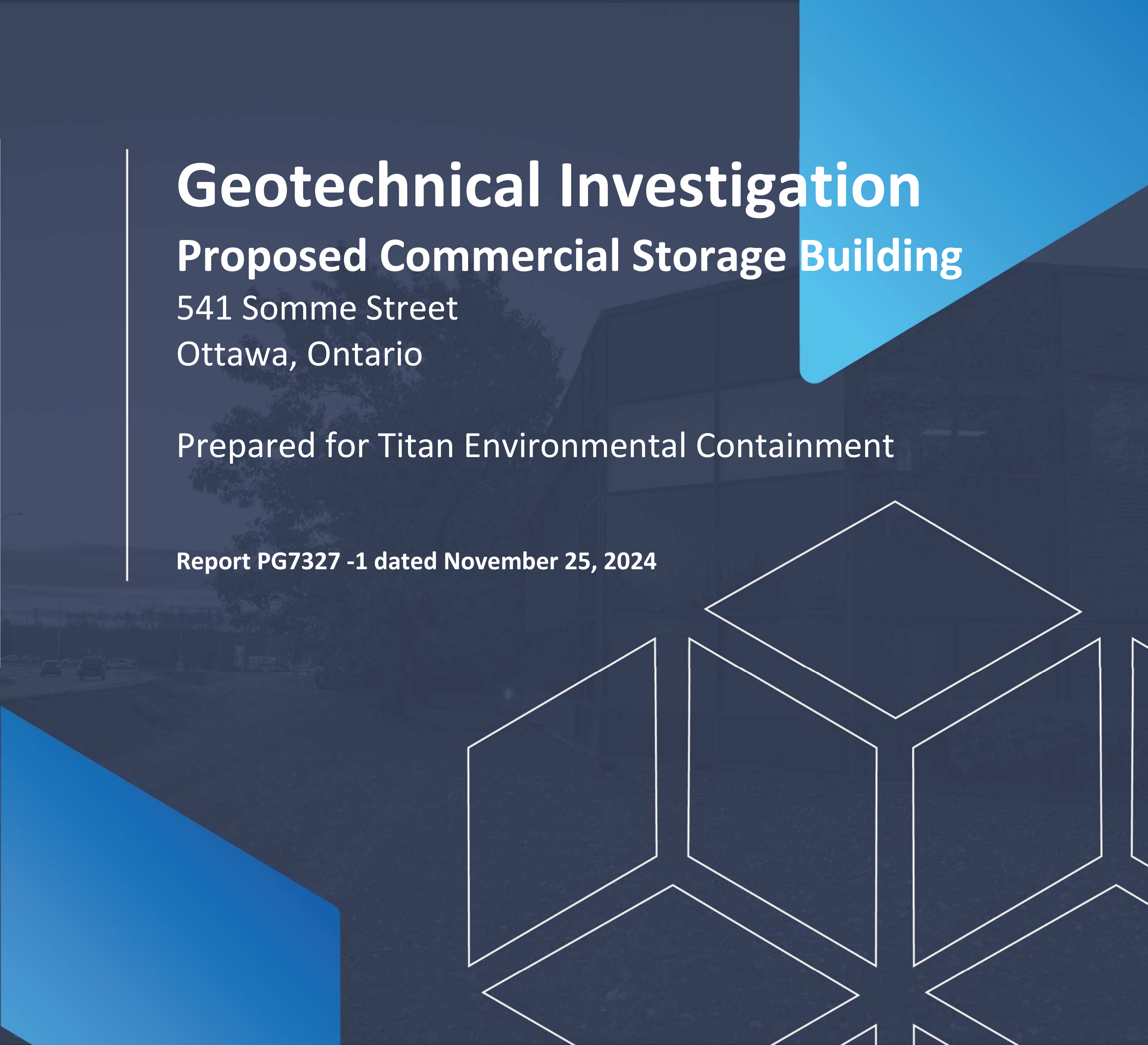

Geotechnical Investigation

Proposed Commercial Storage Building

541 Somme Street
Ottawa, Ontario

Prepared for Titan Environmental Containment

Report PG7327 -1 dated November 25, 2024

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Titan Environmental Containment to conduct a geotechnical investigation for the proposed industrial building to be located at 541 Somme Street in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 for the general site location).

The objectives of the geotechnical investigation were to:

- ❑ Determine the subsoil and groundwater conditions at this site by means of boreholes.

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

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

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of a commercial storage building with a slab-on-grade and an approximate footprint of 300 m^2. It is further understood that associated asphalt-paved access lanes, loading areas, and parking areas will surround the proposed building.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The current geotechnical investigation was carried out on November 11th, 2024, and consisted of a total of 3 boreholes (BH 1-24 through BH 3-24) advanced to a maximum depth of 1.3 m below the existing grade. Previous investigations also included 1 borehole (BH 4) and 1 test pit (TP 12-22) which were advanced at the site in 2019 and 2022, respectively. The test hole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground services and available access. The approximate locations of the boreholes are shown on Drawing PG7327-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a low-clearance track-mounted drill rig operated by a two-person crew. The test pit was excavated using a hydraulic excavator and backfilled using the site excavated soil upon completion. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer.

Sampling and In Situ Testing

The soil samples were collected from the boreholes using a 50 mm diameter split-spoon (SS) sampler or from the drill auger. The depth at which the soil sample was recovered from the test pit is shown as G on the Soil Profile and Test Data sheet presented in Appendix 1. The samples were initially classified on site, placed in sealed plastic bags, and transported to our laboratory. The depths at which the drill auger, split-spoon, and grab samples were recovered from the test holes are shown as AU, SS, and G, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

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

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data Sheets in Appendix 1 of this report.

Groundwater

One (1) monitoring well was installed at borehole BH 2-24 and flexible polyethylene standpipes were installed in the remaining boreholes. The groundwater observations are discussed in Section 4.3 and presented in the Soil Profile and Test Data Sheets in Appendix 1.

3.2 Field Survey

As noted above, the test hole locations were selected by Paterson to provide general coverage of the proposed development taking into consideration the existing site features and underground utilities.

