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Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Studies

Geotechnical Investigation
Proposed Residential Development
Mountshannon Drive
Ottawa, Ontario

Prepared For

Mattino Developments

January 31, 2013

Report: PG2306-1

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by Mattino Developments to conduct a geotechnical investigation for the proposed residential development to be located at 591 Longfields Drive, west of Mountshannon Drive, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report). The objectives of the current investigation were:

- ☐ Determine the subsoil and groundwater conditions at this site by means of test pits.
- ☐ Provide geotechnical recommendations pertaining to 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.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation.

2.0 PROPOSED DEVELOPMENT

It is understood that the proposed development will consist of several blocks of townhouse style and multi-unit residential buildings along with associated at grade parking areas and access lanes. It is further understood that this development will be municipally serviced.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

The field program for the investigation was carried out on December 7, 2012. At that time, ten (10) test pits were advanced to a maximum depth of 6.7 m. The test pits locations were distributed in a manner to provide general coverage of the proposed development. The locations of the test pits are shown on Drawing PG2306-1 - Test Hole Location Plan included in Appendix 2.

The test pits were put down using a track mounted hydraulic shovel. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test pitting procedure consisted of excavating to the required depths at the selected locations, sampling and testing the overburden.

Groundwater

Water infiltration levels observed at the time of investigation were noted and are provided on the Soil Profile and Test Data sheets presented in Appendix 1.

Sampling

Soil samples were recovered from the sidewalls of the excavation, classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. 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.

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

All samples will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test pit locations were selected by Paterson in a manner to provide general coverage of the subject site. The test pits were located in the field and surveyed by Stantec Geomatics. The locations and ground surface elevations at the test pits are presented in Drawing PG2306-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

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

4.0 OBSERVATIONS

4.1 Surface Conditions

At the time of the field program, the site was covered in snow. A large fill pile was noted at the northern portion of the site. A patch of dense trees were noted in the southern portion of the site, with a fill pile directly north of the patch of dense trees.

4.2 Subsurface Profile

The subsurface profile at the test hole locations consists of topsoil or fill overlying a very stiff to stiff silty clay crust overlying a firm grey silty clay. Compact glacial till or clayey silt were encountered below the silty clay. Practical refusal to excavation was encountered at depths of 5.6 and 5.8 m, in TP 7 and TP 9, respectively. Specific details of the soil profile at each test pit location are presented in the Soil Profile and Test Data sheets in Appendix 1.

Based on geological mapping, the bedrock underlying the subject site consists of interbedded sandstone and dolomite of the March formation, and the bedrock surface is expected to be between 5 and 10 m depth.

4.3 Groundwater

All test pits were noted to by dry upon completion. However, the groundwater level can also be estimated based on moisture levels and colour of the recovered soil samples. Based on these observations at the test pit locations, the groundwater table is expected between a 2 to 3 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 DISCUSSION

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed residential development.

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

5.2 Site Grading and Preparation

Stripping Depth

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

Fill Placement

Fill used for grading beneath the proposed buildings, 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. It should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface 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 used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a geocomposite drainage membrane, such as Miradrain G100N or Delta Drain 6000.

5.3 Foundation Design

Strip footings, up to 3 m wide, and pad footings, up to 4 m wide, can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa** placed on an undisturbed stiff silty clay. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

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

The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 15 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 the native soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

Based on the silty clay layer depth and stiffness of the deposit, the following permissible grade raises are recommended for the subject site:

☐ A **permissible grade raise restriction of 1.2 m** is recommended for the **proposed buildings** across the subject site.

☐ A **permissible grade raise restriction of 2 m** is recommended for **parking areas and access roadways**.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics have been conservatively estimated based on the shear strength of the clay and the subsoil conditions observed at the test pit locations.

5.4 Design for Earthquakes

Foundations constructed at the subject site can be designed using a seismic site response **Class D** as defined in the Ontario Building Code 2006 (OBC 2006; Table 4.1.8.4.A). The soils underlying the site are not susceptible to liquefaction.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, such as those containing organic matter, within the footprints of the proposed buildings, the native soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II is recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone. All backfill materials within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Design

Residential driveways and local roadways are anticipated for the proposed development. The proposed pavement structures are shown in Tables 1 and 2 below.

