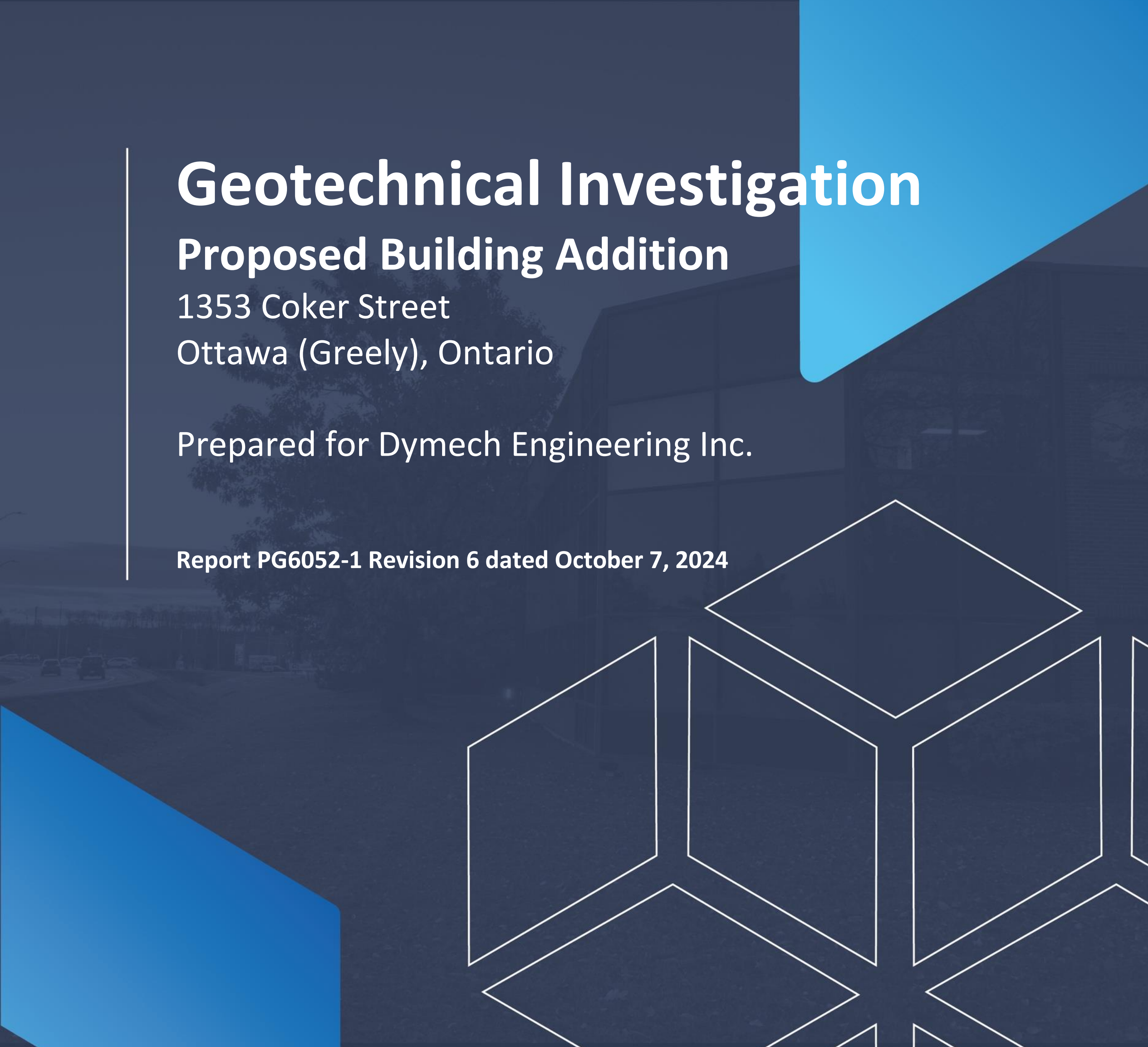

Geotechnical Investigation

Proposed Building Addition

1353 Coker Street
Ottawa (Greely), Ontario

Prepared for Dymech Engineering Inc.

Report PG6052-1 Revision 6 dated October 7, 2024

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Dymech Engineering Inc. to conduct a geotechnical investigation for the proposed warehouse addition to be located on 1353 Coker Street - Ottawa (Greely), Ontario (refer to Figure - Key Plan in Appendix 2 of this report).

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 development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. 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

The subject site is currently occupied by a warehouse located within the central south portion of the site. In addition, an open shed is located within the central north portion of the site. The southern corner of the site is grass covered and has a septic bed system, while the remaining areas have an asphaltic concrete cover surface and are used as driveways and car parking.

Based on the available conceptual plans, it is understood that the proposed development will consist of a single storey warehouse addition to the existing warehouse, to be located within the central north portion of the site. It is further understood that the new building addition will consist of a slab on grade type of construction.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on December 17, 2021. The current investigation consisted of excavating 4 test pits, extending to a maximum depth of 3.2 m, below the existing ground surface. The test hole locations were distributed in a manner to provide general coverage of the subject site. The approximate locations of the test holes are shown on Drawing PG6052-1 - Test Hole Location Plan included in Appendix 2.

The test holes were advanced using a backhoe. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer.

Sampling and In Situ Testing

Soil samples from the test pits were recovered from the side walls of the open excavation. Grab samples were collected from the test pits at selected intervals. The samples were initially classified on site, placed in sealed plastic bags and transported to our laboratory. The depths at which the grab samples were recovered from the test pits and boreholes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Undrained shear strength testing was carried out in cohesive soils using a field vane apparatus.

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

Groundwater

Groundwater infiltration levels were observed and recorded in the open test pits at the time of excavation. Groundwater level observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum. The test hole locations are presented on Drawing PG6052–1 – Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site consists of a single-story warehouse with associated access lane and parking lot. The ground surface across the subject site is generally flat and at grade with neighboring properties to the east.

The site is bordered by Coker Street to the south, industrial warehouse to the north, east and west.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the majority of the test hole locations excavated within the northern portion of the site consists of asphaltic concrete/crushed stone fill with sand and gravel underlain by compact brown silty sand layer, followed by a silty clay deposit.

The encountered fill was observed to extend down to a depth of approximately 0.6 to 0.8m below ground surface and it was observed to consist of brown silty sand with gravel and crushed stone.

The silty sand deposit encountered below the fill layer was observed to extend down to a depth of 1 to 1.35m below existing ground surface, except at the location of TP 2-21, where silty sand was not encountered.

Field vane testing was completed within the silty clay deposits encountered in the test holes at the subject site. The shear strength values, as obtained from the field vane, were generally above 100 KPa, with the exceptions of test holes TP 3-21, where a shear strength value of 50 KPa was measured at a depth of 3 m. The remolded shear strength values as obtained from the field vane testing conducted in the test pits was observed to range between 65 to 75 KPa with the exception of TP 3-21 where the remolded shear strength was measured to be 30 kPa. Based on the measured shear strength values, the strength ratio of the clay was calculated to be below 2 indicating a low sensitivity clay.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location. In addition, the Soil Profile and Test Data sheets from previous investigations within the area have been included in Appendix 1.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of interbedded dolostone of the Oxford formation, with an overburden drift thickness of 5 to 10 m depth.

4.3 Groundwater

Groundwater infiltration level observations were recorded in the open hole test pits at the time of the current investigation. In addition, groundwater conditions were also assessed based on our knowledge acquired through previous experience in the area. The groundwater level observations for the current investigation are summarized in Table 1 and are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

Table 1 – Summary of Groundwater Levels

Borehole Number	Ground Surface Elevation (m)	Measured Groundwater Level		Date Recorded
		Depth (m)	Elevation (m)	
PG6052 – Paterson Group – Current Investigation				
TP 1-21	100.05	1.00	99.05	December 17, 2021
TP 2-21	100.06	0.4	99.66	
TP 3-21	100.26	0.9	99.36	
TP 4-21	100.14	0.6	99.54	

Note: The ground surface elevation at each borehole location was surveyed using a high precision GPS using a geodetic datum.

Based on our groundwater level observations in the open hole test pits made during the current investigation, and on available information from adjacent sites, the seasonal high groundwater level is anticipated to be between ground surface ad a depth of 1.0m. Conservatively, the groundwater level will be taken at an approximate geodetic elevation of **99.8 m** (i.e. 20cm below existing ground surface).

