

Geotechnical Investigation

Proposed Development

304 & 308 Donald Street
Ottawa, Ontario

Prepared for Upscale Homes

Report PG7089-1 dated May 8, 2024

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Upscale Homes to conduct a geotechnical investigation for the proposed development to be located at 304 & 308 Donald Street in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical investigation were to:

- ❑ Determine the subsoil and groundwater conditions at this site by means of test pits, and to;
- ❑ Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect the design.

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

2.0 Proposed Development

Based on the available site plan, it is understood that the proposed development will consist of a multi-storey building with one basement level, covering an approximate footprint of 350 m².

The proposed building will be surrounded by asphalt paved access lanes and parking areas with landscaped margins. It is further anticipated that the proposed building will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The geotechnical investigation was carried out on April 26, 2024 and consisted of a total of 2 test pits advanced to a maximum depth of 3.1 m below the existing grade. The test pit locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground services and available access. The approximate locations of the test pits are shown on Drawing PG7081-1 - Test Hole Location Plan included in Appendix 2.

The test pits were completed using a backhoe, with the full-time supervision of Paterson personnel under the direction of a senior engineer. The test pit procedure consisted of excavating to the required depths at the selected locations and sampling the overburden. The test pits were backfilled with the excavated soil upon completion.

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

Sampling and In Situ Testing

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

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

Groundwater

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

3.2 Field Survey

The test pit locations, and ground surface elevation at each test pit location, were surveyed by Paterson. The test pit locations are referenced to a geodetic datum and were surveyed in the field by Paterson personnel. The test pit locations, and ground surface elevation at the test pit locations, are presented on Drawing PG7089-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Review

Soil samples recovered from the subject site were visually examined in our laboratory to review the field logs. All samples will be stored in the laboratory for a period of one month after the issuance of this report. They will then be discarded unless we are otherwise directed.

3.4 Analytical testing

One (1) soil sample was submitted for analytical testing to assess the potential for exposed ferrous metals and the sulphate potential against subsurface concrete structures. The results are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site consists of 2 contiguous properties: 304 and 308 Donald Street, each of which is currently occupied by a residential structure. The site is bordered by Donald Street to the north, Edith Avenue to the west, and residential properties to east and south. The ground surface across the site is relatively level at approximate geodetic elevation 60 m.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test pit locations consists of a 0.2 to 0.45 m thick topsoil layer, underlain by an approximate 0.35 to 1.5 m thick layer of fill material. The fill was generally observed to consist of brown sand with varying amounts of silt, gravel, clay, brick, concrete, cobbles, and boulders. However, in test pit TP 1-24, the fill was underlain by a 0.3 m thick layer of peat and organic topsoil.

A glacial till deposit was observed underlying the fill and/or topsoil at depths of about 1.1 to 1.7 m below the existing ground surface, consisting of a hard to very stiff, dark grey clayey silt with varying amounts of gravel, sand, cobbles, boulders and some shale fragments.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of shale of the Billings formation with an overburden drift thickness estimated to be between 3 to 5 m depth. Reference should be made to the Soil Profile and Test Data Sheets in Appendix 1 for details of the soil profile encountered at each test pit location.

4.3 Groundwater

Moderate groundwater infiltration was observed within test pit TP 1-24 below an approximate depth of 0.7 m, while no groundwater infiltration was observed within test pit TP 2-24.

However, groundwater levels are subject to seasonal fluctuations and therefore may vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is recommended that the proposed building be founded on conventional spread footings bearing on the undisturbed glacial till.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil, debris and deleterious fill, such as those containing organic materials, should be stripped from under the proposed building, paved areas, pipe bedding, and other settlement sensitive structures.

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

Fill Placement

Fill used for grading beneath the building footprint, unless otherwise specified, should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Imported fill should be tested and approved prior to delivery to the site.

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 98% of the material's SPMDD.

5.3 Foundation Design

Footings placed directly on a bearing surface consisting of undisturbed glacial till can be designed using a bearing resistance value at SLS of **200 kPa** and a factored bearing resistance value at ULS of **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

An undisturbed soil bearing surface consists of a surface from which all topsoil, debris 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.

