patersongroup

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June 12, 2014
PG3218-LET.01

Fallingbrook Chiropractic Clinic
c/o Mar Gard Limited
92 Bentley Avenue, 2nd floor
Ottawa, Ontario
K2E 6T9

Attention: **Mr. Mark Schaffhauser**

Subject: **Geotechnical Investigation**
Proposed Commercial Building(s)
4405 and 4409 Innes Road - Ottawa

Dear Sir,

Paterson Group (Paterson) was commissioned by Mar Gard Limited on behalf of Fallingbrook Chiropractic Clinic to conduct a geotechnical investigation for the proposed commercial building(s) to be located at 4405 and 4409 Innes Road, in the City of Ottawa, Ontario. The following letter report presents the findings and recommendations.

1.0 Field Investigation

The field program for the investigation was conducted on April 23, 2014. At that time, six boreholes were advanced to a maximum of 37.5 m depth. The test hole locations were distributed in a manner to provide general coverage of the subject site.

The boreholes were drill with a track-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test hole procedures consisted of augering to the required depths at the selected locations and sampling the overburden.

The test hole locations were determined in the field by Paterson personnel with consideration of existing site features, such as trees, underground and aboveground services. The borehole locations and elevations were referenced to a temporary benchmark (TBM) consisting of the top of a manhole located on north side of Innes Road between 4405 and 4409 Innes Road. An assumed elevation of 100 m was assigned to the TBM. The locations and the ground surface elevation at each borehole location are presented on Drawing PG3218-1 - Test Hole Location Plan.

2.0 Field Observations

Generally, the ground surface across the subject site is relatively flat and at grade with Innes Road. The subject site is currently occupied by a commercial building and a residential dwelling with the associated parking areas and access lanes. There is an existing drainage ditch between 4405 and 4409 Innes Road. Additionally, existing landscaped areas, grass covered areas and occasional trees have been noted.

Generally, the soil profile encountered in the test holes consists of an asphaltic pavement structure and/or topsoil over stiff to very stiff brown silty clay crust followed by firm to soft grey silty clay layer. Refer to the Soil Profile & Test Data sheets for specific details of the soil profile at each test hole location.

Based on the available geological mapping, the bedrock in this area consists of limestone and dolomite interbedded bedrock of the Gull River formation with an overburden drift thickness of 30 to 50 m depth.

Based on soil colour, consistency and moisture levels of the recovered soil samples, the long-term groundwater level is anticipated to be between 2.5 to 3.5 m depth. 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 commercial building(s). The proposed slab on grade building is expected be constructed over conventional shallow foundations and placed on a silty clay bearing surface.

Due to the presence of the sensitive silty clay layer, the proposed development will be subjected to a permissible grade raise restriction. If the grade raise restriction is exceeded, several options are available, such as a preload/surcharge program or the placement of lightweight fill below the proposed buildings.

Site Grading and Preparation

Asphaltic concrete, topsoil and deleterious fill, such as those containing organic materials, should be removed from under any building and other settlement sensitive structures.

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. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these 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. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless placed in conjunction with a composite drainage system.

Foundation Design

Strip footings, up to 3 m wide, and pad footings, up to 6 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 **75 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**.

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.

Footings designed with the bearing resistance value at SLS provided should be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

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 Recommendations

Based on the existing borehole coverage and results of the undrained shear strength tests completed within the underlying cohesive soils, a **permissible grade raise restriction of 0.5 m** is recommended be implemented for areas where foundations are placed over the silty clay deposit. A post-development groundwater lowering of 0.5 m was considered in the permissible grade raise restriction calculations.

Design for Earthquakes

The site class for seismic site response can be taken as **Class E** 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. The soils underlying the subject site are not susceptible to liquefaction.

Slab-on-Grade Construction

With the removal of all topsoil and deleterious materials, within the proposed building footprint, the native soil, free of organic and deleterious materials, and approved by the geotechnical consultant at the time of construction is considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 200 mm of sub-slab fill should consist of an OPSS Granular A crushed stone material for slab-on-grade construction. All backfill material within the proposed building footprint should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

Pavement Structure

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

Table 1 - Recommended Pavement Structure - Car Only Parking Areas and Fire Access Lanes

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 or OPSS Granular B Type II material placed over fill	

Table 2 - Recommended Pavement Structure
Access Lanes and Heavy Traffic 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 or OPSS Granular B Type I or II material placed over fill	

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 excavated and backfilled 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 98% of the SPMDD with suitable vibratory equipment.

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 could result in the subgrade soil being pumped into the voids in the stone subbase, thereby reducing the load bearing capacity.

Due to the impervious nature of the subgrade materials consideration to installing subdrains during the pavement construction should be provided. These drains should be installed at each catch basin, be a minimum of 3 m long and should extend in four orthogonal directions or longitudinally when placed along a curb. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be shaped to promote water flow to the drainage lines.

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 100 to 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 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, connected to the perimeter foundation drainage system. Otherwise, imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be placed for this purpose.

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 those for 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. Sufficient room should be available for the greater part of the excavation to be construction 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 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 the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

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.