The test hole locations, and the ground surface elevation at each test hole location, were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The locations of the test holes, and the ground surface elevation at each test hhole location, are presented on Drawing PG7327-1 - Test Hole Location Plan 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. All samples from the current investigation will be stored in the laboratory for 1 month after this report is completed. They will then be discarded unless we are otherwise directed.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site is currently vacant, however, based on reviewing available aerial photos, the site has been infilled with fill from the neighboring sites. The site is bordered by vacant land to the north and south, by agricultural lands to the east and by Somme Steet to the west.

The subject site is relatively level at approximate geodetic elevation 89 m. However, there is a slope at the eastern end of the site which extends down to about geodetic elevation 82 m.

4.2 Subsurface Profile

Based on the completed test holes, the subsurface profile generally consists of imported fill material which varies from about 0.61 to 1.30 m in thickness. The fill was generally observed to consist of loose to compact, grey to brown silty sand to sandy silt with occasional traces of topsoil and gravel.

Practical refusal to augering was encountered on the inferred bedrock surface at approximate depths ranging from 0.6 to 1.3 m below the existing ground surface. Where bedrock was cored at borehole BH 4, the upper 1.1 m of the bedrock was observed to consist dolostone, while the lower portion of the bedrock consisted of sandstone, extending to the bottom depth of the borehole at approximately 4.7 m below the existing ground surface.

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 attached in Appendix 1.

Bedrock

Based on available geological mapping, the bedrock at the subject site consists of interbedded sandstone and dolomite of the March Formation.

4.3 Groundwater

Groundwater levels were measured in the monitoring wells and standpipe piezometers on November 16, 2024. The measured groundwater levels are presented on the Soil Profile and Test Data sheets in Appendix 1, and in Table 1 below:

Table 1 – Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-24	Dry	-	89.30	November 16, 2024
BH 2-24*	Dry	-	89.58	
BH 3-24	Dry	-	89.68	

Note:
-*Denotes borehole instrumented with a 51 mm diameter monitoring well.
- Ground surface elevations at borehole locations were surveyed by Paterson and are referenced to a geodetic datum.

Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table is expected to be within the bedrock.

However, it should be noted that groundwater levels are subject to seasonal fluctuations, therefore, the groundwater levels could vary at the time of construction. In particular, perched groundwater could accumulate on the bedrock, within the fill, during period of snow melt and/or precipitation.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed building. It is recommended that foundation support for proposed building consist of conventional spread footings bearing on the clean, surface sounded bedrock.

Due to the presence of the slope at the eastern end of the site, a slope stability analysis has been conducted to determine if there are any geotechnical hazard lands present at the site.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and any fill containing significant amounts of deleterious or organic materials should be stripped from under the proposed building and other settlement sensitive structures.

However, it is anticipated that the existing fill within the proposed building footprint, free of deleterious material and significant amounts of organics, can be left in place below the proposed building slab-on-grade, outside of the lateral support zones for the footings. In this case, it is recommended that the existing fill layer be proof-rolled with several passes of a vibratory drum roller, under dry conditions and above freezing temperatures, and which is approved by Paterson personnel at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

Engineered Fill Placement

Engineered fill used for grading beneath the proposed building, where required, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building and paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Bedrock Removal

Dependent on the depth of the site services, bedrock removal may be required. This can be accomplished by hoe ramming where only small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling in conjunction with controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be completed prior to commencing site activities.

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

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

Vibration Considerations

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

The following construction equipment could be a source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the nearby buildings and structures. Therefore, it is recommended that all vibrations be limited.

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

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

5.3 Foundation Design

Bearing Resistance Values

Footings placed directly on the clean, surface-sounded bedrock can be designed using a factored bearing resistance at serviceability limit states (SLS) and ultimate limit states (ULS) of **1,500 kPa**, incorporating a geotechnical resistance factor of 0.5.

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

Footings supported directly on clean, surface sounded bedrock and designed for the bearing resistance values provided above will be subject to negligible post-construction total and differential settlements.

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 a sound bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at 1H:6V (or flatter) passes only through sound bedrock or a material of the same or higher capacity as the bedrock, such as concrete. Weathered bedrock will require a lateral support zone of 1H:1V (or flatter).

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** (if referencing the OBC 2012) or **Class Xc** (if referencing the OBC 2024). A higher seismic site class (such as Class A or B), may be achievable, however, a site-specific shear wave velocity test would be required to accurately determine the higher seismic site classification for foundation design of the proposed building, as defined in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012 or 2024. If required, Paterson can conduct the site-specific shear wave velocity test.

Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest version of the OBC 2012 for a full discussion of the earthquake design requirements.

5.5 Slab on Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the existing fill subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for slab-on-grade construction.

However, as noted above, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program. Any poor performing areas should be removed and reinstated with an engineered fill, such as OPSS Granular B Type II.

It is recommended that the upper 200 mm of sub-floor fill consists of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Design

Car only parking, heavy truck parking areas and access lanes are proposed at this site. The proposed pavement structures are presented in Tables 2 and 3 on the next page.

Table 2 – Recommended Pavement Structure – Car Only Parking Areas	
Thickness (mm)	**Material Description**
50	**Wear Course –** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE –** OPSS Granular A Crushed Stone
300	**SUBBASE –** OPSS Granular B Type II
Subgrade – Either fill, in-situ soil, or OPSS Granular B Type I or II material placed over fill or in-situ soil.	

Table 3 - Recommended Pavement Structure - Access Lanes/Local Roadways, Loading Areas and Heavy TruckParking	
Thickness (mm)	**Material Description**
40	**Wear Course** - Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placedover fill or in situ soil.	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. 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 99% of the material's SPMDD using suitable compaction equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage and Backfill

Since the proposed building will be immediately surrounded by walkways, it is recommended that the exterior of the foundation walls be backfilled with free-draining, non frost susceptible fill such as OPSS Granular B Type I or II granular material.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. Generally, a minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

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

However, foundations which are founded directly on clean, surface-sounded bedrock with no cracks or fissures, and which is approved by Paterson at the time of construction, is not considered frost susceptible and does not require soil cover.

6.3 Excavation Side Slopes

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

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

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

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

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

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

6.4 Pipe Bedding and Backfill

Bedding and backfill materials for private services 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 150 mm of OPSS Granular A should be placed for bedding for private sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

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 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

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

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Persons as stipulated under O.Reg. 63/16.