Footings placed designed using the bearing resistance values at SLS given above 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 soil bearing medium when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through soil of the same or higher capacity as that of the bearing medium.

5.4 Design for Earthquakes

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

5.5 Basement Floor Slab

With the removal of all topsoil, debris and deleterious fill within the footprint of the proposed building, the glacial till will be considered an acceptable subgrade upon which to commence backfilling for basement slab construction.

Where the existing fill is encountered at the basement slab subgrade, provisions should be made to proof-roll the soil subgrade using heavy vibratory compaction equipment prior to placing any fill. Any soft areas should be removed and backfilled with appropriate backfill material.

It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone. It is further recommended that an underslab drainage system, consisting of lines of perforated drainage pipe sub-drains connected to a positive outlet, should be provided under the basement floor slab. This is discussed further in Section 6.1.

5.6 Basement wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structures. However, the conditions should be designed by assuming the retaining soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m³.

The total earth pressure (P_{AE}) includes both the static earth pressure component (P_o) and the seismic component (ΔP_{AE}).

Lateral Earth Pressures

The static horizontal earth pressure (P_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil (0.5)

γ = unit weight of fill of the applicable retained soil (kN/m³)

H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

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

$a_c = (1.45 - a_{max}/g)a_{max}$

γ = unit weight of fill of the applicable retained soil (kN/m³)

H = height of the wall (m)

g = gravity, 9.81 m/s²

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

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5 K_o \gamma H^2$, where $K_o = 0.5$ for the soil conditions noted 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.

5.7 Pavement Structure

For design purposes, the pavement structures presented in the following tables should be used for the design of access lanes, heavy truck parking areas, car only parking and driveways, which are anticipated throughout the subject site. The proposed pavement structures are shown in Tables 1 and 2 below.

Table 1 – Recommended 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
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.	

Table 2 – Recommended Pavement Structure – Car Only Parking Areas and Driveways	
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.	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

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

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material's SPMDD using suitable compaction equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended to be provided for the portion of the proposed building which will have a basement level. The system should consist of a 100 mm or 150 mm diameter perforated and corrugated plastic pipe, surrounded on all-sides by 150 mm of 19 mm clear crushed stone, which is placed at the footing level around the exterior perimeter of the portion of the structure which has a basement level. The pipe should have a positive outlet, such as a gravity connection to the storm sewer, or sump pit provided below the basement level of the structure.

Underslab Drainage

Underslab drainage will be required to control water infiltration below the lowest level floor slab. For preliminary design purposes, we recommend that 100 mm or 150 mm diameter perforated pipes be placed at approximate 6 m centres below the basement floor slab. The spacing of the underslab drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free draining non frost susceptible granular materials.

The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite board, such as Delta Drain 6000, which is installed over the exterior foundation walls and connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type II granular material, should otherwise be used for this purpose.

6.2 Protection of Footings Against Frost Action

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

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

6.3 Excavation Side Slopes

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

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

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

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

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

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

6.4 Pipe Bedding and Backfill

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

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM

PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be controllable using open sumps. 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.

Groundwater Control for Building Construction

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

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

Impacts to Neighbouring Properties

The subsurface conditions at, and in the vicinity of, the subject site consist of a glacial till deposit, which is generally not susceptible to settlement from dewatering. Therefore, effects to neighbouring structures are not anticipated due to dewatering as part of the proposed excavation and foundation construction at the subject site.

6.6 Winter Construction

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

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

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

6.7 Corrosion Potential and Sulphate

One (1) sample was submitted for testing. The analytical test results of the soil sample indicate that the sulphate content is less than 0.1%. 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 moderate to non-aggressive environment.

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 slope in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

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

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

8.0 Statement of Limitations

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

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

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Upscale Homes 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.



Deepak k Rajendran, E.I.T.