Paterson completed another site visit to collect groundwater information from the ditch located along the northern property boundary on May 5, 2023, following a prolonged period of rainfall (10 days of continuous rainfall). Based on our observations, the highest water level detected in the northern ditch was at a geodetic elevation of 99.6m and there were no signs of water ponding at ground surface. Based on the above discussion, and on observations made during our recent visit, it is anticipated that the seasonal highwater level at the subject site will be below a geodetic elevation of 99.8m. It should also 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 considered suitable for the proposed building addition. It is anticipated that proposed warehouse addition within the northern portion of the site will be founded on conventional footings placed directly over undisturbed stiff silty clay bearing surface.

Due to the presence of a silty clay deposit within the subject site, a permissible grade raise restriction is required for the site. However, based on our review of the gradings plans, it was observed that no significant grading is anticipated for the site, and that the proposed gradings is found to be acceptable from a geotechnical perspective.

It is anticipated that permeable pavers are being considered for the subject site. Due to the shallow ground water level, drainage of the surface water would be challenging, and more frequent inspections and repair will generally be anticipated for the permeable pavers. However, the use of permeable pavers is considered acceptable from a geotechnical perspective.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, such as those containing significant amounts of organic and/or deleterious materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

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

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite drainage membrane, such as Miradrain G100N or Delta Drain 6000.

5.3 Foundation Design

Bearing Resistance Values (Conventional Shallow Foundation)

Strip and pad footings, up to 3 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at SLS of **100 kPa** and a factored bearing resistance value at ULS of **200 kPa** incorporating a geotechnical factor of 0.5.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed, in the dry, prior to the placement of concrete footings.

Footings bearing on an undisturbed soil bearing surface and designed using the bearing resistance values provided herein will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

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 above noted overburden soils bearing media when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil of the same or higher capacity as that of the bearing medium.

As a general procedure, it is recommended that footings for the proposed warehouse addition that are located adjacent to the existing warehouse be founded at the same level as the existing footings. This accomplishes three objectives. First, the behaviour of the two structures at their connection will be similar due to the similar bearing medium. Second, there will be minimal stress added to the existing structure from the new structure. Third, the bearing of the new structure will likely not be influenced by any backfill material associated with the existing structure.

Based on our review of the available project plans, it is understood that the proposed building foundation is not immediately adjacent to the existing building foundation and the available horizontal setback between the existing and proposed footings is minimum 1.5m, if not more. In addition, the USF of the proposed and existing footing will be matching, and the vertical separation will be zero.

Based on the above, the lateral support zone of 1.5H:1V required for bearing medium of the existing footing is protected.

Paterson also assessed the potential risk of excavation floor upward slip due to lowering of the porewater pressure under the existing footing. Based on the USF of the existing and proposed footings, and the anticipated groundwater lowering depth of 1m, which will not be below the USF of the existing footing, and given that the minimum horizontal separation between the existing and proposed footings is 1.5m, then the risk of upward slip of the excavation floor due to lowering of the groundwater table is negligible and no mitigation measures will be needed, provided Paterson completes periodic inspections of the subgrade prior to placement of concrete.

Based on the above review, lowering of the groundwater level due to the proposed footing excavation is not anticipated to have a negative impact on the existing footings, from a geotechnical perspective.

Permissible Grade Raise Restrictions

Based on the test hole coverage and results of the undrained shear strength testing obtained from the field vane completed within the underlying cohesive soils, a permissible grade raise restriction of **2.0 m** is recommended for design purposes.

Paterson reviewed the following grading plan prepared by D.B. Gray Engineering:

☐ Grading Plan and Erosion and Sediment Control Plan- Job No. 20127 – C-2 – Revision 3 dated February 7, 2023.

Based on our review of the above noted plan, it is understood that no significant grading is anticipated for the site. It is further understood that the minimum existing grade noted for the site is at approximate geodetic elevation 100 m and the highest proposed finish floor elevation is at approximate geodetic elevation 100.53 m. Based on that, the proposed grading is within the permissible grade raise of 2.0m with no exceedances noted. Therefore, the proposed grading at the subject site is considered acceptable from a geotechnical perspective, and no lightweight fill will be required.

Based on our review of the grading plans, it should be noted that the proposed grading at the subject site was found to be minimal. Therefore, no additional testing such as consolidation, will be required to verify the proposed PGR.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for foundations constructed at the subject site. Reference should be made to the latest revision of Ontario Building Code 2012 (OBC 2012; Table 4.1.8.4.A) for a full discussion of the earthquake design requirements.

Liquefaction Potential

Based on the design USF of the proposed building addition, the footings will be placed on the undisturbed very stiff to stiff brown silty clay deposit. Therefore, the encountered silty sand deposit will be above USF. Based on the founding depth and the thickness of the encountered silty sand deposit, the soils underlying the subject site are not susceptible to liquefaction potential.

The encountered silty clays were also assessed for cyclic strain softening based on the empirical criteria suggested by Bray et.al (2004) and provided in the Canadian Foundation Engineering Manual 4th Edition. According to Bray et al. (2004), clays with a plasticity index above 20% are not susceptible to liquefaction or cyclic mobility, as shown in Figure 1 below.

Based on our experience in the area, and on the Atterberg limits completed on the silty clay deposit from nearby sites, the silty clays (weather brown crust and grey silty clay) at the subject site are anticipated to have a plasticity index greater than 20%. Therefore, the risk of cyclic mobility is not a concern for the proposed footings supported on the encountered undisturbed silty clay at the subject site.

The Atterberg Limits testing results for the nearby site are enclosed in Appendix 1.

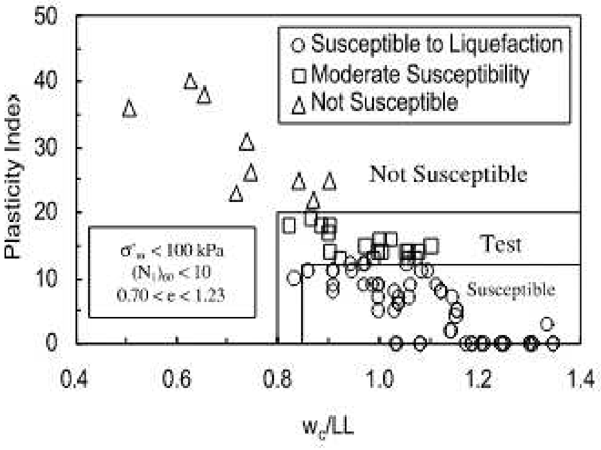

Figure 1. Criteria for evaluating liquefaction susceptibility of fine-grained soils (Bray et al. 2004).

5.5 Floor Slab Construction

With the removal of all deleterious fill, such as those containing significant amounts of organics, within the footprint of the proposed building addition footprint, the existing soil subgrade, which is reviewed and approved by Paterson personnel at the time of construction, will be considered an acceptable subgrade upon which to commence backfilling for floor slab construction.

It is recommended that the upper 200 mm of sub-floor fill consists of OPSS Granular A for slab-on-grade construction. 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 the material's SPMDD.

5.6 Pavement Structure

Permeable Pavement Structures

It is understood that a permeable paver parking area is being considered for the subject site. Based on this, it is anticipated that the overall make-up of the permeable pavement structure will be specified by others specializing in permeable pavement construction. However, the permeable paver structure should be provided by the base and subbase course. The following is recommended for car-only parking areas, access lanes, and heavy-truck park areas:

Table 2 - Recommended Permeable Pavement Structure Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
-	**Permeable Paver Structure (as per manufacturer specifications)**
150	**BASE –** OPSS Granular A Crushed Stone (or as per manufacturer requirements)
350	**SUBBASE –** OPSS Granular B Type II
GEOTEXTILE - Terrafix Non-Woven Geotextile 420R or equivalent should be placed between the subbase and existing subgrade material.	
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill.	

Infiltration Rate

The infiltration rate of the existing silty sand subgrade material was estimated based on the grain size analysis results of the representative soil sample from nearby sites. An infiltration rate range of **100 to 200 mm/hr** for the existing sand material can be used for permeable pavement design considerations.