If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

Impacts to Neighboring Properties

As the proposed building will be a slab-on-grade structure, it is not anticipated that it will be founded below the long-term groundwater level. As a result, long-term groundwater lowering is not anticipated, and therefore no adverse effects are expected to neighboring properties.

Further, as the proposed slab-on-grade structures will be setback from the site limits, no impacts to the neighbouring properties are anticipated as a result of excavation at the subject site.

6.6 Winter Construction

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

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures using 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 into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

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

6.8 Slope Stability Assessment

Paterson completed a field review of the slope along the eastern property boundary of the site, as part of the current investigation.

The field review generally consisted of observing surface conditions along the length of the slope face identifying the presence of vegetation, erosion and other features associated with slope stability.

The top of slope alignment was determined in the field by Paterson personnel based on our field observations and recorded using a high-precision handheld GPS unit.

Topographic surface elevations were measured at select cross-sections to analyze slope stability using SLIDE, a computer program for two-dimensional slope stability analysis. Overall, 1 slope cross-section throughout the above-noted locations was analyzed as part of the slope stability analysis. This is discussed further on the next page:

Field Observations

The slope observed at the eastern end of the site was observed to consist mostly of bedrock. No signs of erosion, distress or sloughing were observed throughout the slope surface at the time of our field review.

Slope Stability Analysis

The slope stability analysis was modelled in SLIDE, a computer program which permits a two-dimensional slope stability analysis calculating several methods including the Bishop's method, which is a widely accepted slope analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to forces favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsurface soil and groundwater conditions, a factor of safety greater than 1.0 is generally required for the failure risk to be considered acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the slope failure would comprise permanent structures. An analysis considering seismic loading was also completed. A horizontal acceleration of 0.18 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.

One (1) slope cross-section (Section A-A') was studied as the worst case scenario. The cross-section location is presented in Drawing PG7327-1 – Test Hole Location Plan in Appendix 2. It should be noted that details of the slope height and slope angle at the cross-section locations are presented in Figures 2 and 3 in Appendix 2, based on the topographic data obtained during the field investigation, as well as the available topographic data.

The effective and total strength soil parameters used for the static and seismic analyses were chosen based on the subsoil information recovered during the site investigation. The effective and total strength soil parameters used for the analyses are presented in Table 4.

Table 4 – Effective and Total Stress Soil Parameters

Soil Layer	Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
Fill	18	32	-
Bedrock	22	-	-

Stable Slope Allowance

The results of the static and seismic analyses, shown on Figures 2 and 3 in Appendix 2, indicate factors of safety exceeding 1.5 and 1.1, respectively. Accordingly, a stable slope allowance is not required from the top of slope at this site.

Toe Erosion Allowance

No erosion or distress associated with erosion was observed at the time of our review. Further, the majority of the slope was observed to consist of bedrock. Therefore, a toe erosion allowance is not considered to be required.

Erosion Access Allowance

As neither a stable slope nor toe erosion allowance are applicable, future maintenance of the slope is not expected to be required. Therefore, a 6 m erosion access allowance is not considered to be required.

Limit of Hazard Lands

As slope stability, toe erosion, and erosion access allowances are not required from the top of slope, there is not a Limit of Hazard Lands setback for this site. Development may proceed anywhere at the site west of the top of slope.

7.0 Recommendations

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

- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

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*.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by Paterson

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 Titan Environmental Containment, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Puneet Bandi, M.Eng.

LICENSED PROFESSIONAL ENGINEER
Nov. 25, 2024
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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

541 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379616.40 **NORTHING:** 5018877.07 **ELEVATION:** 89.30

PROJECT: Proposed Commercial Development

BORINGS BY: CME-55 Low Clearance Drill

REMARKS:

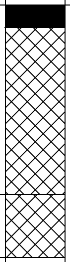
DATE: November 11, 2024

FILE NO. : PG7327

HOLE NO. : BH1-24

SAMPLE DESCRIPTION	DEPTH (m)	TYPE AND NO.	RECOVERY (%)	N, Nc OR RQD	WATER CONTENT (%)	ELEVATION (m)
GROUND SURFACE	0					89.30
TOPSOIL 0.10m [89.20m]						
FILL: Compact , grey silty fine sand to sandy silt , trace gravel 0.84m [88.46m]		SS 1	62	3-8-7-7 15		89
FILL: Compact , brown silty fine sand to sandy silt, topsoil, trace gravel 1.12m [88.18m]	1	SS 2	60	6-50-/-/ 50/0.03		
End of Borehole						88
Practical refusal to augering at 1.12 m depth	2					87
	3					86
	4					85
	5					84
	6					

STRATA PLOT



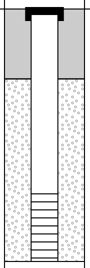
■ PEN. RESIST. (BLOWS/0.3m) DCPT (50mm DIA. CONE) 20 40 60 80

△ REMOULDED SHEAR STRENGTH, Cur (kPa)

▲ PEAK SHEAR STRENGTH, Cu (kPa) 20 40 60 80

PL (%) WATER CONTENT (%) LL (%) 20 40 60 80

PIEZOMETER CONSTRUCTION



PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

541 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379637.62 **NORTHING:** 5018860.97 **ELEVATION:** 89.58

PROJECT: Proposed Commercial Development

BORINGS BY: CME-55 Low Clearance Drill

REMARKS:

DATE: November 11, 2024

FILE NO. : PG7327

HOLE NO. : BH2-24

SAMPLE DESCRIPTION

GROUND SURFACE

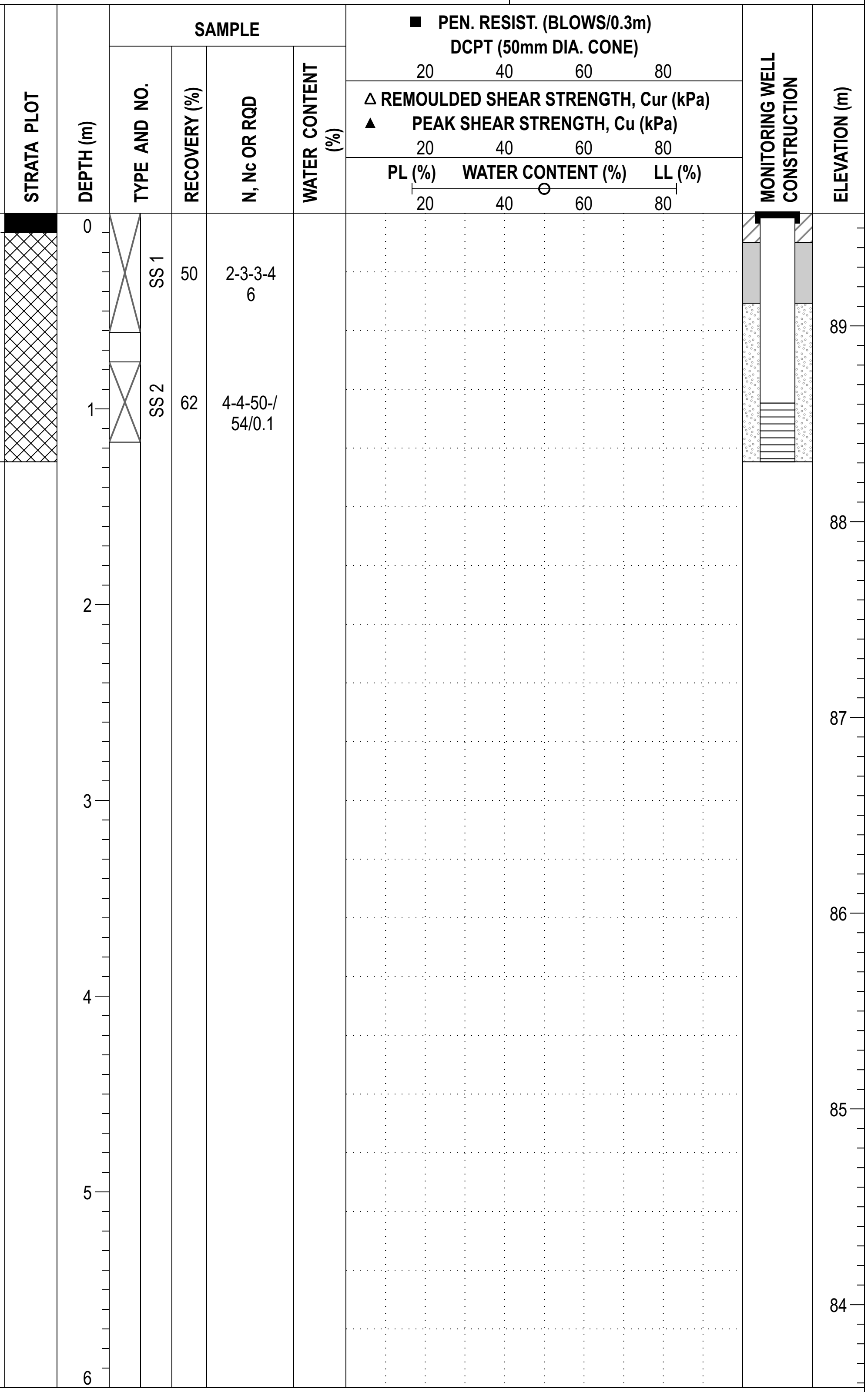
TOPSOIL and organics 0.10m [89.48m]

FILL: Loose, grey silty fine sand to sandy silt 1.27m [88.31m]

End of Borehole

Practical refusal to augering at 1.27 m depth

TYPE AND NO.	RECOVERY (%)	N, Nc OR RQD	WATER CONTENT (%)
SS 1	50	2-3-3-4 6	
SS 2	62	4-4-50-/ 54/0.1	



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PATERSON GROUP

SOIL PROFILE AND TEST DATA

Geotechnical Investigation

541 Somme Street, Ottawa, Ontario

COORD. SYS.: MTM ZONE 9 **EASTING:** 379649.37 **NORTHING:** 5018891.13 **ELEVATION:** 89.68

PROJECT: Proposed Commercial Development

BORINGS BY: CME-55 Low Clearance Drill

REMARKS:

DATE: November 11, 2024

FILE NO. : PG7327

HOLE NO. : BH3-24

SAMPLE DESCRIPTION	DEPTH (m)	SAMPLE TYPE AND NO.	RECOVERY (%)	N, Nc OR RQD	WATER CONTENT (%)	ELEVATION (m)
GROUND SURFACE	0					
FILL: Compact, brown silty fine sand to sandy silt with gravel, trace topsoil and organics 0.30m [89.38m]		SS 1	71	3-7-7-6 14		
FILL: Compact, grey silty fine sand to sandy silt 0.86m [88.82m]		SS 2	51	50-/-/-/ 50/0.05		89
End of Borehole Practical refusal to augering at 0.86 m depth	1					
	2					88
	3					87
	4					86
	5					85
	6					84

■ PEN. RESIST. (BLOWS/0.3m)
DCPT (50mm DIA. CONE)
20 40 60 80

△ REMOULDED SHEAR STRENGTH, Cur (kPa)
▲ PEAK SHEAR STRENGTH, Cu (kPa)
20 40 60 80

PL (%) WATER CONTENT (%) LL (%)
20 40 60 80

STRATA PLOT

PIEZOMETER CONSTRUCTION

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Industrial Development - Rideau Rd. at Hawthorne Rd.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE November 4, 2022

FILE NO. PG6452

HOLE NO. TP12-22

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	90.05		
FILL: Brown silty sand with gravel, trace organics	▨	G	1						
1.10						1	89.05		
End of Test Pit TP terminated on bedrock surface at 1.10m depth. (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
5123 Hawthorne Road
Ottawa, Ontario

DATUM Ground surface elevations provided by the client.

