January 17, 2024
PG5573-LET.03

PATERSON GROUP
Consulting Engineers
9 Auriga Drive
Ottawa, Ontario
K2E 7T9
Tel: (613) 226-7381

Geotechnical Engineering
Environmental Engineering
Hydrogeology
Materials Testing
Building Science
Rural Development Design
Retaining Wall Design
Noise and Vibration Studies

patersongroup.ca

Concorde Properties
408 Tweedsmuir Avenue
Ottawa, Ontario
K1Z 5N5

Attention: **Jordan Tannis**

Subject: **Geotechnical Investigation**
Proposed Residential Development
1291, 1295 and 1305 Summerville Avenue &
1066 Silver Street – Ottawa, Ontario

Dear Jordan,

Paterson Group (Paterson) was commissioned by Concorde Properties to conduct a geotechnical investigation for the proposed apartment building to be located at 1066 Silver Street in the City of Ottawa, Ontario.

It is understood that the proposed development will consist of a four-storey slab-on-grade residential structure throughout 1066 Silver Street, while the remaining buildings along Summerville Avenue have been constructed or are currently under construction. Access lanes and landscaped areas are also anticipated as part of the development. It is anticipated that the proposed development will be municipally serviced.

It is further understood that the existing residential buildings will be demolished as part of the proposed development.

1.0 Field Investigation

The fieldwork for the most recent investigation was conducted on January 13, 2022, and consisted of three test pits excavated to a maximum depth of 4.3 m below the existing ground surface using a rubber-tired backhoe. A previous geotechnical investigation program was completed on February 13, 2021, and consisted of excavating a total of three test pits to a maximum depth of 4.0 m below ground surface. An additional geotechnical investigation program was completed for the neighbouring property on November 17, 2020, and consisted of excavating a total of three test pits to a maximum depth of 3.9 m below ground surface.

All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The test hole procedures consisted of excavating to the required depths at the selected locations and sampling the overburden. In addition to sampling undrained shear strength testing was performed in all cohesive soils, using a field vane apparatus.

The location and ground surface elevation at each test pit was surveyed by Paterson field personnel and are referred to a geodetic datum. The test pit locations along with the ground surface elevation at each test pit location are presented on Drawing PG5573-2 - Test Hole Location Plan attached to the current report.

2.0 Field Observations

One to two storey residential dwellings with associated driveways currently occupy each property parcel along Silver Street. The ground surface across the subject site is relatively flat and slopes gradually downwards from south to north between approximate geodetic elevations 83.6 to 81.9 m. Silver Street was observed to be at grade and approximately 1 m lower than the ground surface around the structures located between 1066 to 1058 Silver Street. The subject site is bordered to the north by a 2.5 storey apartment building, to the west by a four-storey apartment building, to the east by Silver Street and to the south by Summerville Avenue.

Generally, the subsurface profile encountered at the test hole locations consisted of a layer of topsoil underlain by a layer of fill which was further underlain by a deposit of silty clay. The silty clay deposit was observed to consist of a hard to very stiff, weathered, brown silty clay crust. A deposit of glacial till was encountered below the silty clay deposit at TP 1 to TP 3 and TP 2-21, and at a depth of approximately 1.6 to 3.4 m below the ground surface. The glacial till was generally observed to consist of a brown silty clay with sand, gravel, cobbles, and boulders.

Reference should be made to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test pit locations for the current and previous investigations.

Based on available geological mapping, the subject site consists of interbedded dolostone and limestone of the Gull River formation with an anticipated drift thickness between 2 to 3 m.

All test holes were generally observed to be dry upon completion of the sampling program. Based on the moisture levels and colouring of the recovered soil samples, and our experience with the local area, the long-term groundwater table is expected to be at or below the bedrock surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

Laboratory Testing

Atterberg limits testing, as well as associated moisture content testing, were completed on the recovered silty clay samples where encountered. The results of the Atterberg limits test are presented in Table 1. The tested silty clay samples classify as inorganic clays of low plasticity (CL) and inorganic clays of high plasticity (CH) in accordance with the Unified Soil Classification System.

Table 1 - Atterberg Limits Results

Sample	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)	Classification
TP 1-22 G4	2.13	76	38	38	37.5	CL
TP 3-22 G5	2.90	77	38	39	37.7	CL

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; w: Water Content
CL: Inorganic Clay of Low Plasticity, CH: Inorganic Clay of High Plasticity

3.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed apartment building. It is anticipated that the proposed building will be founded upon conventional shallow foundations bearing upon an undisturbed, very stiff silty clay or glacial till bearing surface. Depending on the required depth for site services, bedrock could be encountered within the service trenches. Based on that, all contractors should be prepared for bedrock removal.