CBR

For typical silty sand soils in Ontario, a typical CBR value of 5 can be taken, as provided in Table 2.6. Subgrade Properties, under section 2.4-Subgrade Materials in *Methodology for the Development of Equivalent Pavement Structural Design Matrix for Municipal Roadways- Ontario – 2011.*

Impact of High Ground Water Table

Proper drainage of the subgrade below the permeable pavers should be provided through site grading and through the use of perforated subdrains installed in the subgrade layer and directed towards a positive outlet (northern ditch, southern ditch, landscaped areas, …etc). It should be noted that based on the shallow nature of the groundwater level within the subject site, drainage of the subgrade is anticipated to be challenging. It is anticipated that frequent inspections and maintenance might be required for the permeable pavement structure due to the high-water level. The feasibility and effectiveness of the permeable paver system is outside the scope of this report, and it should be assessed by others.

Flexible Pavement Structures

The following pavement structures may be considered for design of flexible pavement structure, if considered for the proposed development:

Table 4 - Recommended Pavement Structure – Car Only Parking Areas

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

Table 5 - Recommended Pavement Structure –Heavy Truck and Access Lanes

Thickness (mm)	Material Description
40	**Wear Course** - HL3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - HL8 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 placed over in situ soil or fill.	

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

Where the subgrade is observed to be in a loose state of compactness, then proof-rolling should be completed under dry conditions and below freezing temperatures by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by Paterson.

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 compaction equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

Based on our review of the storm management drawings, it is understood that a sump pump is not anticipated for the proposed building. In addition, a sump pump is not required for the proposed building from a geotechnical perspective. Paterson reviewed the groundwater conditions at the subject site. Based on our review, it is understood that proper drainage may not be able to be provided for the proposed footings due to the shallow groundwater level, and a perimeter drainage pipe will not be possible to install and provide gravity drainage. However, surface water drainage can be provided through site grading. The absence of a perimeter drainage and the presence of the footings below groundwater level is acceptable from a geotechnical perspective, provided sufficient frost cover is provided for the subgrade as discussed under section 6.2. In addition, a vertical separation should also be provided between the foundation wall and the shallow groundwater level.

6.2 Protection of Footings Against Frost Action

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 and retaining walls, and bay openings are more prone to deleterious movement associated with frost action. These should be provided with a minimum 2.1 m thick soil cover (or insulation equivalent).

Paterson reviewed the following grading plan prepared by D.B. Gray Engineering:

☐ Grading Plan and Erosion and Sediment Control Plan- Job No. 20127 – C-2 – Revision 3 dated February 7, 2023.

Based on our review of the above noted grading plan, it is understood that the finish floor elevation is at geodetic elevation 100.53m and the proposed USF is at geodetic elevation 98.83 m. Therefore, sufficient frost cover of 1.7m is provided for the proposed footings along the west, south, and east foundation walls. However, the footings along the northern foundation wall will have large bay openings.

Footings at large entrance doors along the northern foundation wall may experience periods of unheated conditions and should be provided with a minimum 50mm layer of rigid insulation, extending a minimum 1.2 m horizontally beyond the edge of the footing face.

Rigid insulation boards should be placed upon a level and flat surface and with negligible gaps between abutting boards. Consideration can be given to placing a thin levelling mat consisting of a layer of compacted OPSS Granular A crushed stone, stone dust or sand below the insulation layer, as required. The placement of the insulation layers should be reviewed by Paterson personnel at the time of construction.

It is understood that 50mm of rigid insulation will be installed along the foundation wall below ground surface. The proposed rigid insulation will provide a barrier between the foundation wall and will act as an added protection against frost action.

6.3 Excavation Side Slopes

The side slopes of excavations in the 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. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations). Where space restrictions exist, or to reduce the trench width, the excavation can be carried out within the confines of a fully braced steel trench box.

Unsupported Side Slopes

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. Excavation side slopes should also be protected from erosion by surface water and rainfall events by the use of tarpaulins or other means of erosion protection along their footprint.

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

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. 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 or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 95% of the material's standard Proctor maximum dry density.

It should generally be possible to re-use the native soil above the cover material if the excavation and filling operations are carried out in dry weather conditions. Any stones greater than 200 mm in their longest dimension should be removed from these materials prior to placement.

The backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce potential differential frost heaving. The backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

Groundwater Control for Building Construction

Based on our observations, it is anticipated that groundwater infiltration into the excavations should be moderate to high. Pumping from open sumps may be sufficient to control the groundwater influx through the sides of shallow excavations. However, the need for localized dewatering shall be assessed depending on the final excavation depth.

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.

Permit to Take Water

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

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

6.6 Winter Construction

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

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

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

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

6.8 Tree Planting Restrictions

Paterson reviewed the available landscaping drawing prepared by CSW for the proposed commercial building addition at the subject site. Based on our review, all existing trees which are to remain have a minimum setback exceeding 20m from the proposed building addition. Furthermore, the new landscaped areas in close proximity to the proposed building addition will consist of grass and shrubs with a maximum mature height of 0.45m and 1.8m. In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), and considering worst-case soils, the tree planting setbacks for the existing and proposed trees are within the minimum setback requirements as per City guidelines noted above, and are considered acceptable from a geotechnical perspective.

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.

☐ 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 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.

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 Dymech Engineering Inc. or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Zubaida A-Moselly, Ph.D., P.Eng.

David J. Gilbert, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Oct. 7, 2024
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Building Addition - 1353 Coker Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

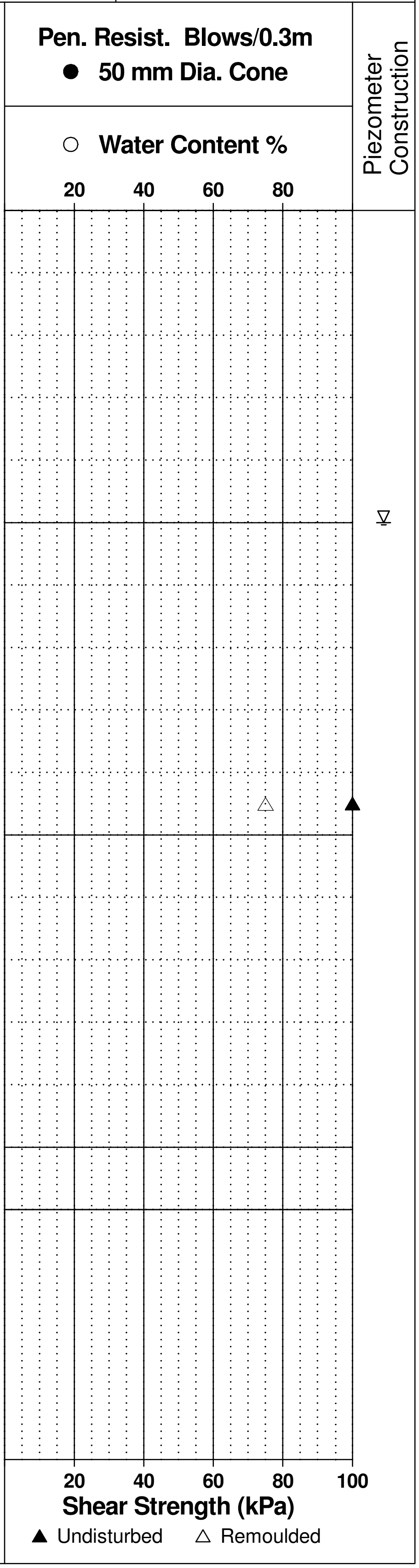
BORINGS BY Backhoe

DATE December 17, 2021

FILE NO. PG6052

HOLE NO. TP 1-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	100.05
Asphaltic concrete 0.20							
FILL: Brown silty sand with gravel and crushed stone 0.60		G	1				
Compact, brown **SILTY SAND** 1.35		G	2			1	99.05
Very stiff to stiff, grey **SILTY CLAY** - silt content increasing with depth 2.50		G	3			2	98.05
Stiff, grey **CLAYEY SILT** 3.20		G	4			3	97.05
End of Test Pit (Groundwater infiltration at 1.0m depth)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