REMARKS

BORINGS BY CME 55 Power Auger

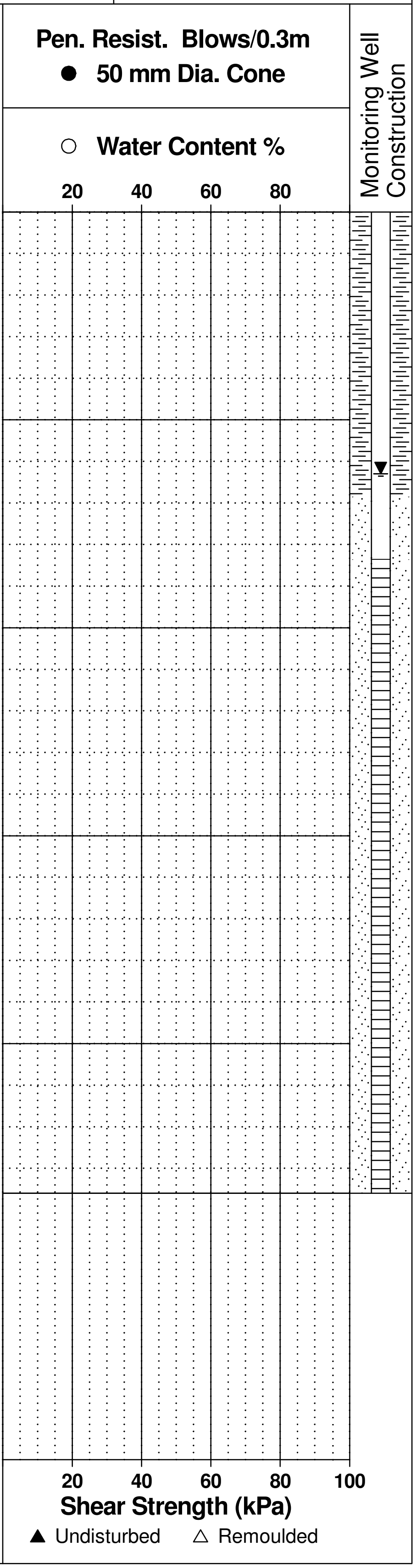
DATE December 10, 2019

FILE NO. PG5306

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Grey crushed stone		AU	1		
0.61					
BEDROCK: Dolostone, some quartz crystals		RC	1		
1.73					
BEDROCK: Sandstone		RC	2		
		RC	3		
4.72					
End of Borehole					
(GWL @ 1.26m - Dec. 16, 2019)					

DEPTH (m)	ELEV. (m)
0	89.43
1	88.43
2	87.43
3	86.43
4	85.43



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

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

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

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

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

CONSOLIDATION TEST

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

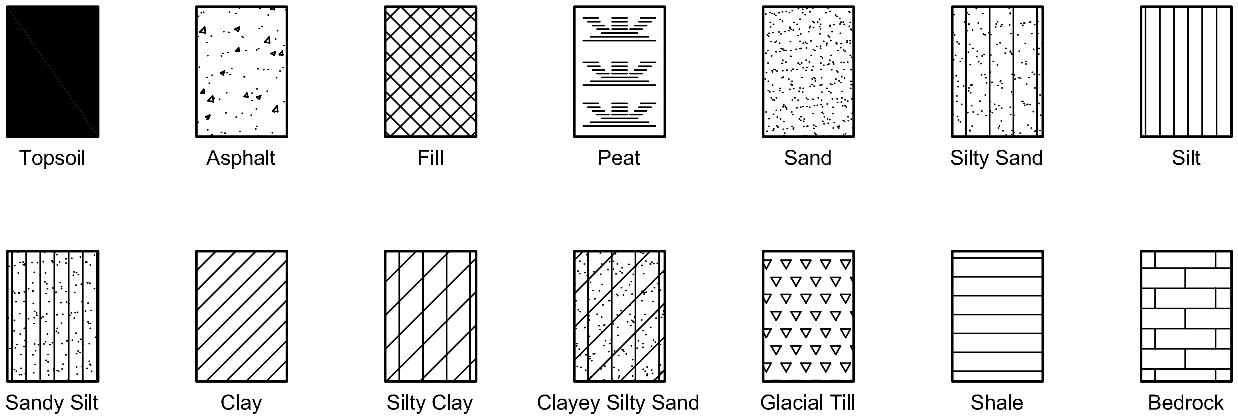
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

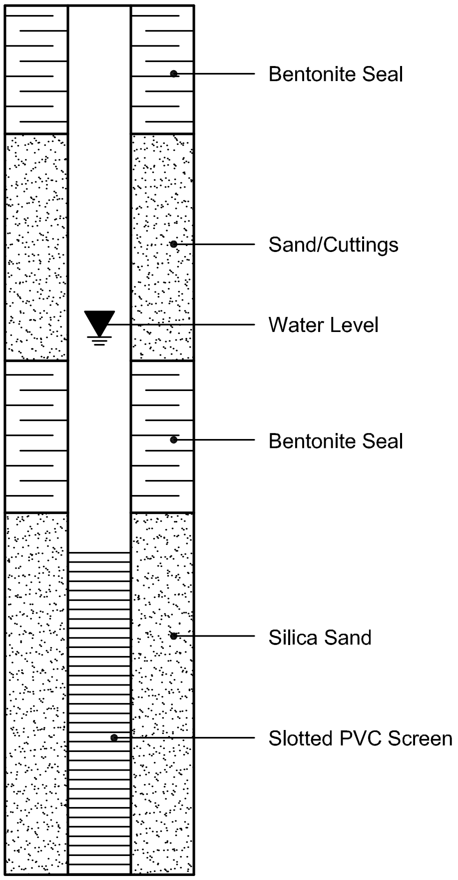
SYMBOLS AND TERMS (continued)