A temporary MOE permit to take water (PTTW) may be required for this project if more than 50,000 L/day are to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOE.

The groundwater flow rate into the excavation through the overburden should be low for expected founding levels of the proposed building. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

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 150 mm of OPSS Granular A should be placed for bedding for sewer and water pipes when placed on 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 300 mm thick lifts compacted to a minimum of 95% 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) 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 SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches that are located in the areas underlain by silty clay. The seals should be at least 1.5 m long (in the trench direction) 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 relatively dry and compactable brown silty clay placed in maximum 200 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 and at strategic locations at no more than 60 m intervals in the service trenches.

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 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.

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.

Corrosion Potential and Sulphate

The analytical test results indicate the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate. The chloride content of the sample indicates a non-significant factor in creating a corrosive environment for exposed ferrous metals, whereas the pH and resistivity is indicative of an moderate to aggressive corrosive environment.

Table 3 - Corrosion Potential

Parameter	Laboratory Results	Threshold	Commentary
	BH3-SS3		
Chloride	49 µg/g	Chloride content less than 400 mg/g	Negligible concern
pH	7.72	pH value less than 5.0	Neutral Soil
Resistivity	3040 ohm.cm	Resistivity greater than 1,500 ohm.cm	Moderate Corrosion Potential
Sulphate	17 µg/g	Sulphate value greater than 1 mg/g	Negligible Concern

Landscaping Considerations -Tree Planting Restrictions

The proposed building addition is located in a moderate sensitivity area with respect to planting trees over a silty clay deposit. Where silty clay is encountered below the proposed footing, trees placed within 5 m of the foundation wall are recommended to consist of low water demanding trees with shallow roots systems that extend less than 1.5 m below ground surface. Trees placed greater than 5 m from the foundation wall may consist of typical street trees, which are typically moderate water demand species with roots extending to a maximum 2 m depth.

It is well documented in the literature, and in Paterson's experience, that fast-growing trees located near buildings founded on cohesive soils could 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 should not be considered in the landscaping design.

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:

- ❏ Review detailed grading plan(s) from a geotechnical perspective.
- ❏ 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 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.

6.0 Statement of Limitations

The recommendations in this report are in accordance with the present understanding of the project. Paterson requests permission to review the grading plan once available and the recommendations when the drawings and specifications are complete.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from the test locations, Paterson requests notification immediately in order to permit reassessment of the recommendations.

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 Fallingbrook Chiropractic Clinic, Mar Gard Limited or their agent(s) is not authorized without review by Paterson Group for the applicability of the recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
J. A. FORSYTH
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PROVINCE OF ONTARIO

Faisal Abou-Seido, B.Eng.

Joe Forsyth, P.Eng.

Attachments

- ❑ Soil Profile and Test Data sheets
- ❑ Symbols and Terms
- ❑ Analytical Test Results
- ❑ Figure 1 - Key Plan
- ❑ Drawing PG3218-1 - Test Hole Location Plan

Report Distribution

- ❑ Fallingbrook Chiropractic Clinic c/o Mar Gard (3 copies)
- ❑ Paterson Group (1 copy)

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 4405 and 4409 Innes Road
Ottawa, Ontario

DATUM TBM - Top of manhole cover located in front of subject property, north side of Innes Road. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE April 23, 2014

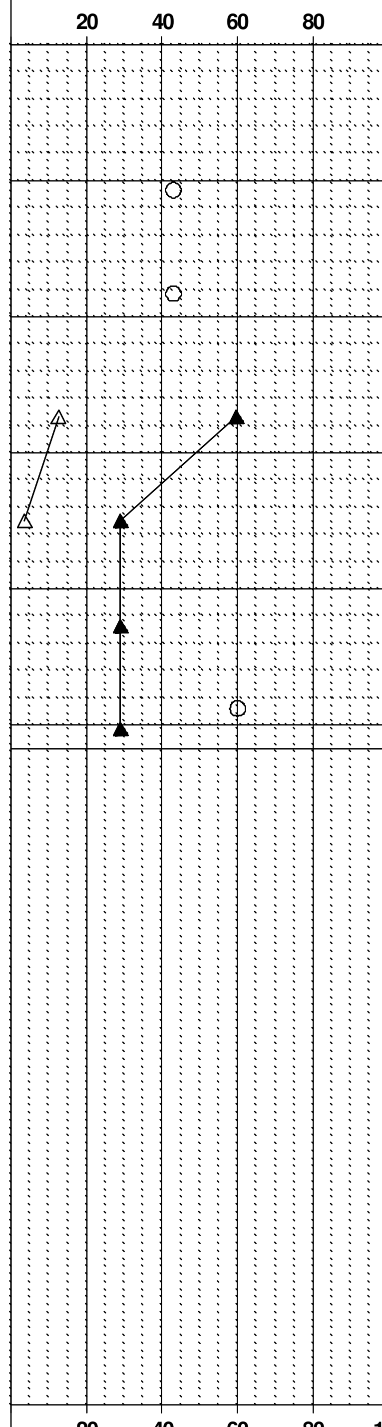
FILE NO. PG3218

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.25
TOPSOIL 0.30		AU	1				
		SS	2	50	3	1	99.25
		SS	3	83	4	2	98.25
Stiff, brown **SILTY CLAY**							
- firm to soft by 3.0m depth						3	97.25
- grey by 3.5m depth							
						4	96.25
5.18		SS	4	83	P	5	95.25
End of Borehole							
(GWL @ 3.0m depth based on field observations)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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DATE April 23, 2014