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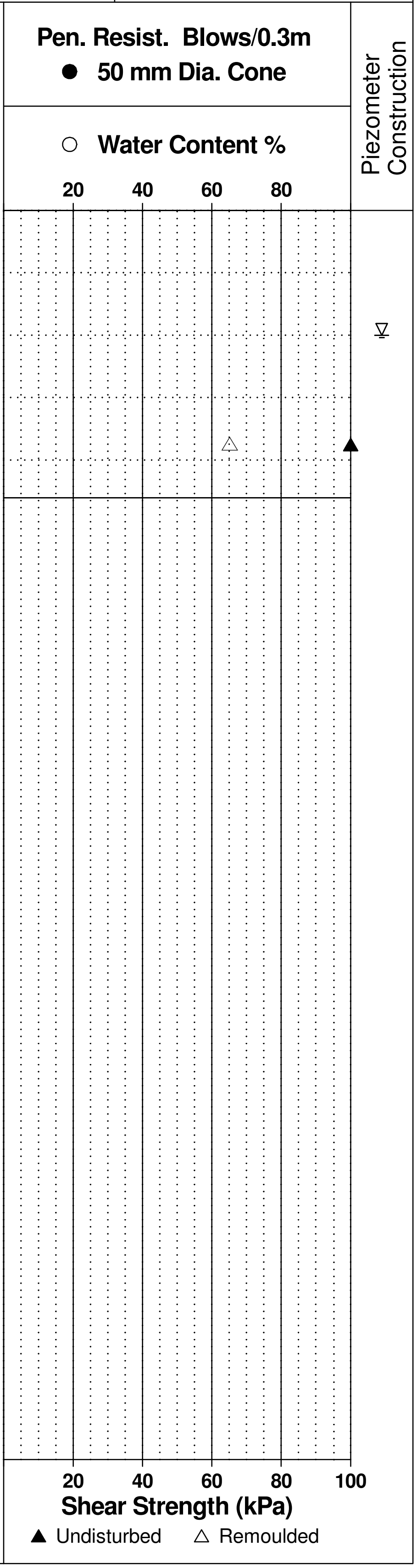
DATE December 17, 2021

FILE NO. PG6052

HOLE NO. TP 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.06
FILL: Crushed stone with sand 0.47							
FILL: Brown silty sand with gravel 0.65		G	1				
Very stiff to stiff, grey **SILTY CLAY** 0.92		G	2				
End of Test Pit (Groundwater infiltration at 0.4m depth)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Building Addition - 1353 Coker Street
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG6052

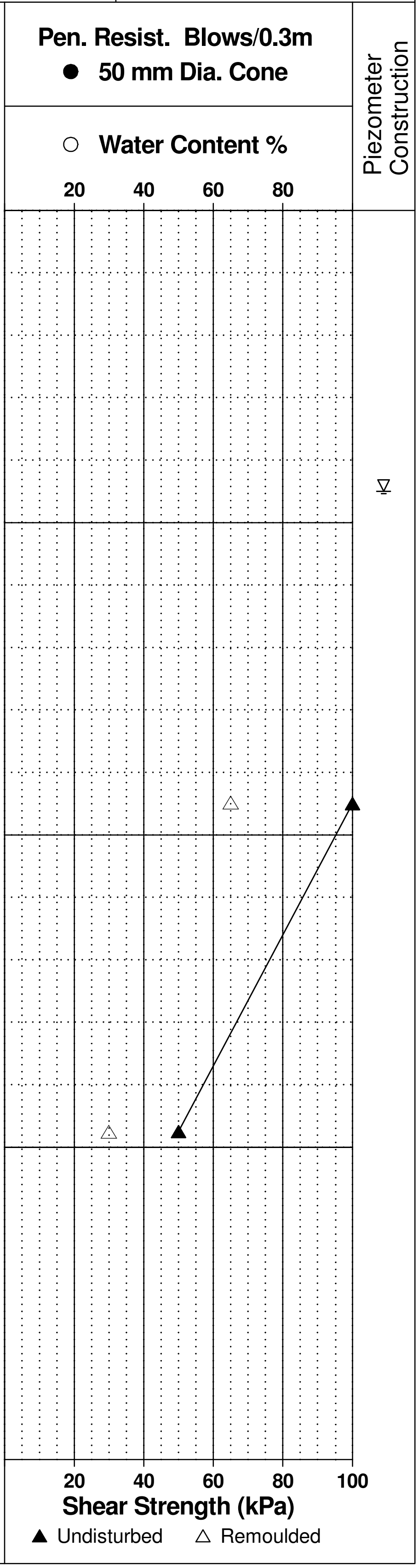
REMARKS

HOLE NO. TP 3-21

BORINGS BY Backhoe

DATE December 17, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.26
FILL: Crushed stone with sand — 0.52							
FILL: Brown silty sand with gravel, trace organics — 0.64		G	1				
Compact, brown **SILTY SAND** — 1.00		G	2			1	99.26
Very stiff to stiff, grey **SILTY CLAY** - silt content increasing with depth — 2.20		G	3			2	98.26
Stiff, grey **CLAYEY SILT** — 3.00		G	4			3	97.26
End of Test Pit (Groundwater infiltration at 0.9m depth)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Building Addition - 1353 Coker Street
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG6052

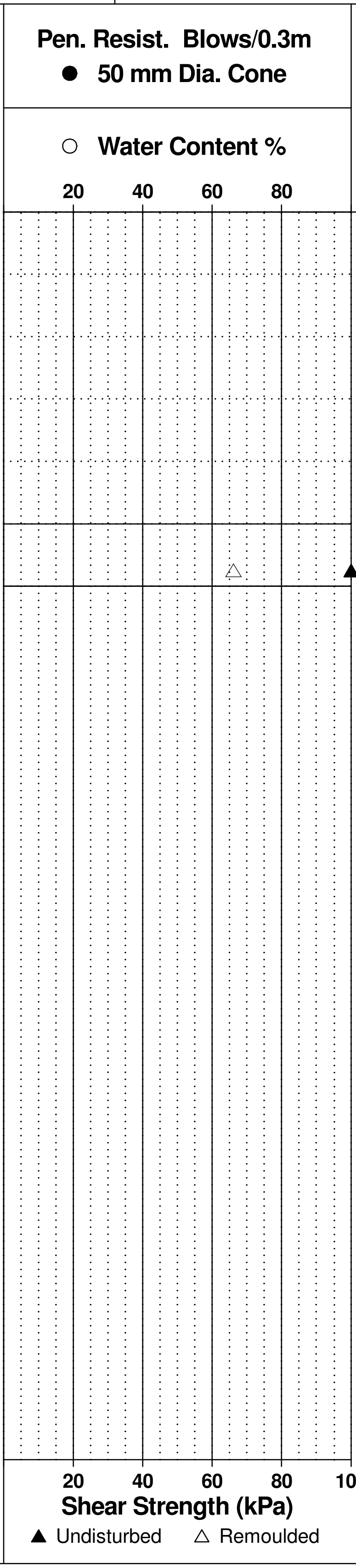
REMARKS

HOLE NO. TP 4-21

BORINGS BY Backhoe

DATE December 17, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	100.14	
FILL: Crushed stone with sand								
0.40								
FILL: Brown silty sand with gravel		G	1					∇
0.82								
Compact, brown **SILTY SAND**		G	2					
1.00						1	99.14	
Very stiff, grey **SILTY CLAY**		G	3					
1.20								
End of Test Pit (Groundwater infiltration at 0.6m depth)								



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 = $(D30)^2 / (D10 \times D60)$
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)

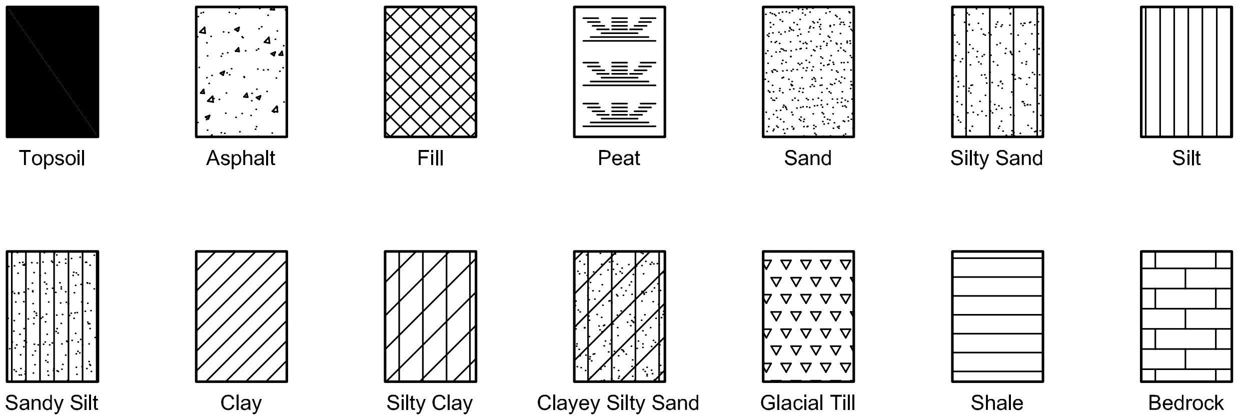
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