STRATA PLOT

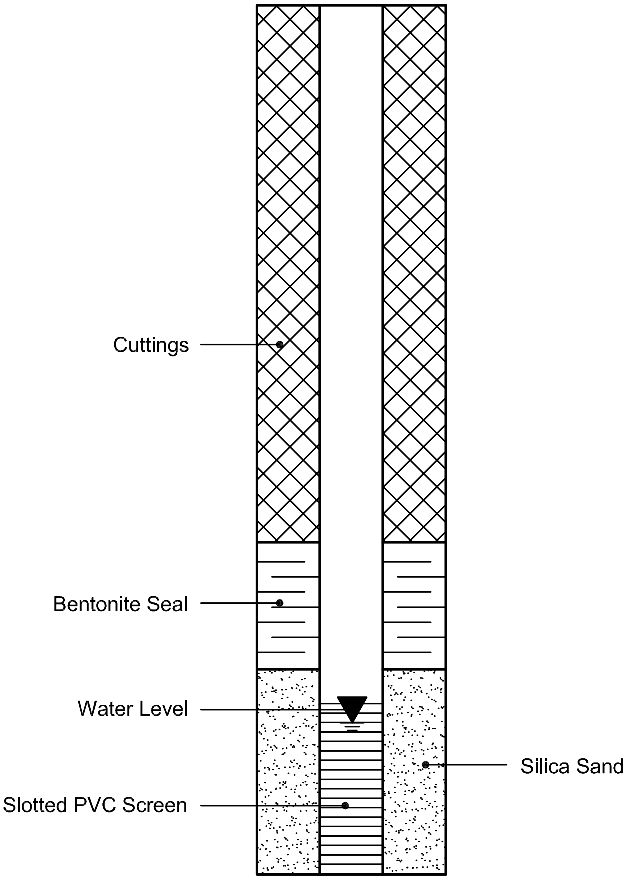


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Order #: 2446600

Certificate of Analysis

Report Date: 21-Nov-2024

Client: **Paterson Group Consulting Engineers (Ottawa)**

Order Date: 15-Nov-2024

Client PO: 61750

Project Description: PG7327

	Client ID:	BH2-24 SS2	-	-	-	-	-
	Sample Date:	11-Nov-24 09:00	-	-	-		
	Sample ID:	2446600-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	87.5	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.54	-	-	-	-	-
Resistivity	0.1 Ohm.m	4.0	-	-	-	-	-
Anions							
Chloride	10 ug/g	<10	-	-	-	-	-
Sulphate	10 ug/g	5080	-	-	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 & 3 – SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG7327 - 1 - TEST HOLE LOCATION PLAN

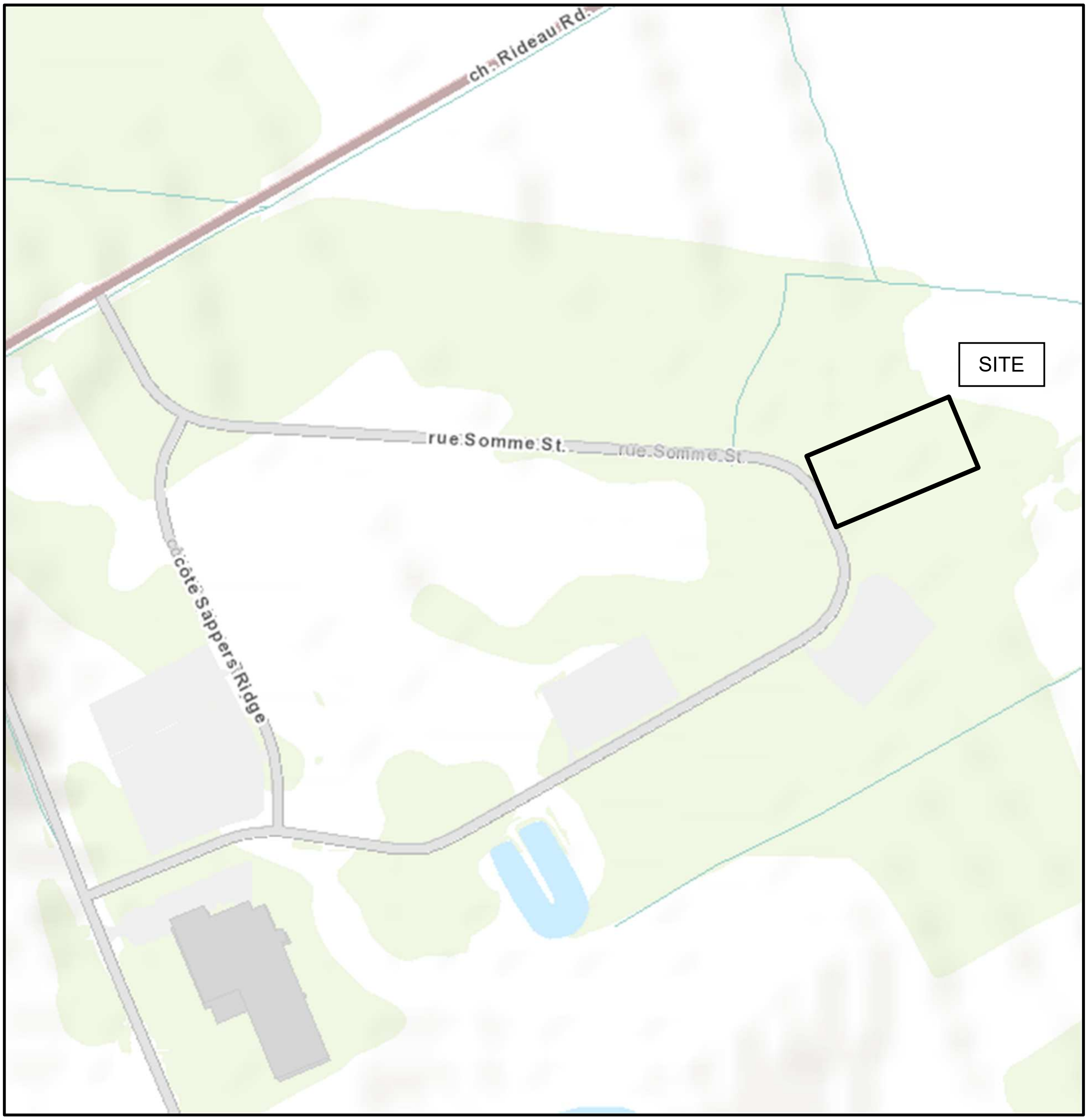
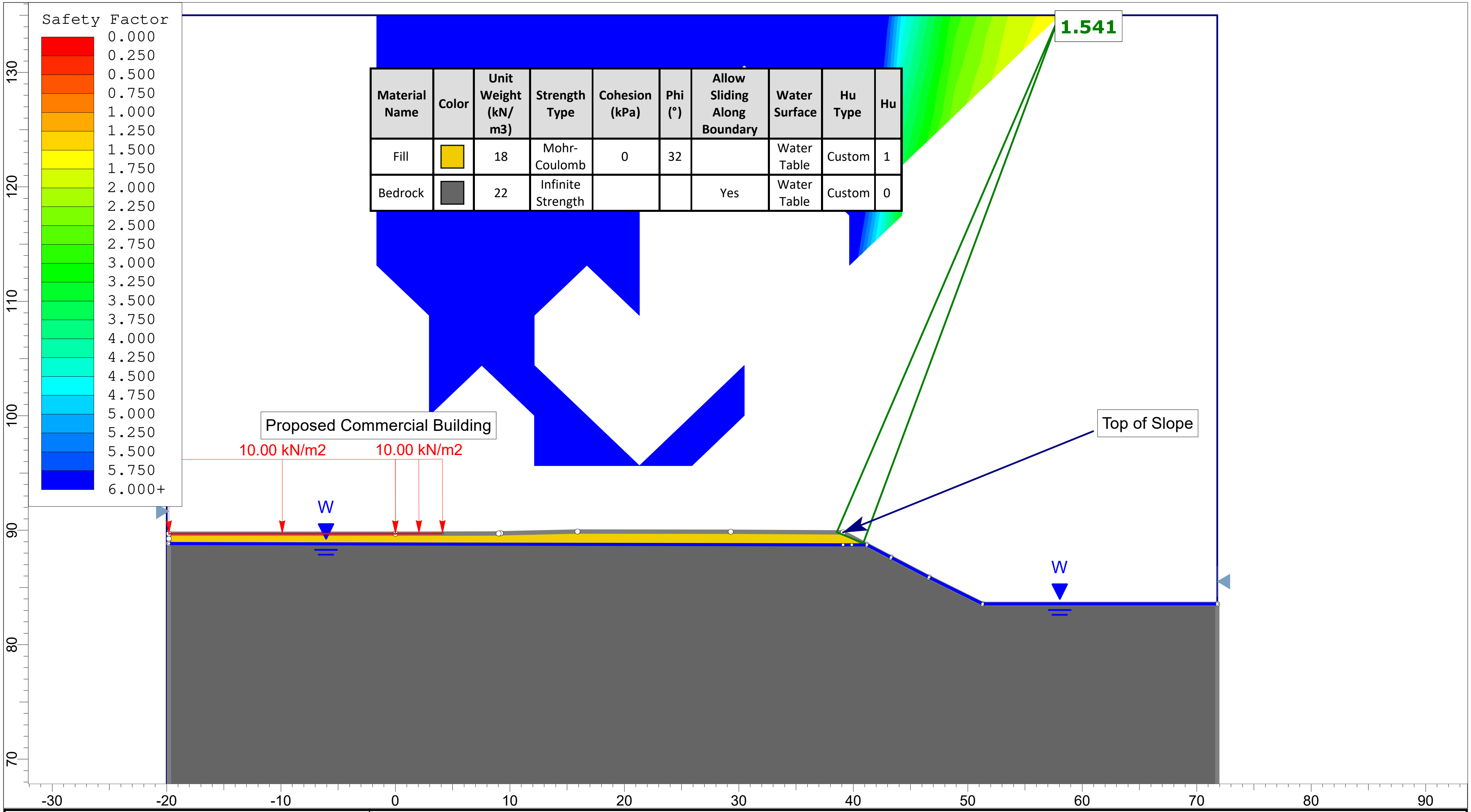