Due to the presence of a silty clay deposit underlying the subject site, a permissible grade raise restriction will be required for settlement sensitive structures founded within the silty clay deposit.

Stripping Depth

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

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

Bedrock Removal

Where a small quantity of bedrock removal is required, it can be accomplished by a combination of hoe ramming and conventional excavation techniques. Larger volumes of competent bedrock removal would require the use of line-drilling and blasting.

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

Vibration Considerations

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

The following construction equipment could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to 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). The guidelines are for current construction standards.

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

Fill Placement

Fill placed for grading beneath the structure or other settlement sensitive 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. This material should be tested and approved prior to delivery to the site. The engineered fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's standard Proctor maximum dry density (SPMDD).

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

If the non-specified backfill is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Foundation Design

Pad footings, up to 5 m wide, and strip footings, up to 3 m wide, placed on an undisturbed, very stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance value at ULS.

Footings placed on an undisturbed, compact glacial till bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

Non-specified fill encountered at the founding depth of the structure should be removed to expose the underlying native, undisturbed in-situ subgrade soil. The area should be reinstated to the design underside of footing elevation with crushed stone fill such as OPSS Granular A or OPSS Granular B Type II compacted to a minimum SPMDD of 98%.

Fill placed for these areas should be placed in maximum 300 mm thick loose lifts and each lift verified to have attained acceptable levels of compaction at the time of construction by Paterson personnel. Footings placed on an engineered fill pad prepared using the above-noted methodology can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**.

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

Settlement

Footings placed on a soil bearing surface and designed using the bearing resistance values at SLS given for the soil bearing surface 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 a very stiff silty clay or compact glacial till above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Restriction

Based on the current test hole information, a permissible grade raise restriction of **3 m** may be considered for the proposed residential building and settlement sensitive structures founded over a silty clay deposit. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risk of unacceptable long-term post construction total and differential settlements.

Design for Earthquakes

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

Seismic Conditions

The seismic earth pressure (ΔP_{AE}) can be calculated using the earth pressure distribution equal to $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c	=	$(1.45 - a_{max}/g)a_{max}$
γ	=	unit weight of fill of the applicable retained soil (kN/m^3)
H	=	height of the wall (m)
g	=	gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions could be calculated using

$P_o = 0.5\ K_o \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of the pavement structure for the car only parking areas and access lanes.

Table 1 - Recommended Flexible Pavement Structure – Driveways/Car Only Parking Areas	
Thickness (mm)	**Material Description**
50	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil.	

Table 2 - Recommended Flexible Pavement Structure - Access Lanes and Heavy Truck Parking Areas	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**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.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be sub-excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the SPMDD.

Pavement Structure Drainage

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

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

4.0 Design and Construction Precautions

Foundation Drainage and Backfill

Since the building will consist of a slab-on-grade, a perimeter foundation drainage system is considered optional throughout the landscaped portions of the proposed building footprint. In areas where hard-scaping or pavement structures will abut the building footprint, it is recommended to implement a foundation drainage system. The system should consist of a 100 or 150 mm diameter perforated corrugated plastic pipe wrapped in a geosock and surrounded by 150 mm of 10 or 19 mm clear crushed stone. The clear stone should be wrapped in a non-woven geotextile. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Alternatively, the perimeter drainage pipe throughout hardscaped areas may be placed up to 600 mm below proposed finished grade and against the building footprint upon site-generated compacted soil backfill to ensure adequate drainage of the overlying granular fill layer is provided from precipitation events and/or spring meltwater. In this configuration, provided the backfill overlying the pipe consists of crushed stone fill associated with a pavement structure, a composite foundation drainage board will not be required. The installation of the perimeter drainage system should be reviewed by Paterson personnel at the time of construction.

Backfill against the exterior sides of the foundation walls should consist of free draining, non-frost susceptible granular materials. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a composite drainage blanket, such as Miradrain G100N or Delta Drain 6000.

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 of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation (and as advised by Paterson), should be provided.

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

Excavation Side Slopes

The temporary excavation side slopes should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled.

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soil 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 maintain safe working distance from the excavation sides. Slopes in excess of 3 m in height should be periodically inspected by Paterson personnel in order to detect if the slopes are exhibiting signs of distress.