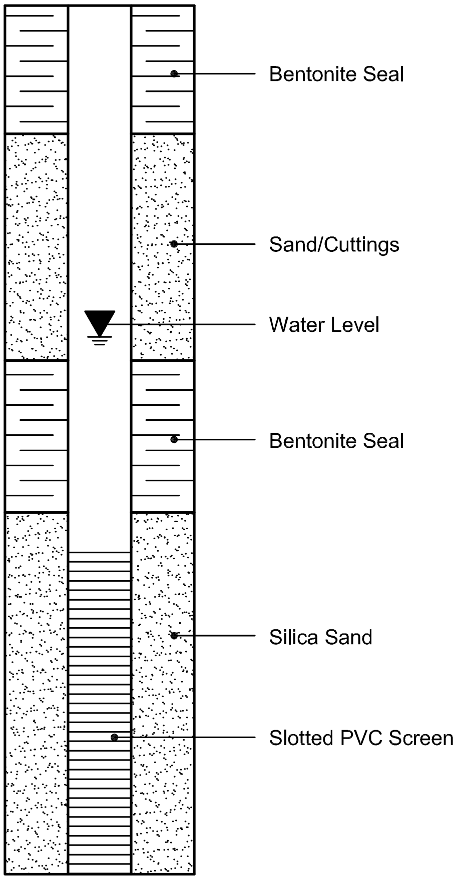
SYMBOLS AND TERMS (continued)

STRATA PLOT

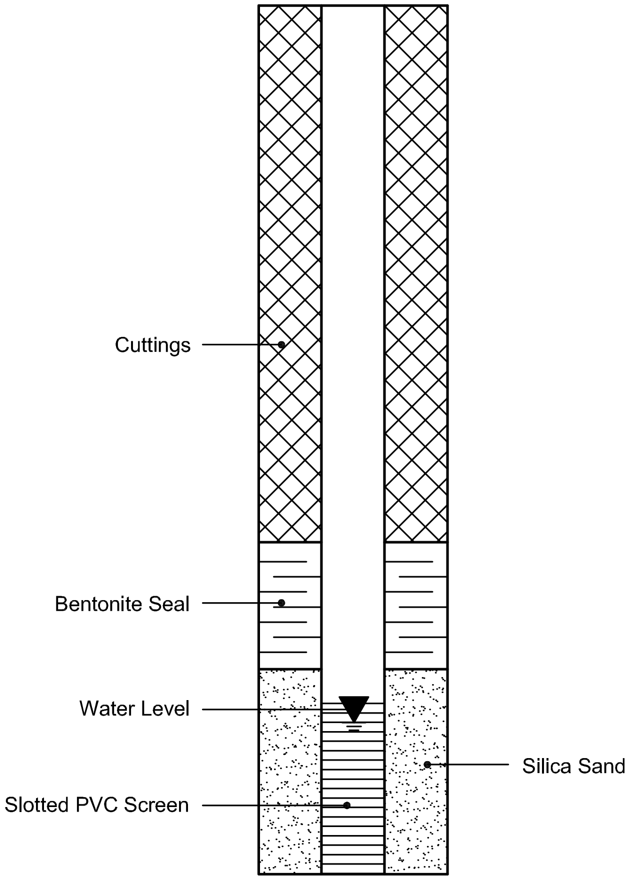


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 33480

Report Date: 04-Jan-2022

Order Date: 23-Dec-2021

Project Description: PG6052

Client ID:		TP3-21-G2	-	-	-
Sample Date:		17-Dec-21 09:00	-	-	-
Sample ID:		2152468-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	86.3	-	-	-
General Inorganics					
pH	0.05 pH Units	6.99	-	-	-
Resistivity	0.10 Ohm.m	55.6	-	-	-
Anions					
Chloride	5 ug/g dry	28	-	-	-
Sulphate	5 ug/g dry	65	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6052-1 - TEST HOLE LOCATION PLAN

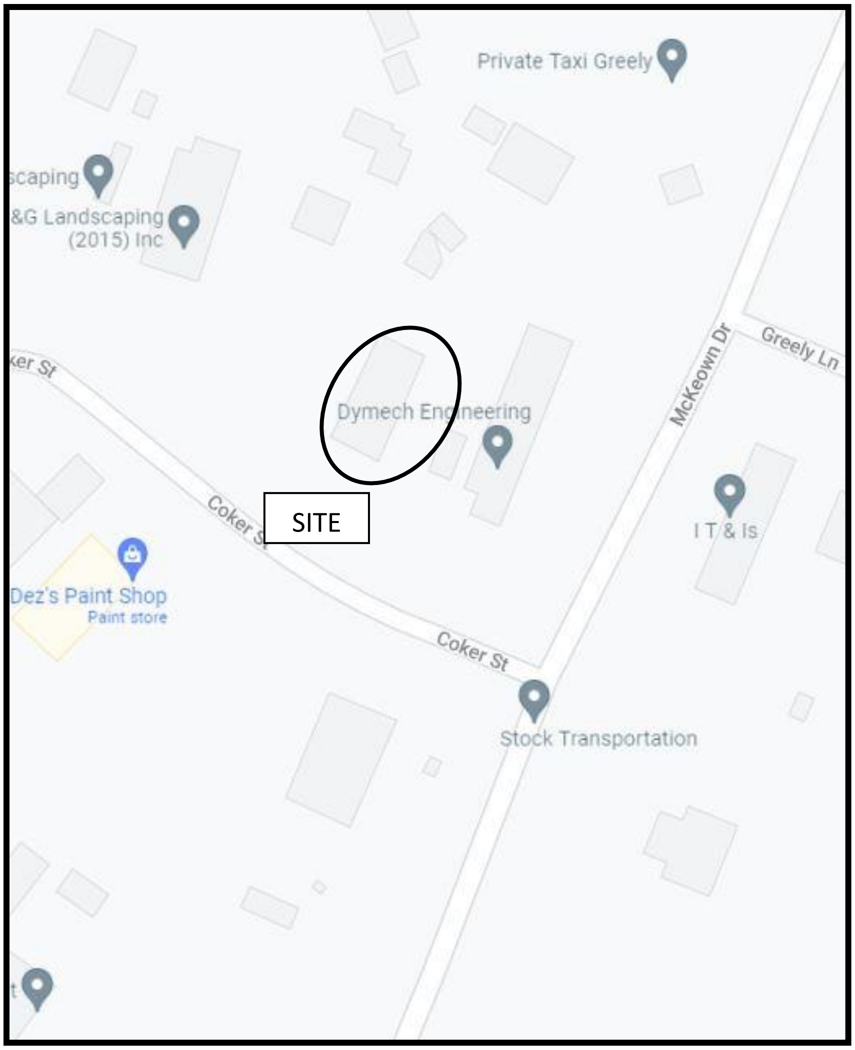
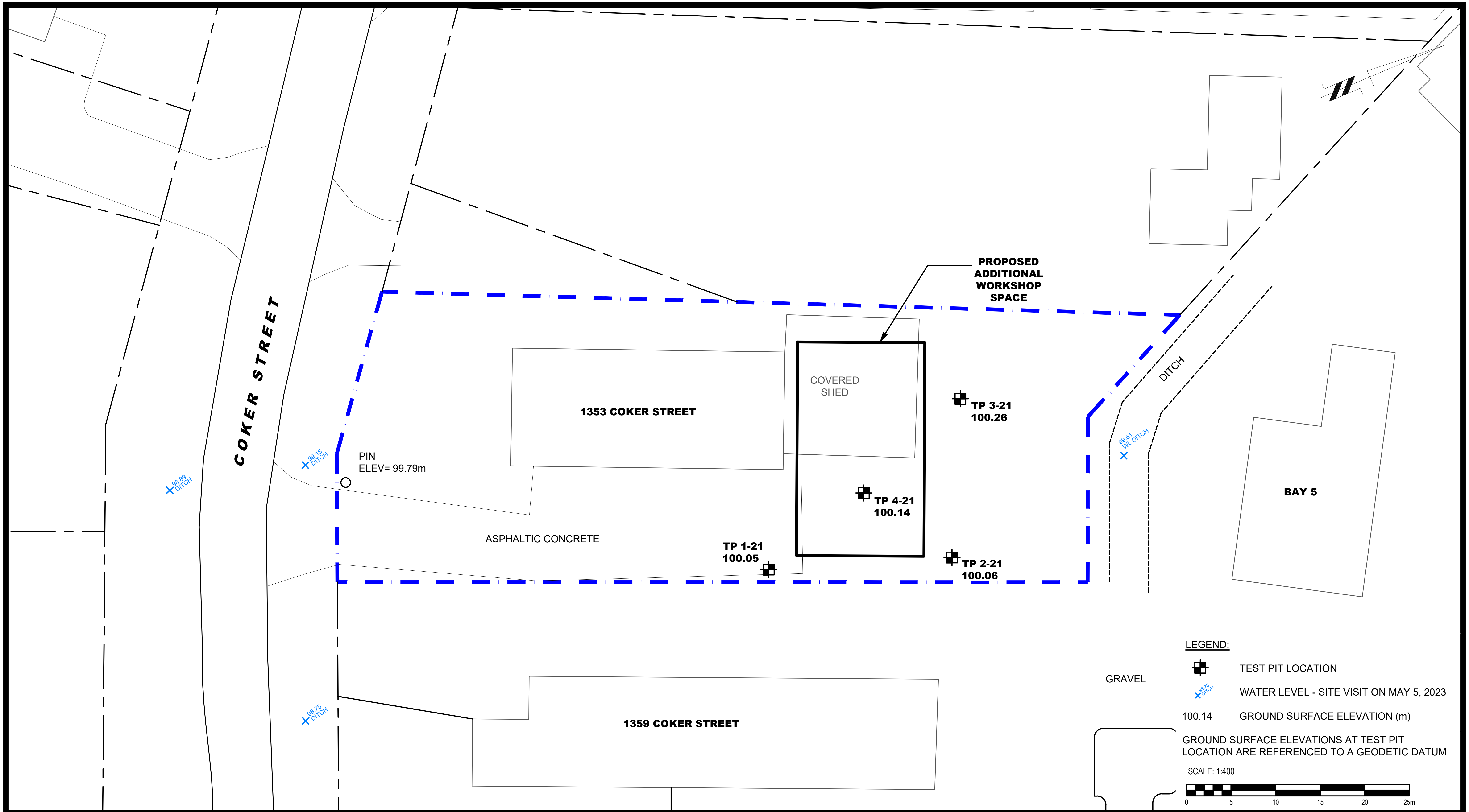