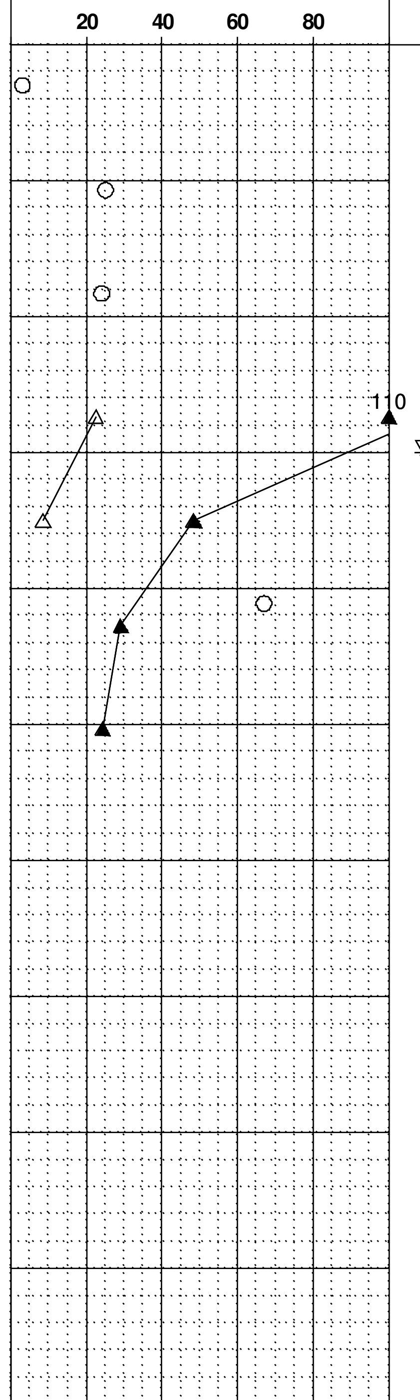
FILE NO. PG3218

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.62
Asphaltic concrete 0.10							
FILL: Brown silty sand with gravel 0.46		AU	1				
Brown **SILTY CLAY** with organics 0.76							
		SS	2	50	9	1	99.62
		SS	3	58	7	2	98.62
Very stiff to stiff, brown **SILTY CLAY**							
- firm to soft by 3.0m depth						3	97.62
- grey by 3.5m depth							
		SS	4	83	P	4	96.62
5.03						5	95.62
Dynamic Cone Penetration Test commenced at 5.03m depth. Cone pushed to 32.9m depth.							
						6	94.62
						7	93.62
						8	92.62
						9	91.62
						10	90.62

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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DATE April 23, 2014

FILE NO. PG3218

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE									
						10	90.62		
						11	89.62		
						12	88.62		
						13	87.62		
						14	86.62		
						15	85.62		
						16	84.62		
						17	83.62		
						18	82.62		
						19	81.62		
						20	80.62		

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

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REMARKS

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HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE									
						20	80.62		
						21	79.62		
						22	78.62		
						23	77.62		
						24	76.62		
						25	75.62		
						26	74.62		
						27	73.62		
						28	72.62		
						29	71.62		
						30	70.62		

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

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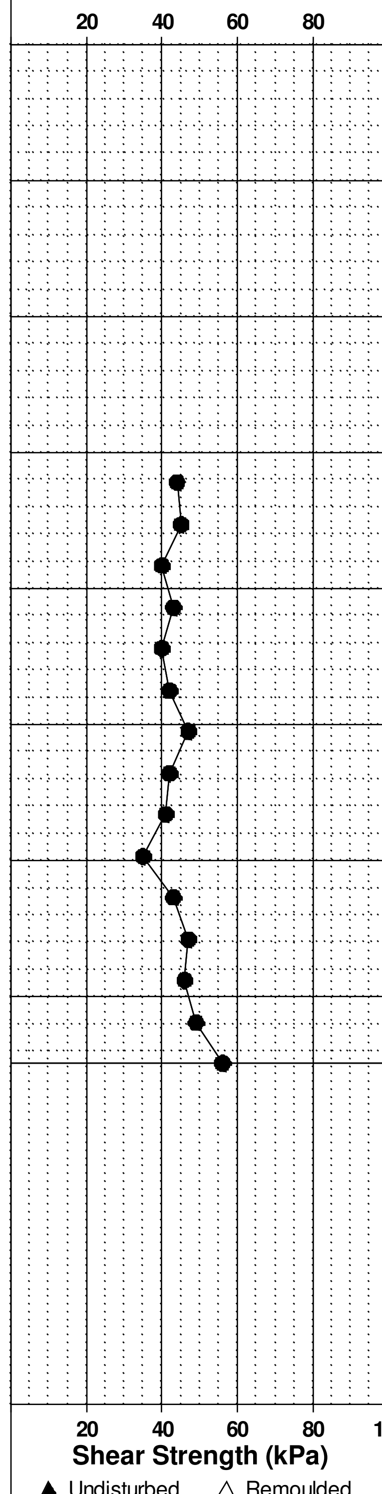
HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						30	70.62
						31	69.62
						32	68.62
						33	67.62
						34	66.62
						35	65.62
						36	64.62
						37	63.62
37.49							
End of Borehole (GWL @ 2.2m depth based on field observations)							