Excavation side slopes carried out for the building footprint are recommended to be provided surface protection from erosion due to rain and surface water runoff if shoring is not anticipated to be implemented. This can be accomplished by covering the entire surface of the excavation side-slopes with tarps secured between the top and bottom of the excavation and approved by Paterson personnel at the time of construction. It is further recommended to maintain a relatively dry surface along the bottom of the excavation footprint to mitigate the potential for sloughing of the side-slopes.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not be remain exposed for extended periods of time.

Pipe Bedding and Backfill

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

A minimum of a 150 mm layer of OPSS Granular A crushed stone should be placed for pipe bedding for sewer and water pipes for a soil subgrade. The bedding thickness should be increased to 300 mm for areas where the subgrade consists of bedrock, if encountered.

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

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

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD. Within the frost zone (1.8 m below finished grade), non-frost susceptible materials should be used when backfilling trenches below the original bedrock level.

To reduce long-term lowering of the groundwater level at the subject site, clay seals should be provided in the servicing trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of a relatively dry brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries within each service lateral trench.

Groundwater Control for Building Construction

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

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

Winter Construction

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 installation of straw, propane heaters and tarpaulins or other suitable means.

The excavation base 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 difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

Corrosion Potential and Sulphate

One (1) sample was submitted for testing. The analytical test results of the soil sample indicate that the sulphate content is less than 0.01%. These results along with the chloride and pH value are indicative that Type 10 Portland cement (Type GU) would be appropriate for this site. The chloride content and the pH of the sample indicate they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a low to slightly aggressive corrosive environment.

Tree Planting Restrictions

Paterson completed a soils review of the site to determine the applicable tree planting setbacks, in accordance with the City of Ottawa’s Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines). Atterberg limits testing was completed for recovered silty clay samples, where silty clay was encountered at the site. The above-noted test results were completed on samples taken at depths between the anticipated underside of footing elevation and a 3.5 m depth below anticipated finished grade. The results of our testing are attached at the end of this memorandum.

Based on the results of our review, the plasticity index was found to be less than 40%. In addition, the silty clay encountered throughout the subject site consists of a clay of low to medium potential for volume change as per the City of Ottawa’s *Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines)*. The following tree planting setbacks are recommended for the low to medium sensitivity silty clay deposit, where silty clay was encountered. It should be noted that footings bearing upon a compact glacial till deposit will not be subject to tree planting setback restrictions.

Large trees (mature height over 14 m) can be planted within the silty clay areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g., in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature height up to 7.5 m) and medium size trees (mature tree height 7.5 to 14 m), provided that the conditions noted below are met.

❒ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

- ❐ A small tree must be provided with a minimum 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❐ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ❐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree).

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

5.0 Recommendations

A material testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by Paterson:

- ❐ Review detailed grading plan(s), architectural and structural drawings from a geotechnical perspective to ensure adequate frost protection is provided to the subsoil and the buildings foundation drainage system.

- ❐ Observation of all bearing surfaces prior to the placement of concrete.

- ❐ Sampling and testing of the concrete and fill materials used.

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

- ❐ Observation of all subgrades prior to backfilling.

- ❐ Field density tests to determine the level of compaction achieved.

- ❐ Sampling and testing of the bituminous concrete including mix design reviews

A report confirming that the construction work has been conducted in general accordance with the above recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by Paterson.

6.0 Statement of Limitations

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

A geotechnical investigation is a limited sampling of a site. Should any conditions encountered during construction differ from the test pit locations, Paterson requests immediate notification to permit reassessment of the recommendations provided herein.

The recommendations provided should only be used by the design professionals associated with this project. The recommendations are not intended for contractors bidding on or constructing the project. The latter should evaluate the factual information provided in the report. The contractor should also determine the suitability and completeness for the intended construction schedule and methods. Additional testing may be required for the contractor's purpose.

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 Concorde Properties or their agent(s) is not authorized without review by Paterson for the applicability of our recommendations to the altered use of the report.

We trust this report meets your present requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
January 17, 2024
D. J. PETAHTEGOOSE
100568013
PROVINCE OF ONTARIO

Killian Bell, B.Eng.

Drew Petahtegoose, P.Eng.