FIGURE 1

KEY PLAN

PATERSON GROUP

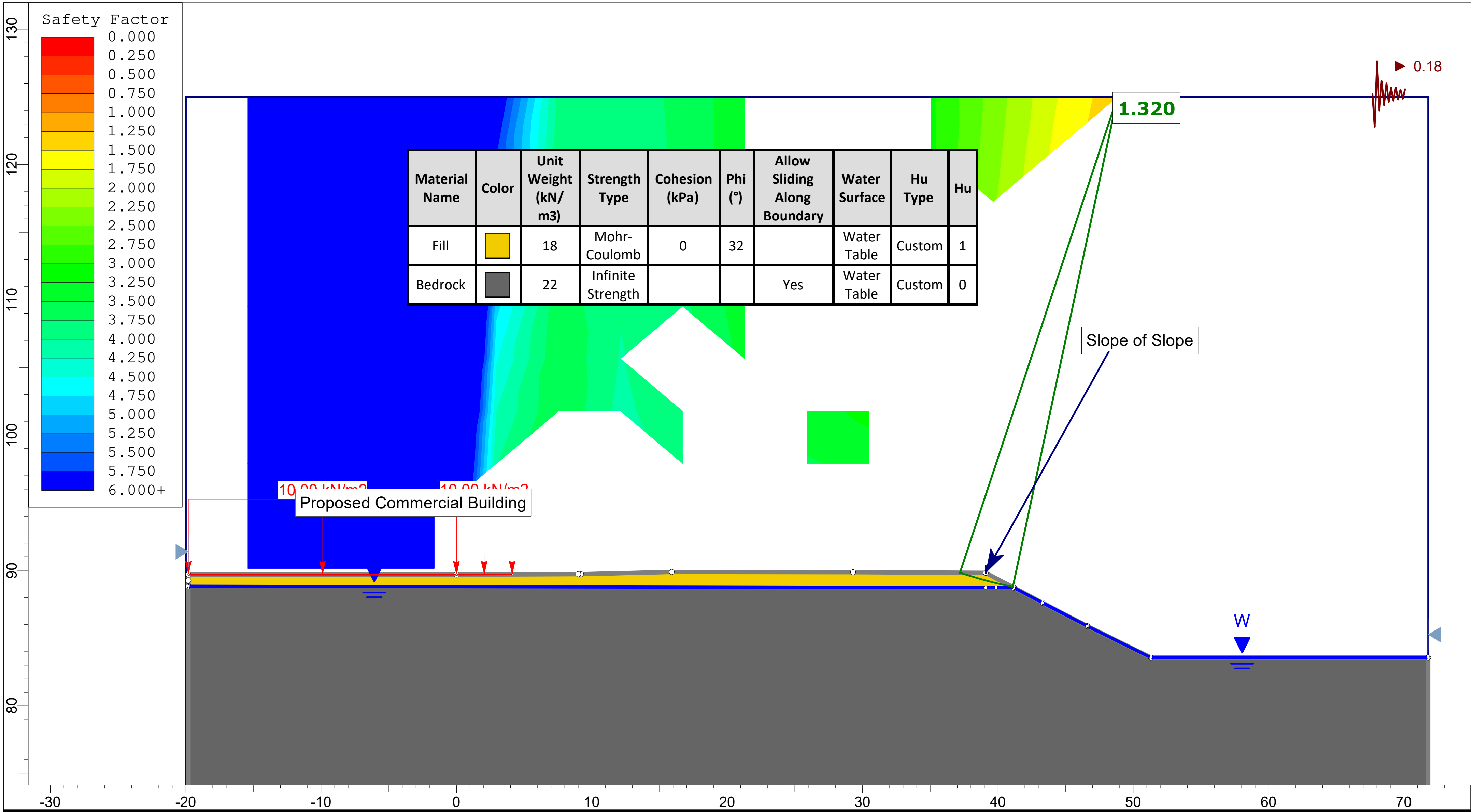


Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (°)	Allow Sliding Along Boundary	Water Surface	Hu Type	Hu
Fill	🟨	18	Mohr-Coulomb	0	32		Water Table	Custom	1
Bedrock	⬛	22	Infinite Strength			Yes	Water Table	Custom	0

rocscience

SLIDEINTERPRET 9.031

Project	Slide2 - An Interactive Slope Stability Program		
Group	Group 1	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	2024-11-13, 10:22:47 AM	*File Name*	Proposed Static Condtion- Section A-A.slmd



