

March 21, 2017
PG4062-LET.01

Concorde Management and Development
5689 Power Road
Ottawa, ON
K1G 3N4

Attention: **Mr. Jordan Tannis**

Subject: **Geotechnical Investigation
Proposed Low-Rise Residential Building
33 Heney Street - Ottawa**

154 Colonnade Road South
Ottawa, Ontario
K2E 7J5
Tel: (613) 226-7381
Fax: (613) 226-6344

Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
Building Science
Archaeological Services

www.patersongroup.ca

Dear Sir,

Paterson Group (Paterson) was commissioned by Concorde Management and Development to conduct a geotechnical investigation for a proposed low-rise residential building to be located at 33 Heney Street, in the City of Ottawa, Ontario.

The proposed development is understood to consist of a three-storey residential building with one basement level, an access lane and landscaped areas. It is further understood that the existing building is to be demolished as part of the proposed development.

1.0 Field Investigation

The fieldwork for the current investigation was conducted on March 2, 2017, and consisted of excavating three (3) test pits to a maximum 3.3 m depth. The test pits were excavated using a rubber-tired backhoe. The test pits were reviewed in the field by Paterson personnel under the direction of a senior engineer from the geotechnical division. The field procedure consisted of reviewing the excavation, sampling and testing the overburden at selected locations.

The test pits were placed in a manner to provide general coverage of the property taking into consideration existing site features and underground services. The approximate location of the test hole is shown on Drawing PG4062-1 - Test Hole Location Plan attached to the present report.

2.0 Field Observations

The subject site is currently occupied by a 3-storey residential dwelling with an associated driveway and landscaped areas with mature trees. The property is relatively flat and generally at grade with Heney Street. The property is surrounded by residential dwellings to the east, north and west and Heney Street followed by a neighbourhood park to the south.

Generally, the subsurface profile encountered at the test pit locations consisted of a layer of asphalt or topsoil overlying a layer of brown silty sand fill mixed with topsoil, gravel, cobbles and construction debris. The fill layer is underlain by a native brown silty sand layer of varying thickness followed by a stiff grey silty clay deposit. Refer to the Soil Profile and Test Data sheets attached for specific details of the soil profile encountered at the test pit locations.

Based on available geological mapping, the bedrock consists of interbedded limestone and shale from the Verulam formation. Bedrock is expected to range between 10 and 15 m depth.

Groundwater infiltration levels were noted during the excavation of the test pits. The groundwater level varied between 2.4 and 3.1 m depth at the test pit locations. Groundwater levels are subject to seasonal fluctuations and therefore, the groundwater levels could vary at the time of construction.

3.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed residential building. The proposed low-rise residential building is expected to be founded over conventional shallow foundations and placed on either an undisturbed, compact silty sand or stiff silty clay bearing surface.

Due to the presence of a silty clay layer, the subject site will be subjected to permissible grade raise restrictions. The permissible grade raise recommendations will be discussed in the following sections.

Site Grading and Preparation

Topsoil, asphalt, and fill, containing deleterious or organic materials, should be stripped from under any building, paved areas, pipe bedding and other settlement sensitive structures. The existing building foundation should be removed from below the proposed building footprint. Precautions should be taken to not disturb adequate bearing soils at subgrade level during site preparation activities.

Engineered fill placed for grading beneath the proposed 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. The fill should be tested and approved prior to delivery to the site. The fill should be placed in maximum lift thickness of 300 mm and compacted with 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 surface settlement is of minor concern. The existing materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If the existing materials are to be placed to increase the subgrade level for areas to be paved, the non-specified existing fill should be compacted in 300 mm lifts and compacted to a minimum density of 95% of the respective SPMDD.

Foundation Design

Footings placed on an undisturbed, compact silty sand bearing surface can be designed using a bearing resistance value at Serviceability Limit States (SLS) of **100 kPa** and a factored bearing resistance value at Ultimate Limit States (ULS) of **150 kPa**.

Pad footings, up to 4 m wide, and strip footings, up to 2 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at Serviceability Limit States (SLS) of **100 kPa** and a factored bearing resistance value at Ultimate Limit States (ULS) of **150 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

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 prior to the placement of concrete for footings. The bearing resistance value at SLS given for footings 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 horizontally and vertically from the footing perimeter at a minimum of 1.5H:1V, passing through in situ soil or engineered fill of equal or higher capacity as the soil.

Permissible Grade Raise

Based on available information, a permissible grade raise restriction of **1 m** above existing ground surface is recommended for the subject site.

Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for foundations constructed at the subject site. Refer to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

4.0 Design and Construction Precautions

Foundation Drainage and Backfill

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

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 are not recommended for placement as backfill against the foundation walls, unless placed in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000. The drainage geocomposite should be connected to the perimeter foundation drainage system. Otherwise, imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be placed for foundation backfill.

Protection of Footings Against Frost Action

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

Exterior unheated footings, such as isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the 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 excavation side slopes in overburden materials should either be excavated to acceptable slopes or be retained by shoring systems from the beginning of the excavation until the structure is backfilled. If sufficient room is unavailable due to existing structures or property boundaries, a shoring system may be required.

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 subsurface soil 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 maintain safe working distance 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.

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 remain exposed for extended periods of time.

Groundwater Control

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.

Infiltration levels are anticipated to be low through the excavation face. The groundwater infiltration will be controllable with open sumps and pumps.

A temporary Ministry of the Environment and Climate Change (MOECC) 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 MOECC.

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 MOECC review of the PTTW application.

Winter Construction

If winter construction is considered for this project, precautions should be provided for frost protection. The subsurface soil conditions mainly consist of frost susceptible materials. In 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.

The trench excavations should be completed in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. Where excavations are constructed in proximity of existing structures precaution to adversely affecting the existing structure due to the freezing conditions should be provided.

5.0 Recommendations

A materials 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 the geotechnical consultant:

- ☐ 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 have been conducted in general accordance with Paterson's recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

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

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 contractors purpose.

The present report applies only to the project described in the report. The use of the report for purposes other than those described above or by person(s) other than Concorde Management and Development or their agents is not authorized without review by Paterson.

Best Regards,

Paterson Group Inc.



Colin Belcourt, M.Eng.



David J. Gilbert, P.Eng.

Attachments

- ☐ Soil Profile and Test Data sheets
- ☐ Analytical Testing Results
- ☐ Drawing PG4062-1 - Test Hole Location Plan

Report Distribution

- ☐ Concorde Management and Development (3 copies)
- ☐ Paterson Group (1 copy)

SOIL PROFILE AND TEST DATA

FILE NO. PG4062

HOLE NO. TP 1

REMARKS

BORINGS BY Backhoe

DATE March 2, 2017

[illegible]

SOIL PROFILE AND TEST DATA

FILE NO. PG4062




HOLE NO. TP 2

DATUM	Top of manhole cover along Heney Street, across from subject site. Geodetic elevation = 64.83m
--------------	--

REMARKS

BORINGS BY Backhoe

DATE March 2, 2017

SOIL 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 %					
								20	40	60	80		
GROUND SURFACE						0	64.71						
Asphaltic Concrete 0.03		G	1										
FILL: Crushed stone, some sand, silt and debris(brick,ash,glass and metal) 0.30													
FILL: Loose, brown silty sand trace glass		G	2			1	63.71						
1.20													
Compact, brown SILTY SAND		G	3										
1.70													
End of Test Pit													
Existing stone block foundation wall over large aggregate concrete footing extending to 1.46m depth.													
(Groundwater not encountered)													

20406080100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

FILE NO. PG4062

HOLE NO. **TP 3**

DATUM	Top of manhole cover along Heney Street, across from subject site. Geodetic elevation = 64.83m
--------------	--

REMARKS

BORINGS BY Backhoe

DATE March 2, 2017

SOIL 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 %					
								20	40	60	80		
GROUND SURFACE													
FILL: Topsoil with River Rock Landscaping	0.20					0	65.13						
FILL: Loose to compact, brown silty sand trace brick and concrete boulders		G	1			1	64.13						
		G	2										
	2.00					2	63.13						
Compact, brown SILTY SAND	2.40												
		G	3										
Stiff, grey SILTY CLAY													
	3.10					3	62.13						
End of Test Pit													
(Groundwater observed at 2.4m depth)													

20406080100

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 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 = $(D_{30})^2 / (D_{10} \times D_{60})$
Cu	-	Uniformity coefficient = D_{60} / D_{10}

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		Overconsolidation 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

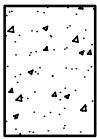
k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during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

SYMBOLS AND TERMS (continued)