Attachments

- ❑ Soil Profile and Test Data Sheets
- ❑ Symbols and Terms
- ❑ Figure 1 - Key Plan
- ❑ Drawing PG5573-2 - Test Hole Location Plan

Report Distribution

- ❑ Concorde Properties (e-mail copy)
- ❑ Paterson Group (Digital copy)

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Prop. Residential Building - 1058 to 1066 Silver Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

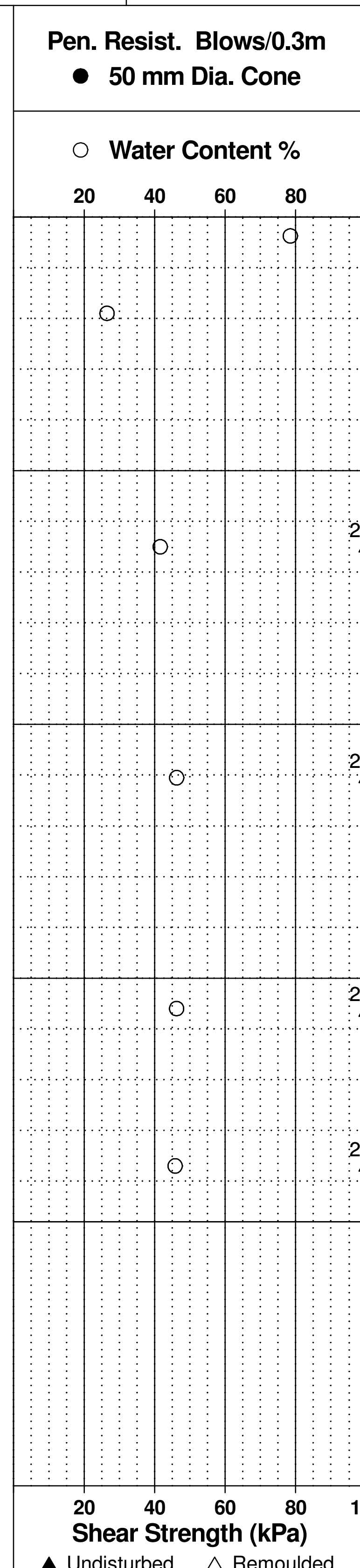
BORINGS BY Excavator

DATE January 13, 2022

FILE NO. PG6115

HOLE NO. TP 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.89
TOPSOIL (to 0.18)		G	1				
FILL: Brown silty sand with organics and roots, trace clay, gravel and cobbles (0.18 to 1.22)		G	2			1	80.89
Hard, brown **SILTY CLAY** (1.22 to 3.96)		G	3			2	79.89
		G	4			3	78.89
		G	5				
		G	6				
End of Test Pit (3.96)							
(TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Prop. Residential Building - 1058 to 1066 Silver Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

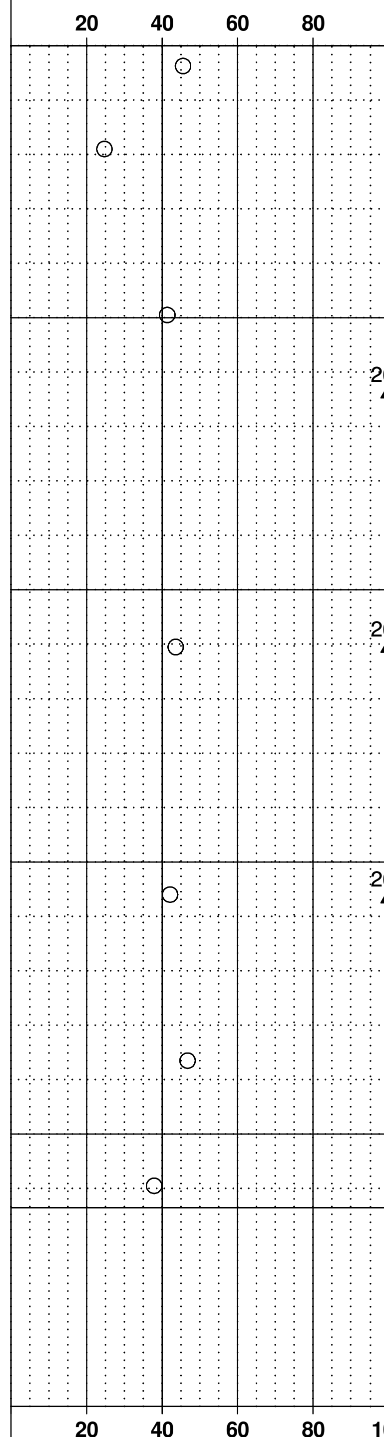
DATE January 13, 2022

FILE NO. PG6115

HOLE NO. TP 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	82.86
TOPSOIL (to 0.30)		G	1				
FILL: Brown silty sand with gravel, organics, trace clay and cobbles (0.30 to 0.91)		G	2				
Hard, brown **SILTY CLAY** (0.91 to 4.27)		G	3			1	81.86
						2	80.86
		G	4				
		G	5			3	79.86
- some sand by 3.7m depth		G	6				
						4	78.86
		G	7				
End of Test Pit (4.27)							
(TP dry upon completion)							