Scott S. Dennis, P.Eng

Report Distribution:

- Upscale Homes (e-mail copy)
- Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

9 Auriga Drive, Ottawa, Ontario K2E 7T9

Geotechnical Investigation
 Prop. Residential Dev. - 304 & 308 Donald Street
 Ottawa, Ontario

EASTING: NORTHING: ELEVATION: 60.243
 DATUM: Geodetic
 REMARKS:
 BORINGS BY: Backhoe DATE: April 26, 2024

FILE NO. **PG7089**
 HOLE NO. **TP 1-24**

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				PIEZOMETER CONSTRUCTION	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
Ground Surface								20	40	60	80		
TOPSOIL and organics						0	60.24						
	0.45												
FILL: Loose brown silty sand some brick, trace gravel		G	1										
	0.80												
Loose TOPSOIL and peat		G	2										
	1.10					1	59.24						
GLACIAL TILL: Hard to very stiff dark grey clayey silt, some sand, gravel with occasional cobble, boulders and some shale fragments		G	3										
		G	4			2	58.24						
		G	5										
	3.00					3	57.24						
End of Test Pit													

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

9 Auriga Drive, Ottawa, Ontario K2E 7T9

Geotechnical Investigation
 Prop. Residential Dev. - 304 & 308 Donald Street
 Ottawa, Ontario

EASTING: NORTHING: ELEVATION: 60.464

DATUM: Geodetic

REMARKS:

BORINGS BY: Backhoe

DATE: April 26, 2024

FILE NO. **PG7089**

HOLE NO. **TP 2-24**

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				PIEZOMETER CONSTRUCTION	
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			○ Water Content %					
Ground Surface								20	40	60	80		
TOPSOIL and organics	[Solid Black]					0	60.46						
FILL: Loose brown silty sand, trace gravel	[Cross-hatch]	G	1										
FILL: Dense brown silty sand with gravel, occasional cobble, boulders and trace clay	[Cross-hatch]	G	2										
FILL: Firm dark brown silty clay with gravel, occasional cobble, boulders	[Cross-hatch]	G	3			1	59.46						
GLACIAL TILL: Hard to very stiff dark grey clayey silt, some sand, gravel with occasional cobble, boulders and some shale fragments	[Upward-pointing triangles]	G	4			2	58.46						
	[Upward-pointing triangles]	G	5										
	[Upward-pointing triangles]	G	6			3	57.46						
End of Test Pit													

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)
D _{xx}	-	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
D ₁₀	-	Grain size at which 10% of the soil is finer (effective grain size)
D ₆₀	-	Grain size at which 60% of the soil is finer
C _c	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
C _u	-	Uniformity coefficient = D_{60} / D_{10}

C_c and C_u are used to assess the grading of sands and gravels:

Well-graded gravels have: $1 < C_c < 3$ and $C_u > 4$

Well-graded sands have: $1 < C_c < 3$ and $C_u > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

C_c and C_u 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
C _{cr}	-	Recompression index (in effect at pressures below p' _c)
C _c	-	Compression index (in effect at pressures above p' _c)
OC Ratio		Overconsolidation ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
W _o	-	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.
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SYMBOLS AND TERMS (continued)