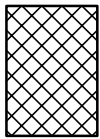
STRATA PLOT



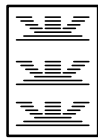
Topsoil



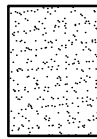
Asphalt



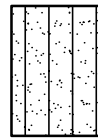
Fill



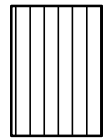
Peat



Sand



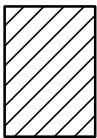
Silty Sand



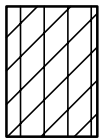
Silt



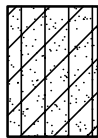
Sandy Silt



Clay



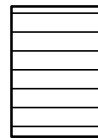
Silty Clay



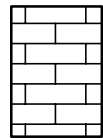
Clayey Silty Sand



Glacial Till



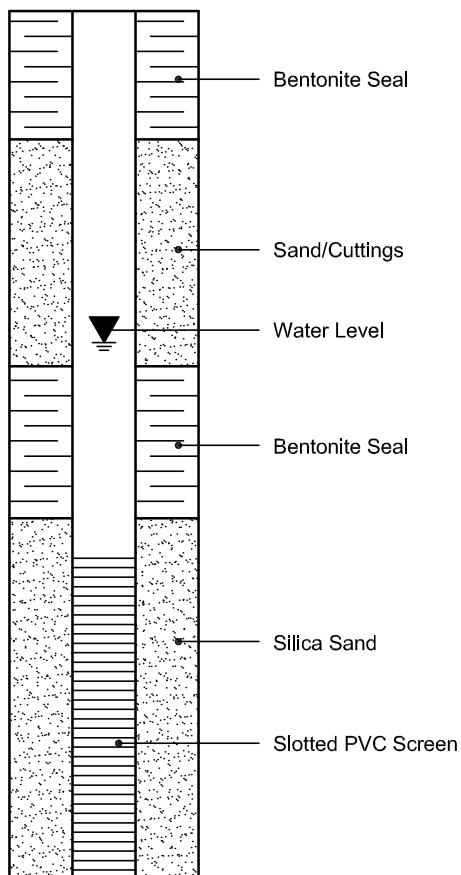
Shale



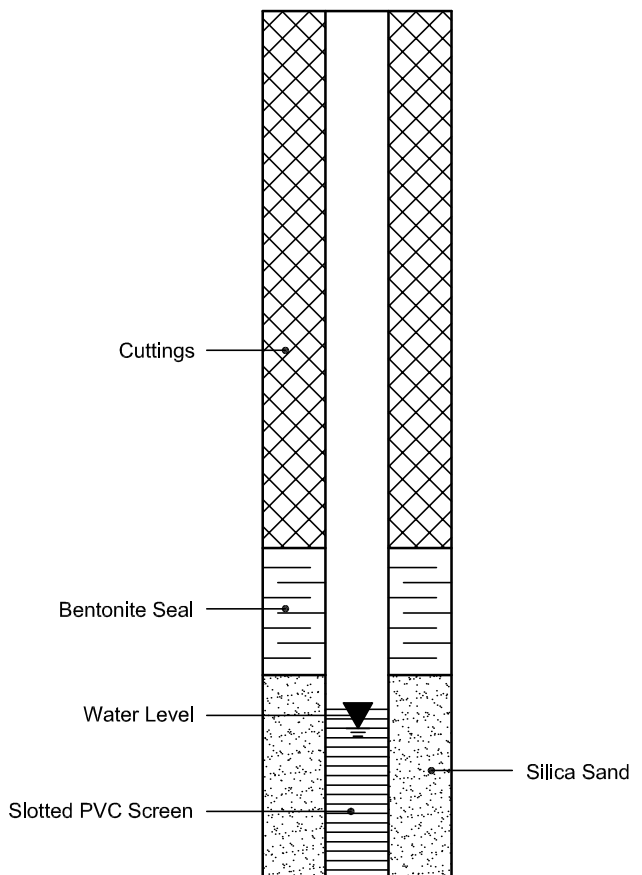
Bedrock

MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 21644

Report Date: 07-Mar-2017

Order Date: 3-Mar-2017

Project Description: PG4062

Client ID:	TP3 G3	-	-	-
Sample Date:	02-Mar-17	-	-	-
Sample ID:	1709435-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