Pen. Resist. Blows/0.3m	Piezometer Construction
● 50 mm Dia. Cone	
○ Water Content %	



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Prop. Residential Building - 1058 to 1066 Silver Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

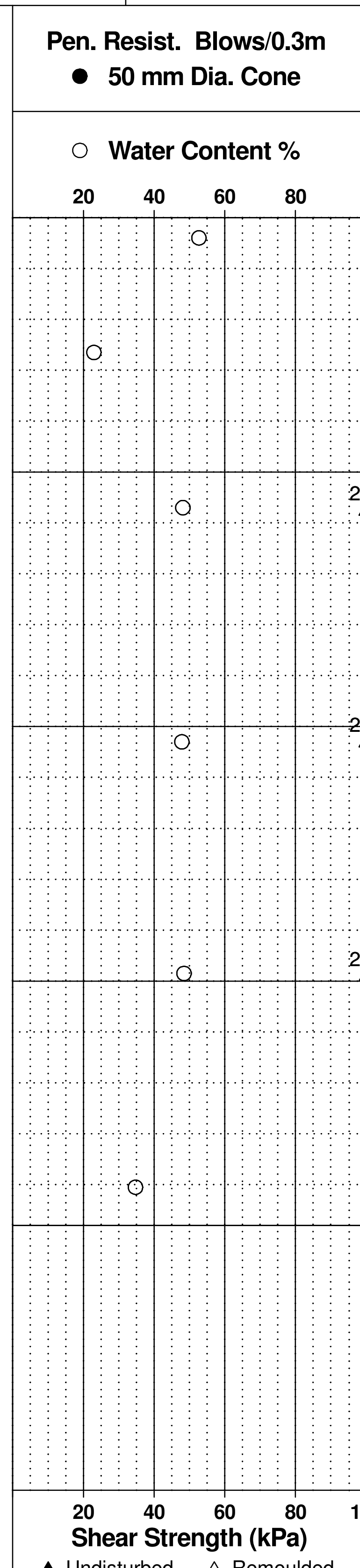
BORINGS BY Excavator

DATE January 13, 2022

FILE NO. PG6115

HOLE NO. TP 3-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	83.32
TOPSOIL		G	1				
0.30							
FILL: Brown silty sand, some clay, trace gravel and organics		G	2				
0.91						1	82.32
Hard, brown **SILTY CLAY**		G	3				
		G	4			2	81.32
		G	5			3	80.32
- some sand by 3.7m depth		G	6				
3.96							
End of Test Pit							
(TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building
1062 and 1066 Silver Street - Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5573

REMARKS

HOLE NO. TP 1-21

BORINGS BY Backhoe

DATE 2021 February 23

SOIL DESCRIPTION	Depth to base of layer (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.30	G	1		
FILL: Reddish brown silty sand trace topsoil, organics, clay, crushed stone, gravel and cobbles	0.91	G	2		
Hard to very stiff brown **SILTY CLAY** - Some sand by 3.3 m depth	3.96	G	3		
		G	4		
		G	5		
		G	6		
End of Test Pit (TP dry upon completion)					

DEPTH (m)	ELEV. (m)
0	83.64
1	82.64
2	81.64
3	80.64

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

○ Water Content %

Shear strength (undisturbed): 260 kPa at approximately 1.4 m depth

Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building
1062 and 1066 Silver Street - Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE 2021 February 23

FILE NO. PG5573

HOLE NO. TP 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	83.35		
TOPSOIL (to 0.30)		G	1						
FILL: Brown silty sand trace topsoil, organics, clay, crushed stone and gravel (0.30 – 0.76)		G	2						
Hard to very stiff brown **SILTY CLAY** (0.76 – 3.35)		G	3			1	82.35	▲ 205	
		G	4			2	81.35	▲ 240	
		G	5			3	80.35		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders (3.35 – 3.96)		G	6						
End of Test Pit (3.96)									
(TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building
1062 and 1066 Silver Street - Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE 2021 February 23