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

○ Water Content %

Piezometer Construction



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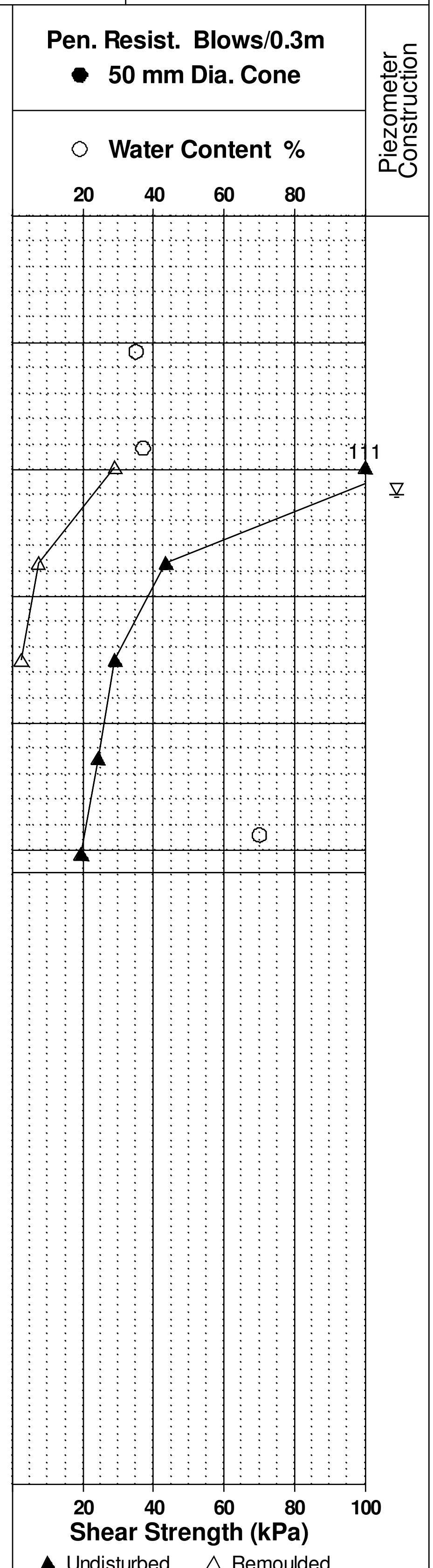
FILE NO. PG3218

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.09
TOPSOIL 0.30		AU	1				
Very stiff to stiff, brown **SILTY CLAY**		SS	2	17	2	1	99.09
- firm by 2.3m depth		SS	3	92	3	2	98.09
						3	97.09
- soft and grey by 3.5m depth						4	96.09
5.18		SS	4	92	P	5	95.09
End of Borehole							
(GWL @ 2.2m depth based on field observations)							