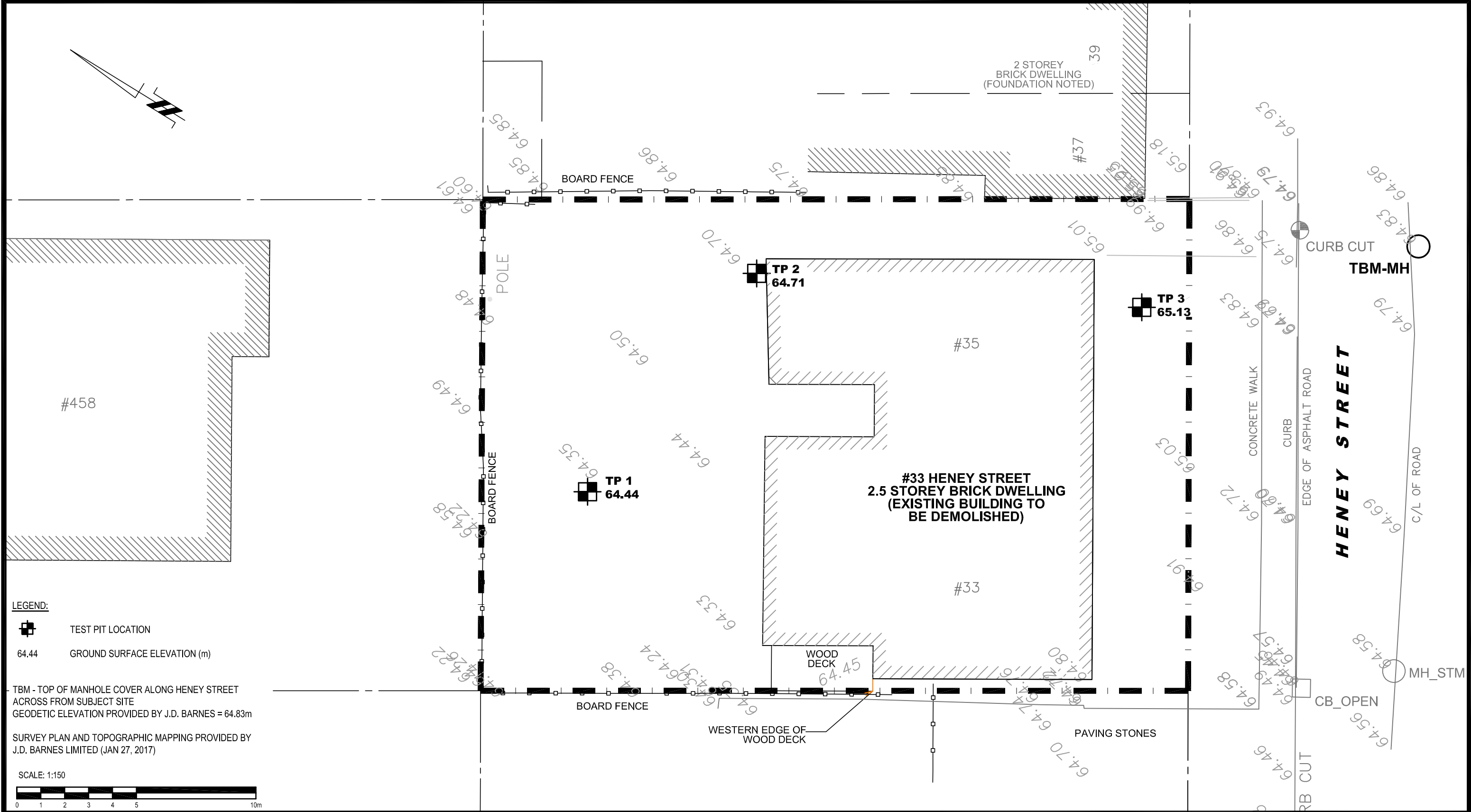
% Solids	0.1 % by Wt.	64.4	-	-	-
----------	--------------	------	---	---	---

General Inorganics

pH	0.05 pH Units	7.70	-	-	-
Resistivity	0.10 Ohm.m	7.85	-	-	-

Anions

Chloride	5 ug/g dry	787	-	-	-
Sulphate	5 ug/g dry	60	-	-	-



<div><div>patersongroup</div><div>consulting engineers</div><div>154 Colonnade Road South Ottawa, Ontario K2E 7J5 Tel: (613) 226-7381 Fax: (613) 226-6344</div></div>					<div>CONCORDE MANAGEMENT AND DEVELOPMENT</div> <div>GEOTECHNICAL INVESTIGATION</div> <div>33 HENEY STREET</div> <div>OTTAWA, ONTARIO</div> <div>TEST HOLE LOCATION PLAN</div>	Scale:	1:150	Date:	03/2017
						Drawn by:	RCG	Report No.:	PG4062-1
						Checked by:	RM	Dwg. No.:	PG4062-1
						Approved by:	DJG	Revision No.:	0
	0								
NO.	REVISIONS	DATE	INITIAL						