FILE NO. PG5573

HOLE NO. TP 3-21

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Well graded gravel	0.05				
FILL: Brown silty sand trace topsoil, clay, brick fragments, gravel and crushed stone	0.15	G	1		
		G	2		
FILL: Brown silty clay with sand, trace topsoil, brick fragments, gravel and crushed stone	0.76				
FILL: Brown silty sand trace organics, clay, gravel and crushed stone	0.91	G	3		
Hard to very stiff brown **SILTY CLAY**	2.13	G	4		

DEPTH (m)	ELEV. (m)
0	83.31
1	82.31
2	81.31

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

○ Water Content %

20 40 60 80

Shear strength value plotted: 260 (approx. 1.35 m depth)

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

End of Test Pit

Test Pit terminated due to mechanical failure

(TP dry upon completion)

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Building - 1291 Summerville Ave.
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5573

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe

DATE November 17, 2020

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.17	G	1		
FILL: Brown silty sand, some gravel, trace organics	0.76	G	2		
FILL: Brown silty clay, some sand, trace gravel	1.72	G	3		
Compact, brown **SILTY SAND,** some cobbles and boulders	1.81	G	4		
Very stiff, dark brown **SILTY CLAY**	2.82	G	5		
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders	3.85	G	6		
		G	7		

End of Test Pit

Practical refusal to excavation at 3.85m depth.

(TP dry upon completion)

DEPTH (m)	ELEV. (m)
0	84.50
1	83.50
2	82.50
3	81.50

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

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Building - 1291 Summerville Ave.
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE November 17, 2020

FILE NO. PG5573

HOLE NO. TP 2

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.22	G	1		
FILL: Brown silty sand, some gravel, cobbles, boulders	0.34	G	2		
FILL: Brown silty clay with sand, trace gravel	0.93	G	3		
Dense, brown **SILTY SAND,** trace clay and gravel	1.14	G	4		
Very stiff, brown **SILTY CLAY**	3.39	G	5		
		G	6		
GLACIAL TILL: Compact, brown silty clay with sand, gravel, cobbles and boulders	3.74	G	7		

End of Test Pit

Practical refusal to excavation at 3.74m depth.

(TP dry upon completion)

DEPTH (m)	ELEV. (m)
0	85.41
1	84.41
2	83.41
3	82.41

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Building - 1291 Summerville Ave.
Ottawa, Ontario

DATUM Geodetic

FILE NO. **PG5573**

REMARKS

HOLE NO. **TP 3**

BORINGS BY Backhoe

DATE November 17, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	85.86
TOPSOIL (to 0.27)		G	1				
FILL: Brown silty sand, some clay, gravel, cobbles and boulders (0.27 – 0.74)		G	2				
Dense, brown **SILTY SAND,** some gravel, trace clay and boulders (0.74 – 1.64)		G	3			1	84.86
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders (1.64 – 2.23)		G	4			2	83.86

End of Test Pit

Practical refusal to excavation at 2.23m depth.

(TP dry upon completion)

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

○ Water Content %

20 40 60 80

Piezometer Construction

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

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

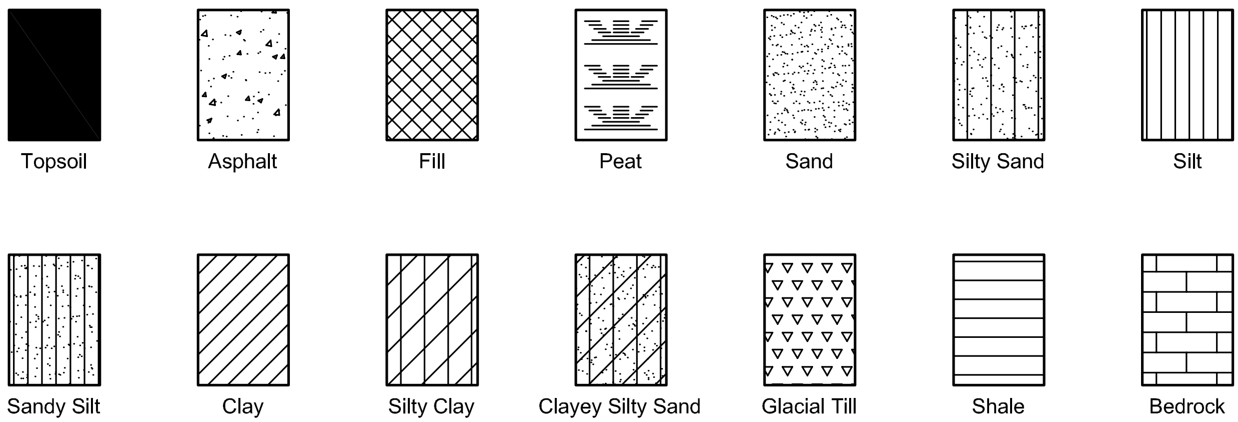
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