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REMARKS

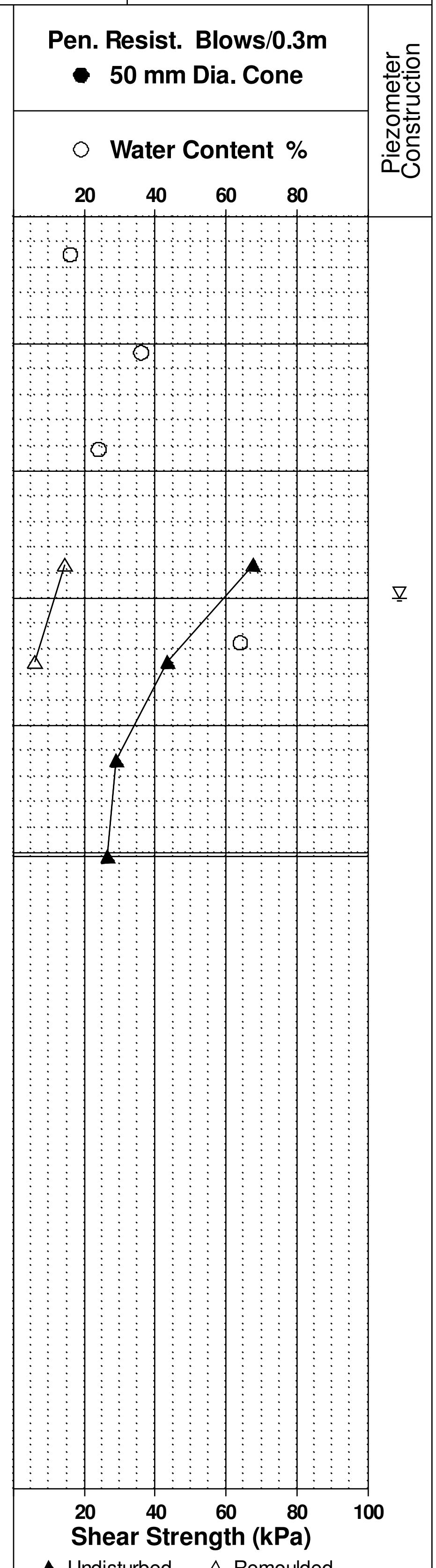
BORINGS BY CME 55 Power Auger

DATE April 23, 2014

FILE NO. **PG3218**

HOLE NO. **BH 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.13
FILL: Gravel (0.15)		AU	1				
Dark brown **SILTY CLAY,** some roots (1.37)		SS	2	58	7	1	99.13
Stiff to firm, brown **SILTY CLAY**		SS	3	50	4	2	98.13
- grey by 3.5m depth		SS	4	100	P	3	97.13
(5.03)						4	96.13
End of Borehole						5	95.13
(GWL @ 3.0m depth based on field observations)							



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REMARKS

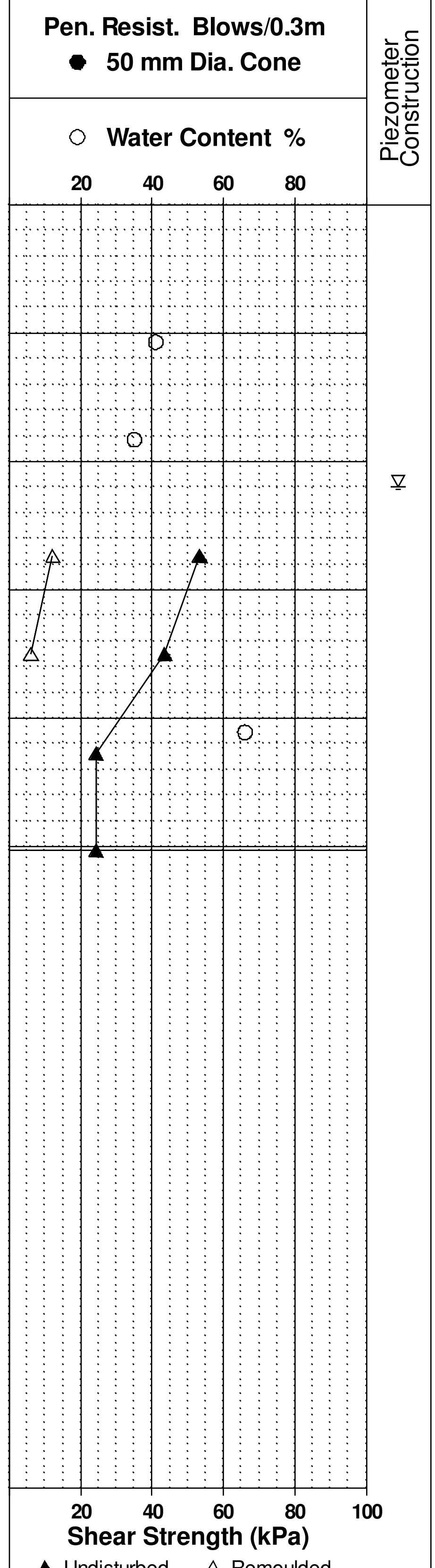
BORINGS BY CME 55 Power Auger

DATE April 23, 2014

FILE NO. PG3218

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.40
TOPSOIL 0.10		AU	1				
		SS	2	83	5	1	99.40
Stiff to firm, grey **SILTY CLAY**		SS	3	92	6	2	98.40
						3	97.40
- soft by 3.5m depth		SS	4	92	P	4	96.40
5.03						5	95.40
End of Borehole (GWL @ 2.2m depth based on field observations)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Building - 4405 and 4409 Innes Road
Ottawa, Ontario

DATUM TBM - Top of manhole cover located in front of subject property, north side of Innes Road. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