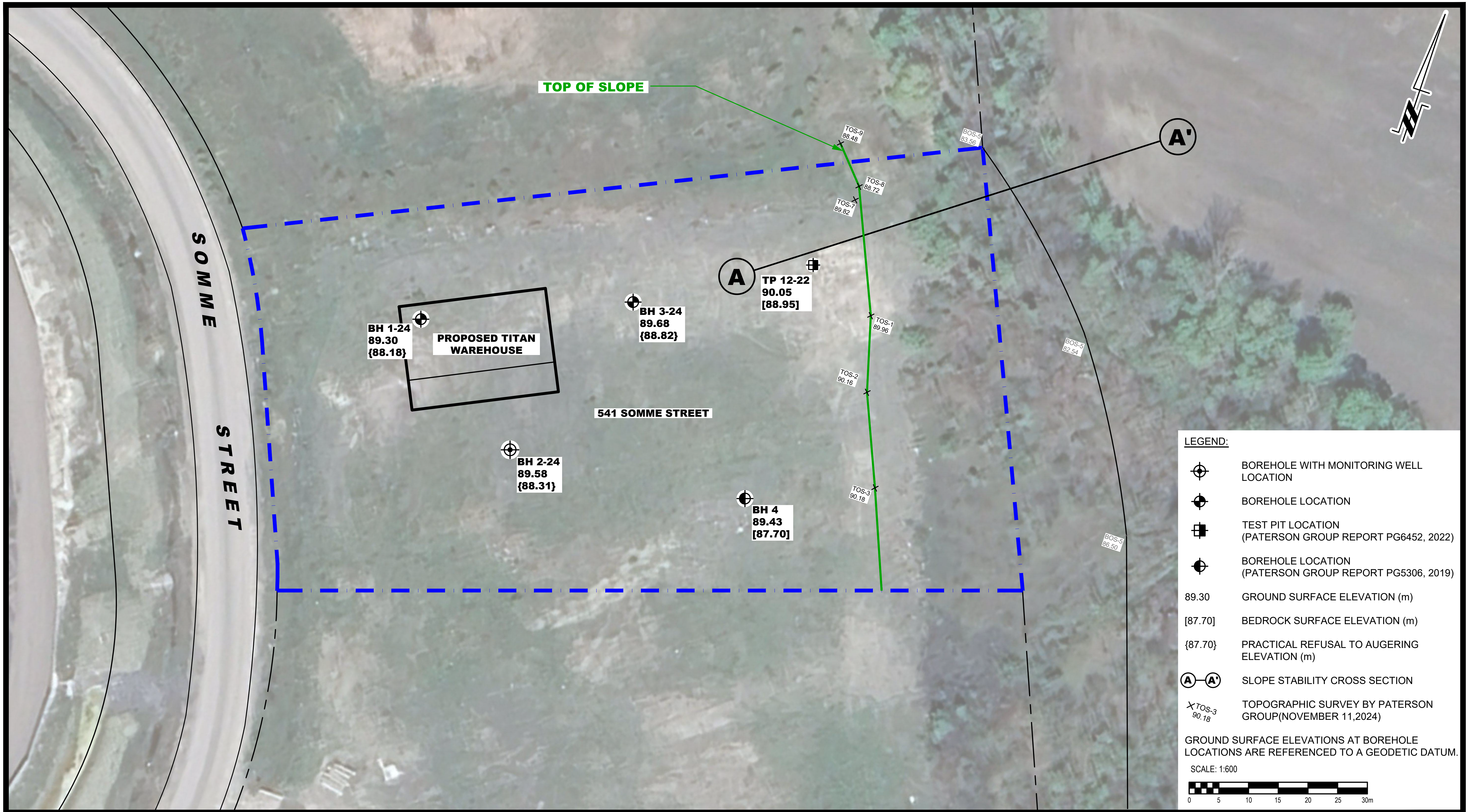
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Allow Sliding Along Boundary	Water Surface	Hu Type	Hu
Fill	🟨	18	Mohr-Coulomb	0	32		Water Table	Custom	1
Bedrock	⬛	22	Infinite Strength			Yes	Water Table	Custom	0

rocscience

SLIDEINTERPRET 9.031

Project	Slide2 - An Interactive Slope Stability Program

Group	Group 1	*Scenario*	Master Scenario
Drawn By		*Company*	
Date	2024-11-13, 10:22:47 AM	*File Name*	Proposed Seismic Condtion- Section A-A.slmd



LEGEND:

⊕	BOREHOLE WITH MONITORING WELL LOCATION
⊕	BOREHOLE LOCATION
⊞	TEST PIT LOCATION (PATERSON GROUP REPORT PG6452, 2022)
⊕	BOREHOLE LOCATION (PATERSON GROUP REPORT PG5306, 2019)
89.30	GROUND SURFACE ELEVATION (m)
[87.70]	BEDROCK SURFACE ELEVATION (m)
{87.70}	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
Ⓐ—Ⓐ'	SLOPE STABILITY CROSS SECTION
✕TOS-3 90.18	TOPOGRAPHIC SURVEY BY PATERSON GROUP(NOVEMBER 11,2024)

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:600

0 5 10 15 20 25 30m

PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL

TITAN ENVIRONMENTAL CONTAINMENT
GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
541 SOMME STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:600	Date: 11/2024
Drawn by: GK	Report No.: PG7327-1
Checked by: PB	Dwg. No.: **PG7327-1**
Approved by: SD	Revision No.:

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11x17