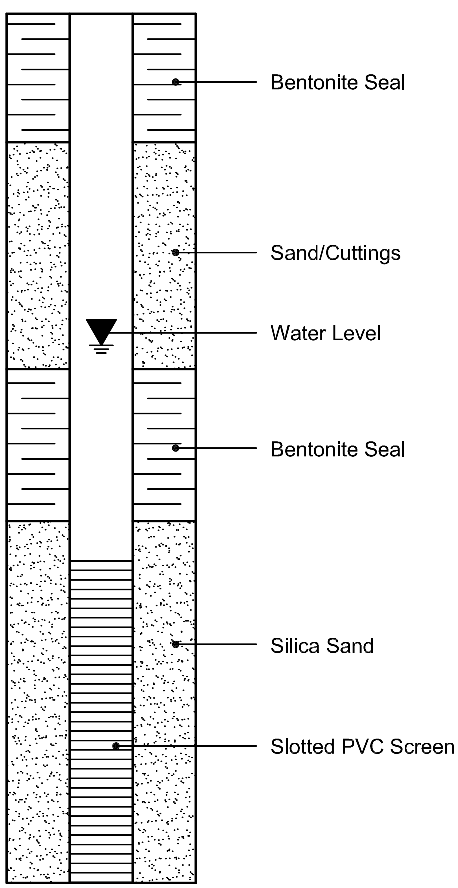
SYMBOLS AND TERMS (continued)