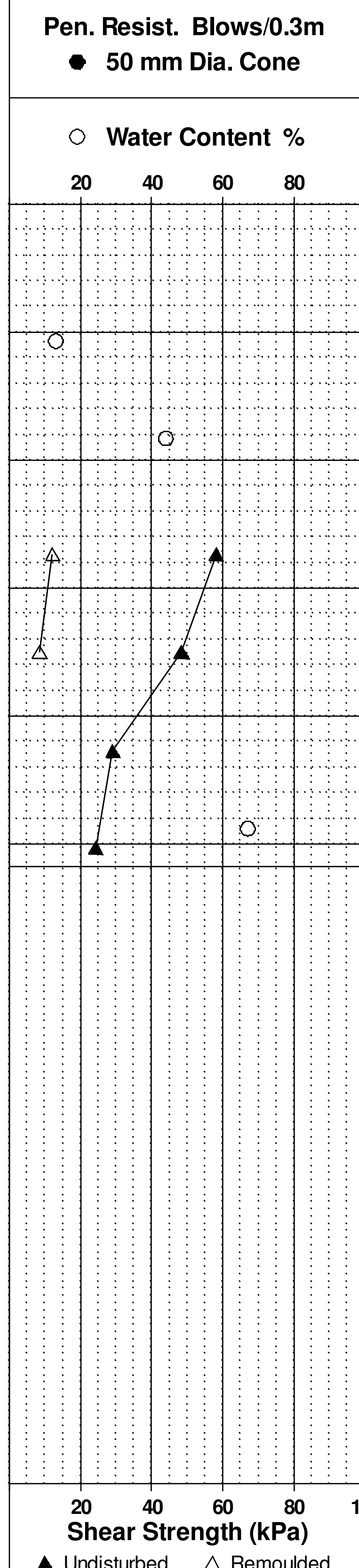
BORINGS BY CME 55 Power Auger

DATE April 23, 2014

FILE NO. PG3218

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.49
TOPSOIL 0.10							
FILL: Gravel 1.07		AU	1				
		SS	2	33	7	1	99.49
Stiff to firm, brown **SILTY CLAY**		SS	3	75	4	2	98.49
- grey by 2.7m depth						3	97.49
						4	96.49
- soft by 4.5m depth 5.18		SS	4	100	P	5	95.49
End of Borehole							
(GWL @ 2.2m depth based on field observations)							



Piezometer Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

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

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x 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

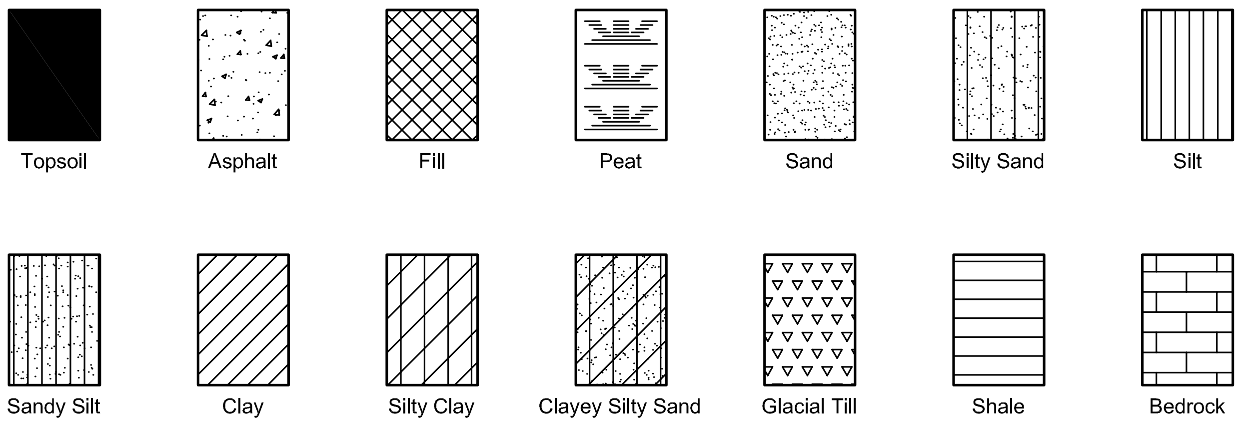
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

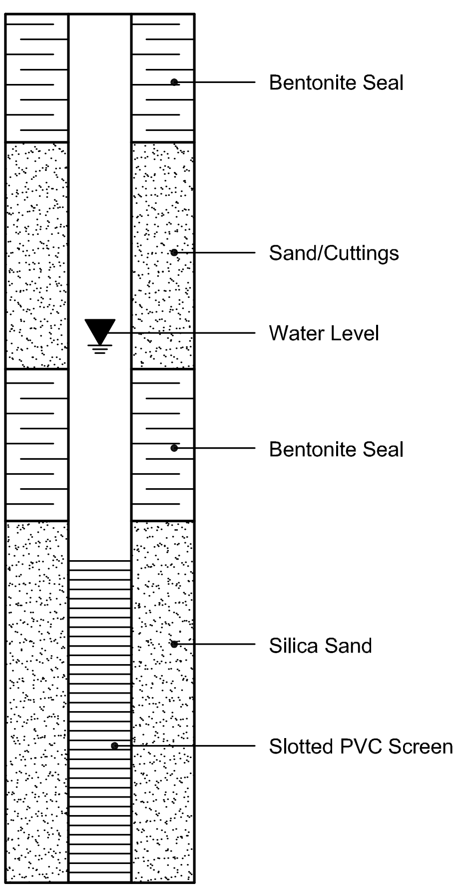
SYMBOLS AND TERMS (continued)