FIGURE 1

KEY PLAN

PATERSON
GROUP



PATERSON GROUP

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

NO.	REVISIONS	DATE	INITIAL
1.	ADDED TOPOGRAPHIC DATA FOR WATER LEVEL	09/05/2023	MS

DYMECH ENGINEERING INC.
GEOTECHNICAL INVESTIGATION
PROPOSED BUILDING ADDITION
1353 COKER STREET

GREELY, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:400
Date: 12/2022
Drawn by: YA
Report No.: PG6052-1 REVISION 2
Checked by: ZM
Dwg. No.: PG6052-1
Approved by: MS
Revision No.: 1

p:\autocad drawings\geotechnical\pg60xx\pg6052\pg6052-1-test hole location plan.dwg

APPENDIX 3

INFORMATION FROM PREVIOUS SITES

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Prop. Rural Subdivision - 1240 Old Prescott Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

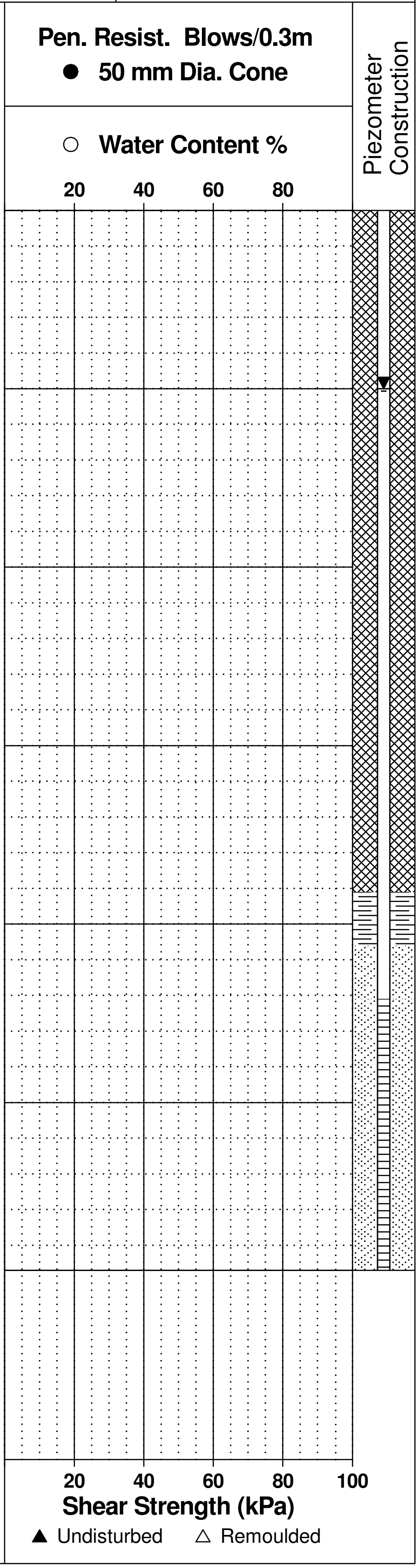
DATE December 7, 2021

FILE NO. **PG6045**

HOLE NO. **BH 3-21**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Compact to loose, brown **SILTY SAND**		AU	1		
		SS	2	50	14
- some running sand by 1.5m depth		SS	3	50	4
1.83					
Very stiff, grey **SILTY CLAY**					
2.21					
Loose, brown **SILTY SAND**					
2.59		SS	4	83	9
Compact to dense, grey **SANDY SILT**		SS	5	75	17
		SS	6	50	24
		SS	7	42	35
5.26					
GLACIAL TILL: Grey silty clay to clayey silt with sand, gravel, cobbles and boulders		SS	8	33	9
5.94					
End of Borehole					
(GWL @ 1.00m - Dec. 14, 2021)					

DEPTH (m)	ELEV. (m)
0	100.75
1	99.75
2	98.75
3	97.75
4	96.75
5	95.75



SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Prop. Rural Subdivision - 1240 Old Prescott Road
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG6045

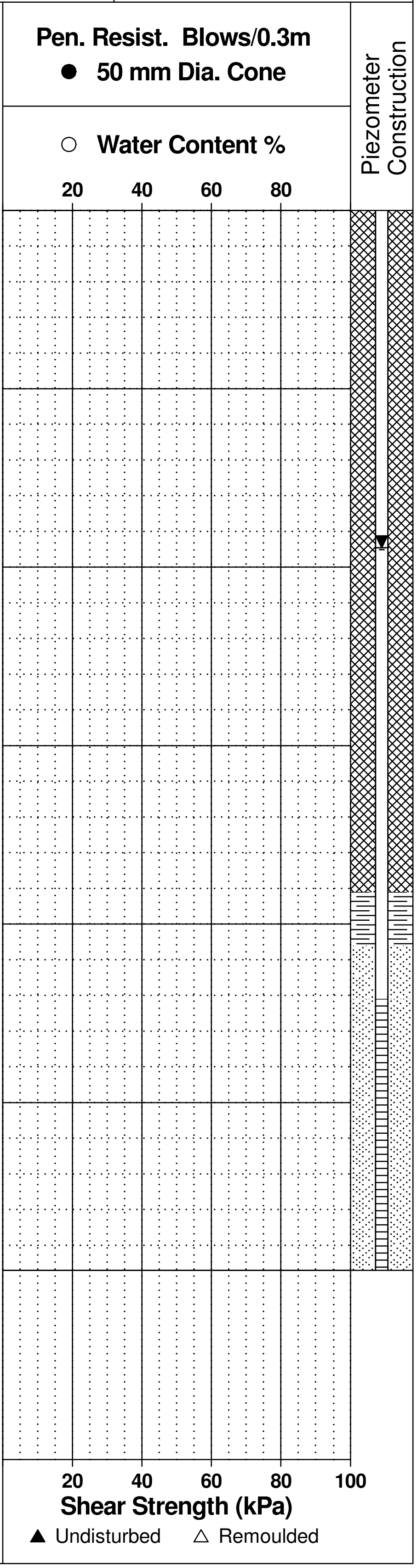
REMARKS

HOLE NO. BH 4-21

BORINGS BY Track-Mount Power Auger

DATE December 8, 2021

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	100.10
FILL: Brown silty sand, trace crushed stone	AU	1				
0.60						
FILL: Crushed stone with gravel						
0.91						
Compact, brown **SILTY SAND**	SS	2	58	16	1	99.10
	SS	3	50	10	2	98.10
- grey and some running sand by 2.3m depth	SS	4	58	19		
3.05					3	97.10
Stiff, grey **SILTY CLAY**	SS	5	100	1		
- silt content increasing with depth	SS	6	25	2	4	96.10
4.42						
Compact, grey **SANDY SILT**	SS	7	50	12	5	95.10
	SS	8	50	15		
5.94						
End of Borehole						
(GWL @ 1.89m - Dec. 14, 2021)						