STRATA PLOT

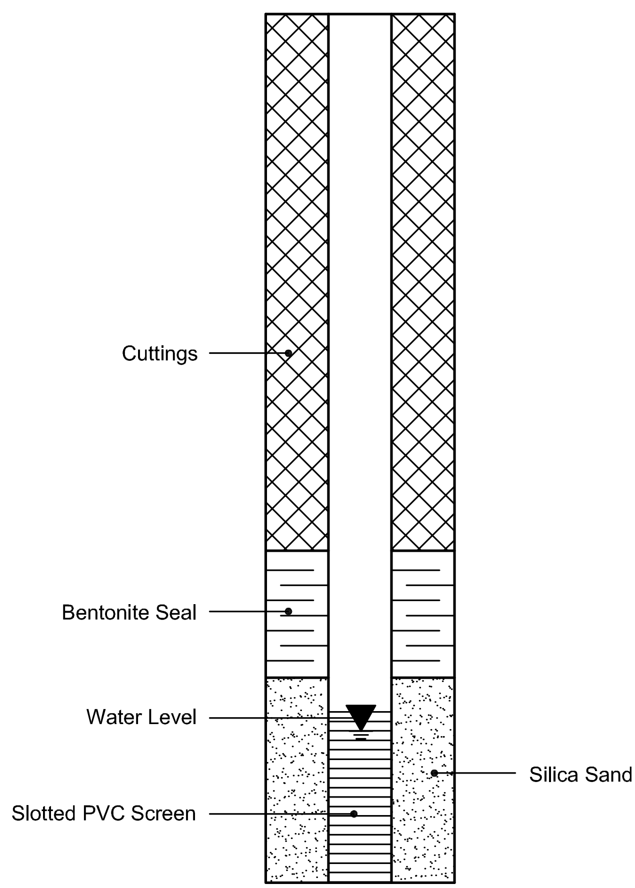


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

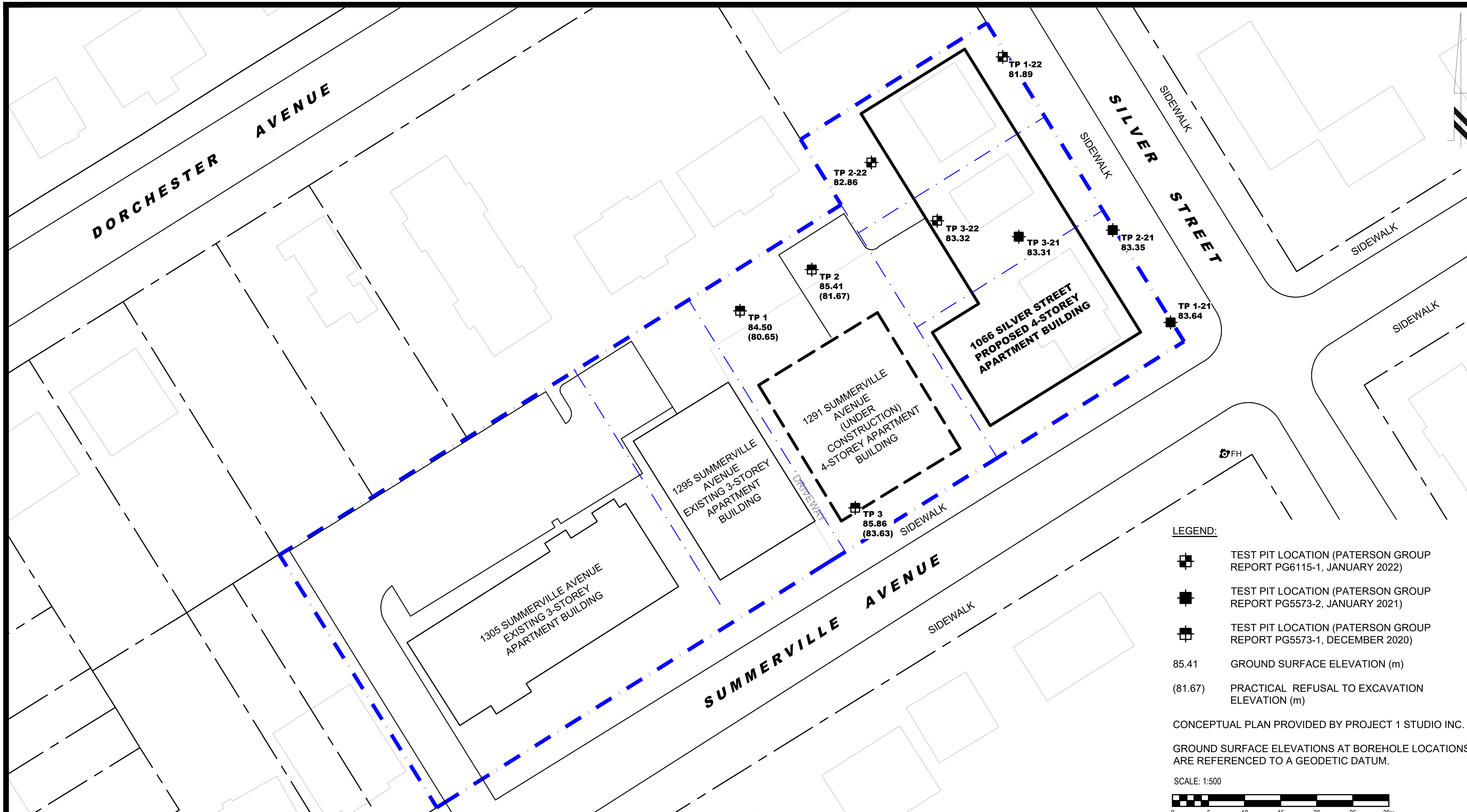
Client PO:

Report Date: 01-Mar-2021

Order Date: 24-Feb-2021

Project Description: PG5573

	Client ID:	TP2-21-G7	-	-	-
	Sample Date:	23-Feb-21 09:00	-	-	-
	Sample ID:	2109339-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	71.4	-	-	-
General Inorganics					
pH	0.05 pH Units	6.46	-	-	-
Resistivity	0.10 Ohm.m	53.5	-	-	-
Anions					
Chloride	5 ug/g dry	49	-	-	-
Sulphate	5 ug/g dry	57	-	-	-



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

NO.	REVISIONS	DATE	INITIAL

CONCORDE PROPERTIES
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
OTTAWA, 1291, 1295 AND 1305 SUMMRVILLE AVENUE & 1066 SILVER STREET ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 01/2024
Drawn by: YA	Report No.: PG5573-LET.03
Checked by: DP	Dwg. No.: PG5573-2
Approved by: DJG	Revision No.:

11x17

p:\autocad drawings\geotechnical\pg55xx\pg5573\pg5573-2-test hole location plan.dwg