STRATA PLOT

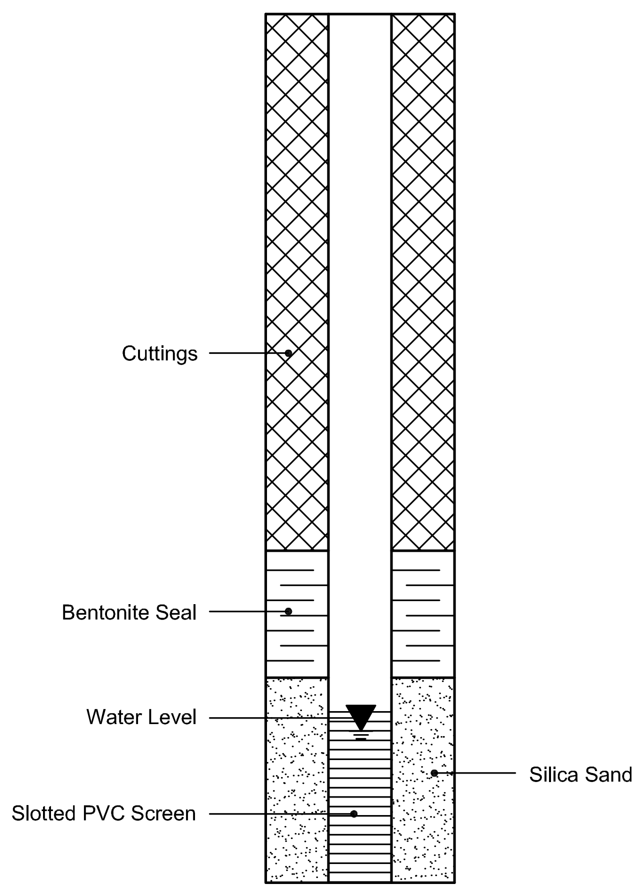


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 29-Apr-2014
Order Date:24-Apr-2014

Client: **Paterson Group Consulting Engineers**
Client PO: 15353
Project Description: PG3218

	Client ID:	BH3-SS3	-	-	-
	Sample Date:	23-Apr-14	-	-	-
	Sample ID:	1417248-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	69.1	-	-	-
General Inorganics					
pH	0.05 pH Units	7.72	-	-	-
Resistivity	0.10 Ohm.m	30.4	-	-	-
Anions					
Chloride	5 ug/g dry	49	-	-	-
Sulphate	5 ug/g dry	17	-	-	-