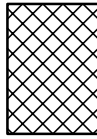
STRATA PLOT



Topsoil



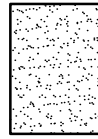
Asphalt



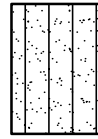
Fill



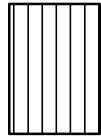
Peat



Sand



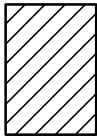
Silty Sand



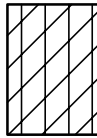
Silt



Sandy Silt



Clay



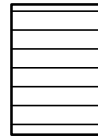
Silty Clay



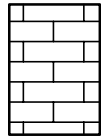
Clayey Silty Sand



Glacial Till



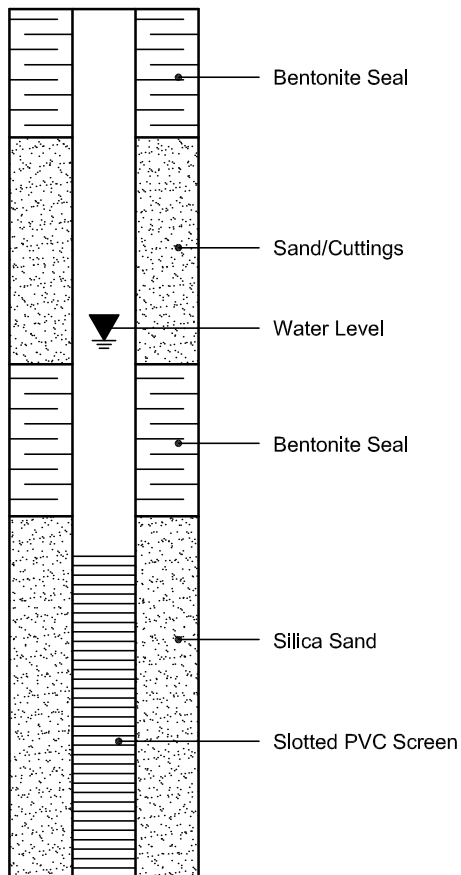
Shale



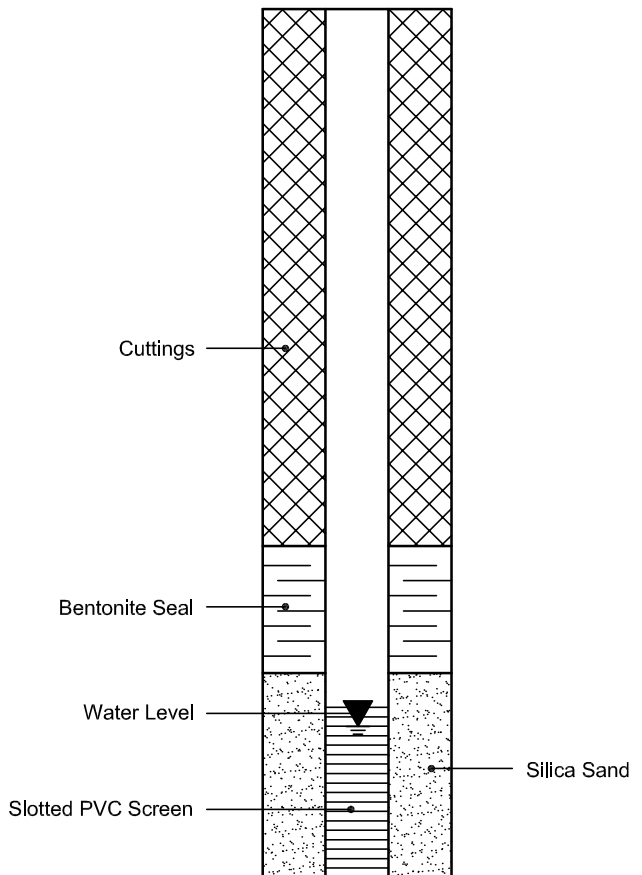
Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 07-May-2024

Client: Paterson Group Consulting Engineers (Ottawa)

Order Date: 1-May-2024

Client PO: 60072

Project Description: PG7089

Client ID:	TP1-24 G3	-	-	-	-
Sample Date:	29-Apr-24 09:00	-	-	-	-
Sample ID:	2418311-01	-	-	-	-
Matrix:	Soil	-	-	-	-
MDL/Units					

Physical Characteristics

% Solids	0.1 % by Wt.	87.9	-	-	-	-
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General Inorganics