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 6045 Bank Street
Ottawa, Ontario

DATUM Ground surface elevations provided by ARK Engineering

REMARKS

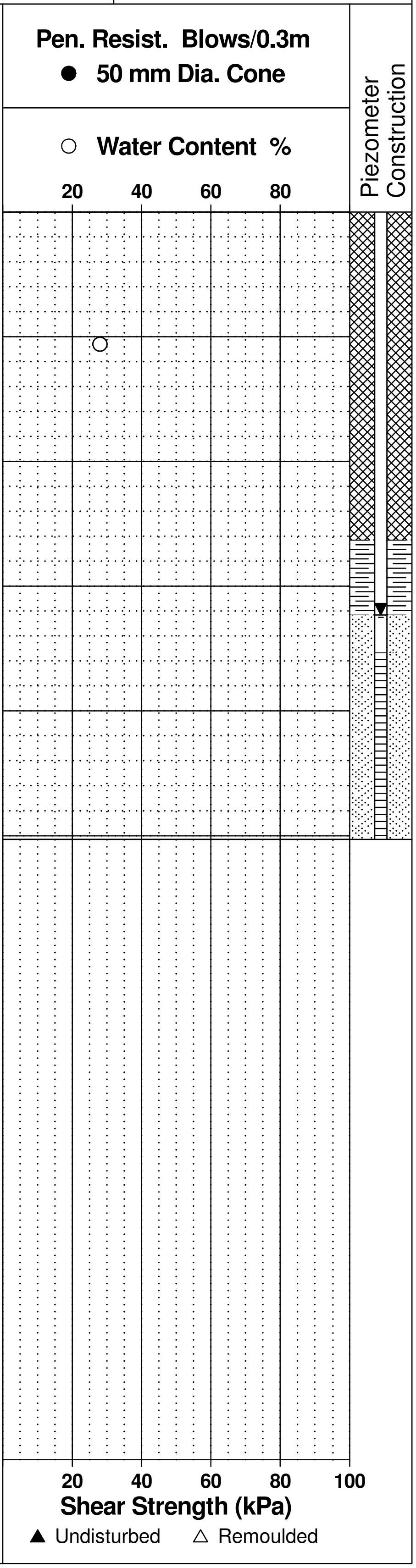
BORINGS BY CME 55 Power Auger

DATE October 12, 2016

FILE NO. PG3957

HOLE NO. BH 3-16

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	91.30
FILL: Silty sand, some gravel — 0.46	AU	1				
Compact, brown **SILTY SAND** with gravel — 0.76						
Stiff, brown **SILTY CLAY,** trace sand and gravel — 1.62	SS	2	58	10	1	90.30
Dense, brown **SILTY SAND,** trace clay — 2.29	SS	3	58	31	2	89.30
Compact to dense, brown **SILTY SAND,** trace cobbles — 3.96	SS	4	62	24		
	SS	5	83	43	3	88.30
Very dense to dense, grey **SILTY SAND,** some gravel, trace cobbles and boulders — 5.03	SS	6	67	50+	4	87.30
	SS	7	62	46	5	86.30
End of Borehole (GWL @ 3.23m-October 26, 2016)						



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

SOIL PROFILE AND TEST DATA

Proposed Residential Development
1240 Old Prescott Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Hand Auger

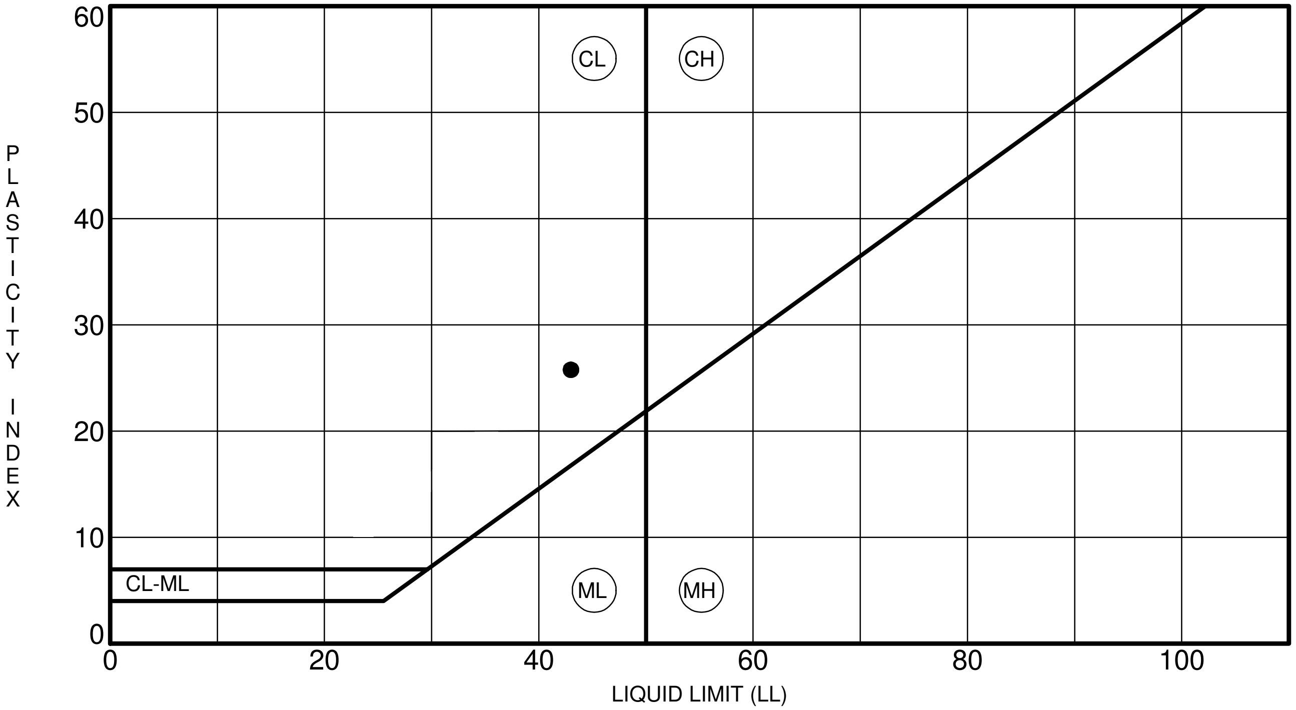
DATE December 16, 2015

FILE NO. PH2095

HOLE NO. TH14

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			
Sandy **TOPSOIL** with roots 0.13									
Dense, brown medium to coarse **SAND** 0.31									
Dense, grey-brown medium to coarse **SAND,** some silt and clay						1			
1.35		G	6						
End of Test Hole Terminated in sand at target depth. (TH dry upon completion)									

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



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 3-16**	**SS 2**	**43**	**17**	**26**		**CL - Inorganic clays of low plasticity**

CLIENT **Greely Family Farm & Maverick Dev.**

PROJECT **Geotechnical Investigation - Prop. Commercial Development - 6045 Bank Street**