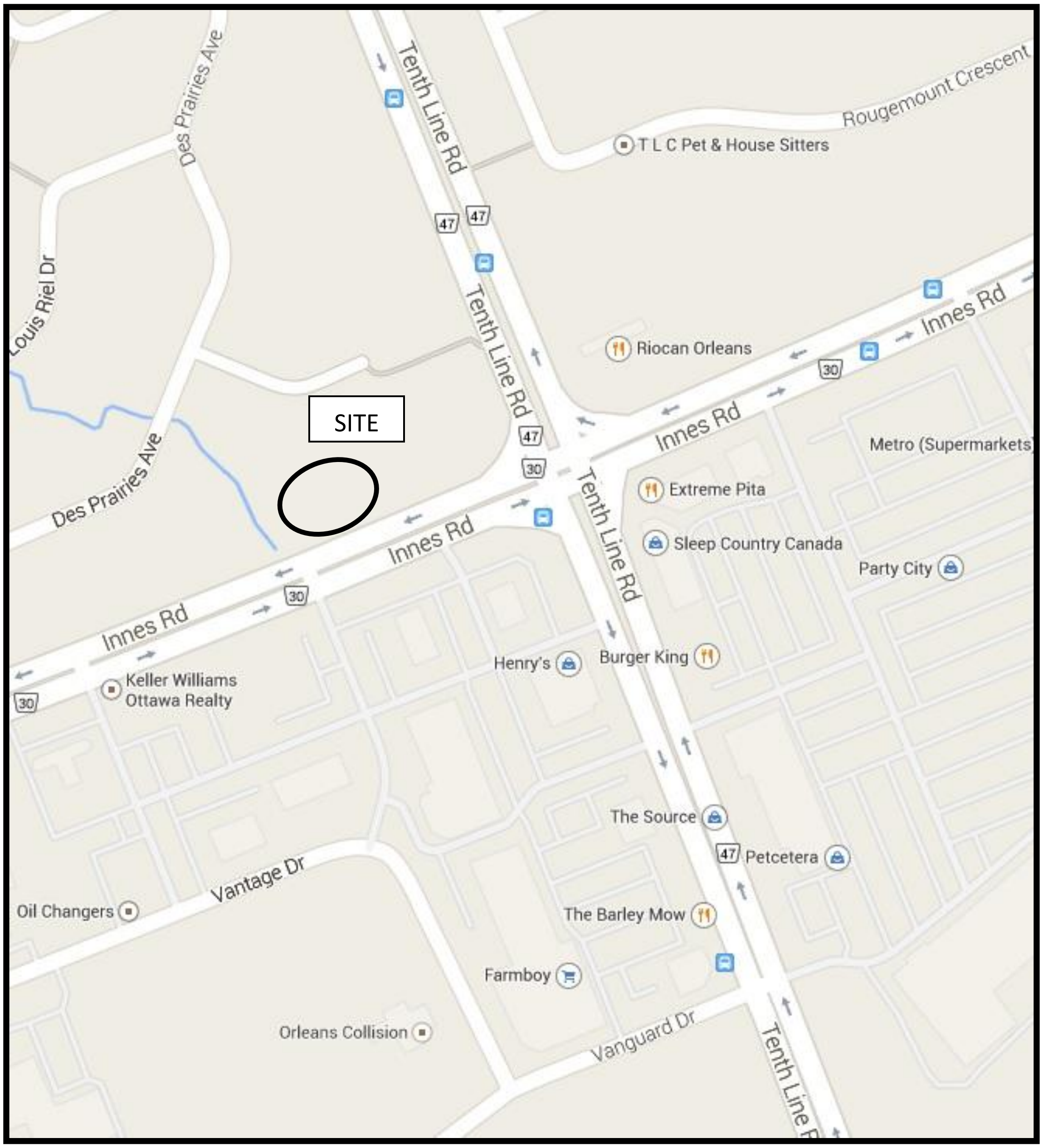
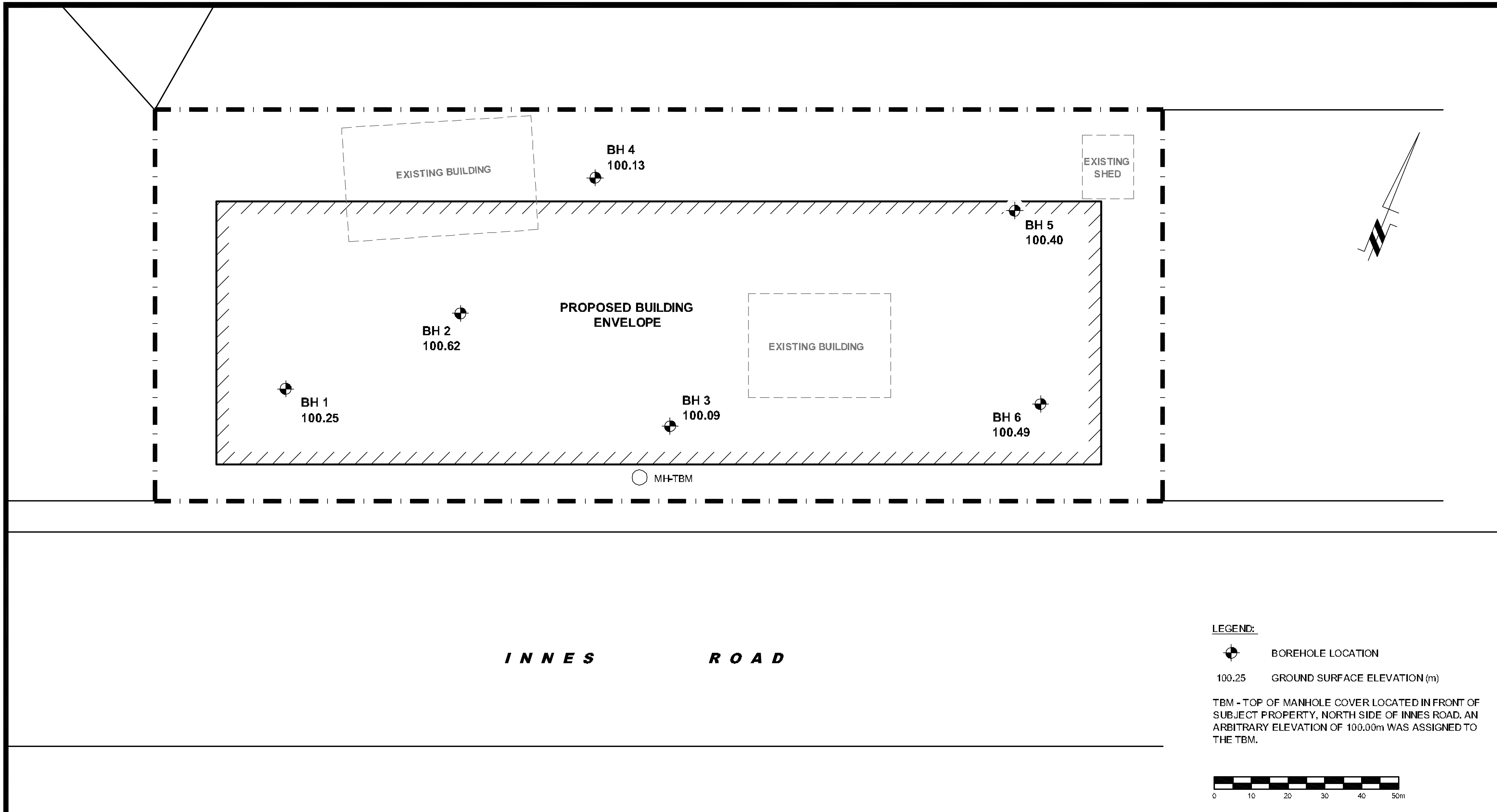


FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL

MAR GARD LIMITED

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL BUILDING - 4405 AND 4409 INNES ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Drawn by:	Checked by:	Date:
MPG	DJG	05/2014

Scale: 1:300

Report No.: PG3218-1

Drawing No.: PG3218-1

p:\autocad drawings\geotechnical\pg32xx\pg3218-1.dwg