pH	0.05 pH Units	7.03	-	-	-	-
Resistivity	0.1 Ohm.m	61.9	-	-	-	-

Anions

Chloride	10 ug/g	<10	-	-	-	-
Sulphate	10 ug/g	54	-	-	-	-

APPENDIX 2

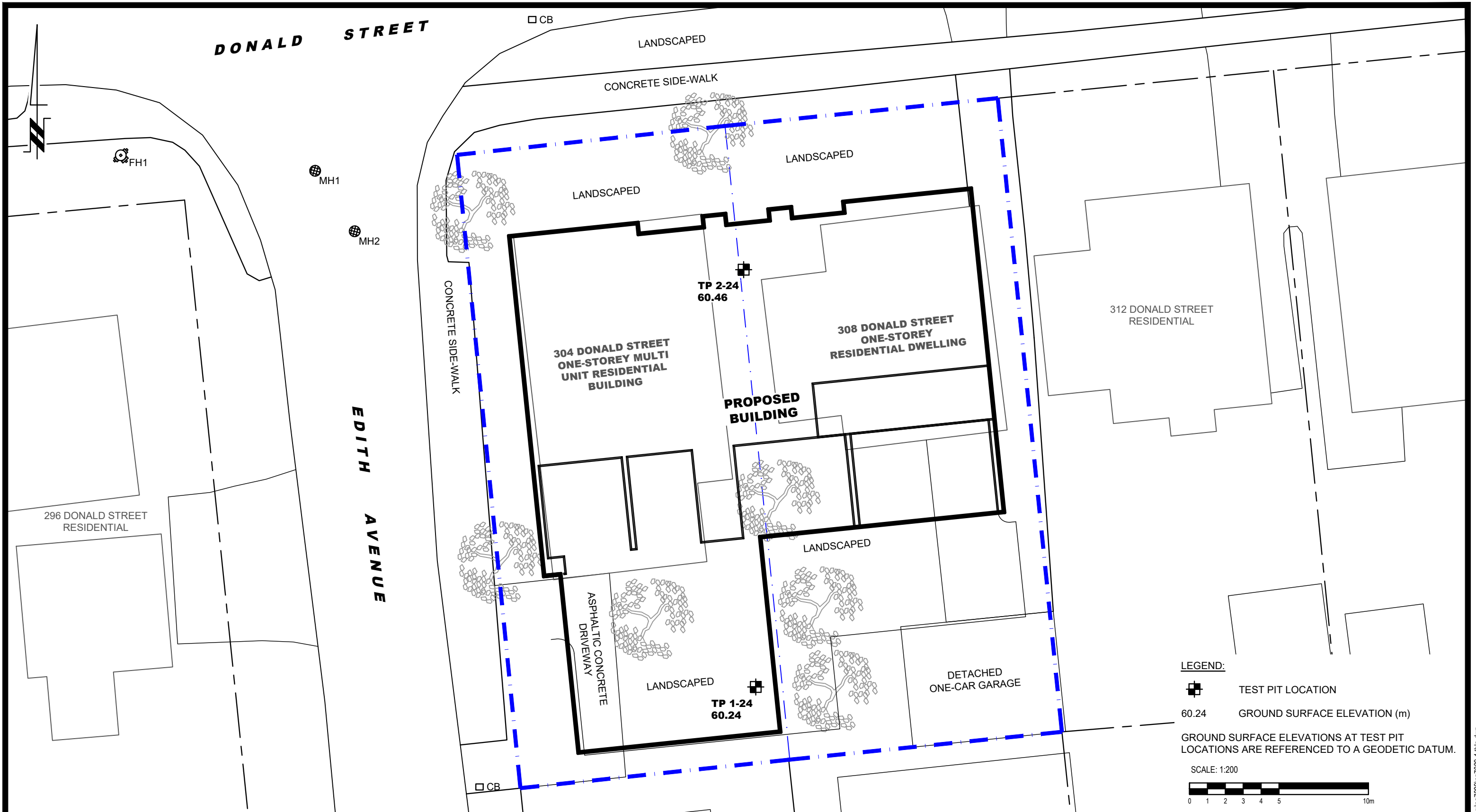
FIGURE 1 - KEY PLAN

DRAWING PG7089-1 - TEST HOLE LOCATION PLAN



FIGURE 1

KEY PLAN



NO.	REVISIONS	DATE	INITIAL

UPSCALE HOMES
GEOTECHNICAL INVESTIGATION
304 & 308 DONALD STREET

OTTAWA, ONTARIO

Title: **TEST HOLE LOCATION PLAN**

Scale:	1:200	Date:	05/2024
Drawn by:	GK	Report No.:	PG7089-1
Checked by:	DR	Dwg. No.:	PG7089-1
Approved by:	SD	Revision No.:	