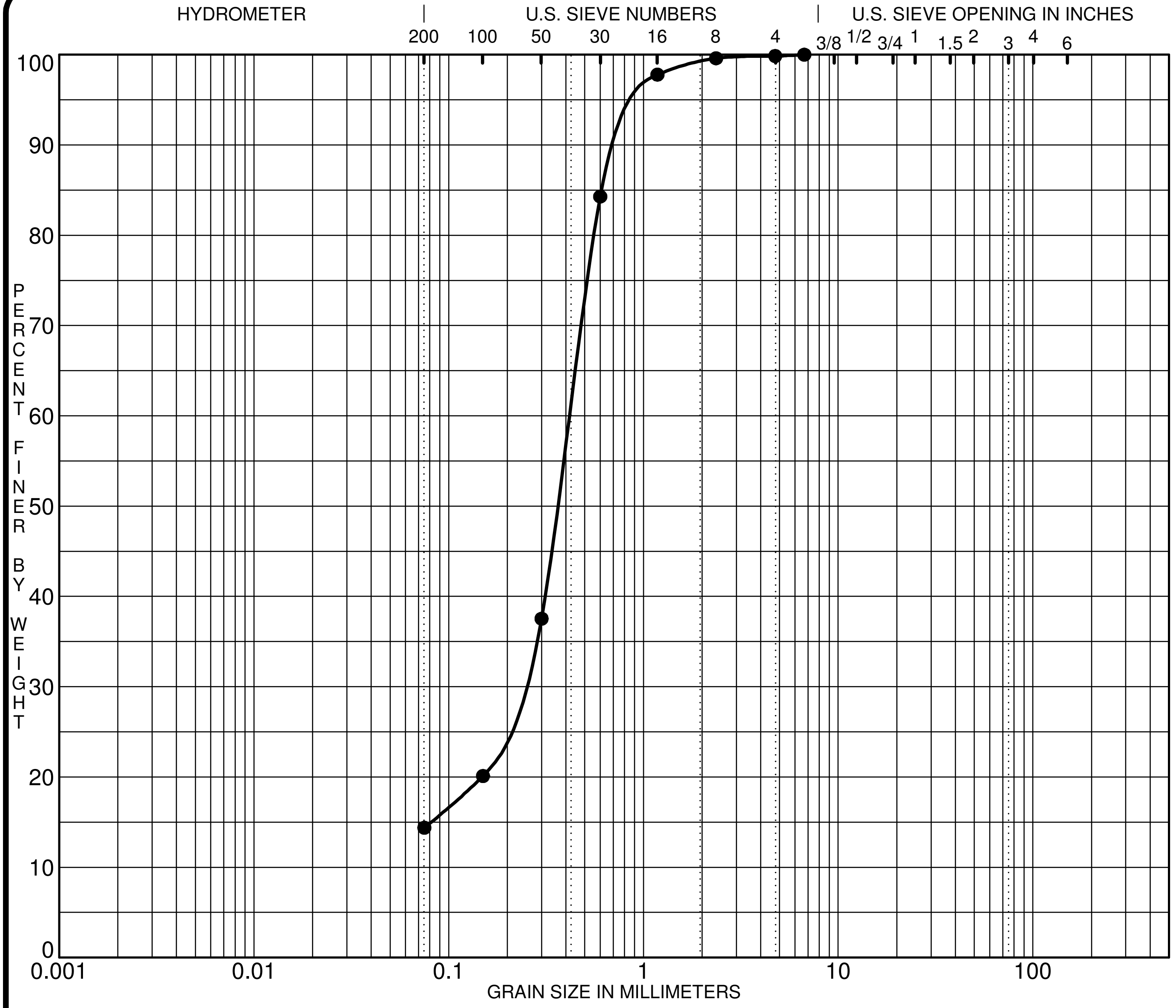
FILE NO. **PG3957**

DATE **13 Mar 17**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**TH14**	**G 6**	**SAND, some silt and clay**						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TH14**	**G 6**	**6.70**	**0.42**	**0.222**		**0.1**	**85.5**	**14.4**	

CLIENT **1384341 Ontario LTD.**

FILE NO. **PH2095**

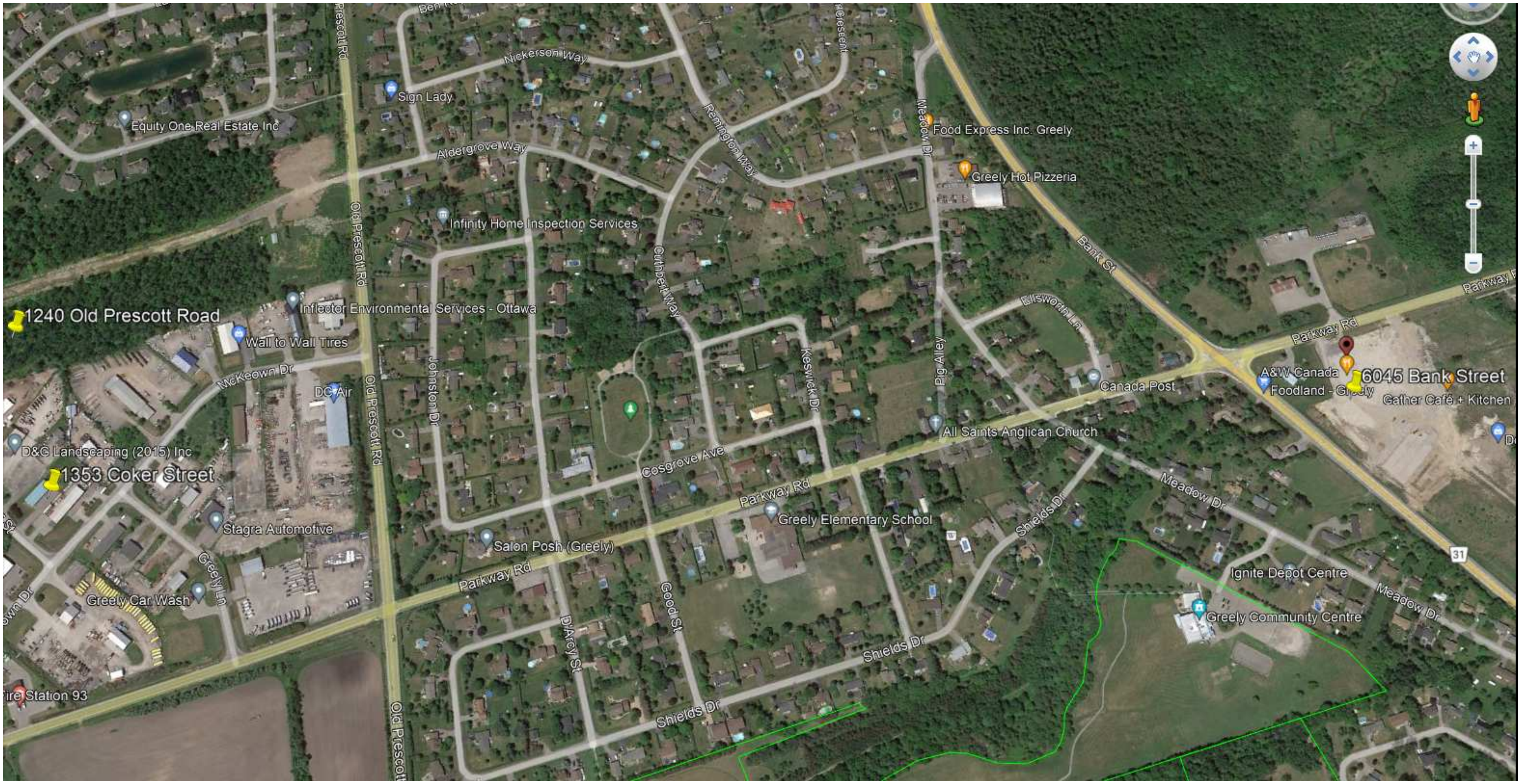
PROJECT **Proposed Residential Development - 1240 Old Prescott Road**

DATE **16 Dec 15**

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION


Ben Ro
Prescott Rd
Nickerson Way
Sign Lady
Equity One Real Estate Inc
Remington Way
Meadow Dr
Food Express Inc. Greely
Greely Hot Pizzeria
Aldergrove Way
Old Prescott Rd
Infinity Home Inspection Services
Bank St
Cuthbert Way
Parkway Rd
1240 Old Prescott Road
Inflector Environmental Services - Ottawa
Wall to Wall Tires
Ellsworth Ln
Pig Alley
Keswick Dr
Parkway Rd
A&W Canada
6045 Bank Street
Foodland - Greely
Gather Café + Kitchen
McKeown Dr
DC Air
Johnston Dr
Old Prescott Rd
Canada Post
All Saints Anglican Church
D&G Landscaping (2015) Inc
1353 Coker Street
Cosgrove Ave
Meadow Dr
Parkway Rd
Greely Elementary School
Stagra Automotive
Salon Posh (Greely)
Shields Dr
Parkway Rd
Greely Ln
Greely Car Wash
Good St
D'Arcy St
Ignite Depot Centre
31
Meadow Dr
Greely Community Centre
Shields Dr
Fire Station 93
Shields Dr
Old Prescott