Table 1 - Recommended Pavement Structure - Residential 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

Table 2 - Recommended Pavement Structure - Local Roadways

Thickness mm	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or 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 replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

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

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

6.0 DESIGN AND CONSTRUCTION PRECAUTIONS

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. 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, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 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 in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for exterior unheated footings, not thermally connected to a heated space, such as exterior columns and/or wing walls.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill 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 assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

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

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 95% of the material’s SPMDD.

Generally, it should be possible to re-use the silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions.

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 material’s SPMDD.

6.5 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.

It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations.

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

6.6 Winter Construction

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

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

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

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a non-aggressive to slightly aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Restrictions

The proposed residential dwellings are located in a low sensitivity area with respect to tree plantings over a silty clay deposit. It is recommended that trees placed within 4 m of the foundation wall shall consist of low water demanding trees with shallow roots systems that extend less than 1.5 m below ground surface. Trees placed greater than 4 m from the foundation wall may consist of typical street trees, which are typically moderate water demand species with roots extending to a maximum depth of 2 m below ground surface.

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

Swimming Pools

The in-situ soils are considered to be acceptable for in-ground swimming pools. Above ground swimming pools must be placed at least 3 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

7.0 RECOMMENDATIONS

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

❑ Review of the grading plan.

❑ 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 request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 STATEMENT OF LIMITATIONS

The recommendations made in this report are in accordance with our present understanding of the project. The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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 Mattino Developments or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie Boisvenue, B.Eng.

David J. Gilbert, P.Eng.

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Report Distribution:

- ☐ Mattino Developments (3 copies)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TEST RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

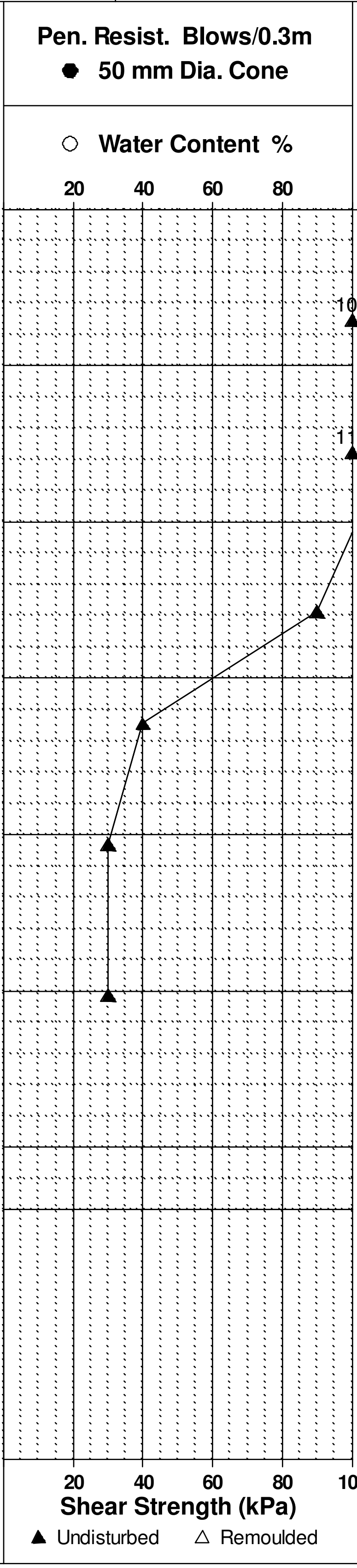
BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. PG2306

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.23
TOPSOIL 0.36		G	1				
		G	2				
						1	91.23
		G	3				
Very stiff to stiff, brown **SILTY CLAY**						2	90.23
		G	4				
						3	89.23
- firm and grey by 3.2m depth		G	5				
		G	6			4	88.23
		G	7			5	87.23
5.79							
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		G	8			6	86.23
6.40							
End of Test Pit (TP dry upon completion)							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. PG2306

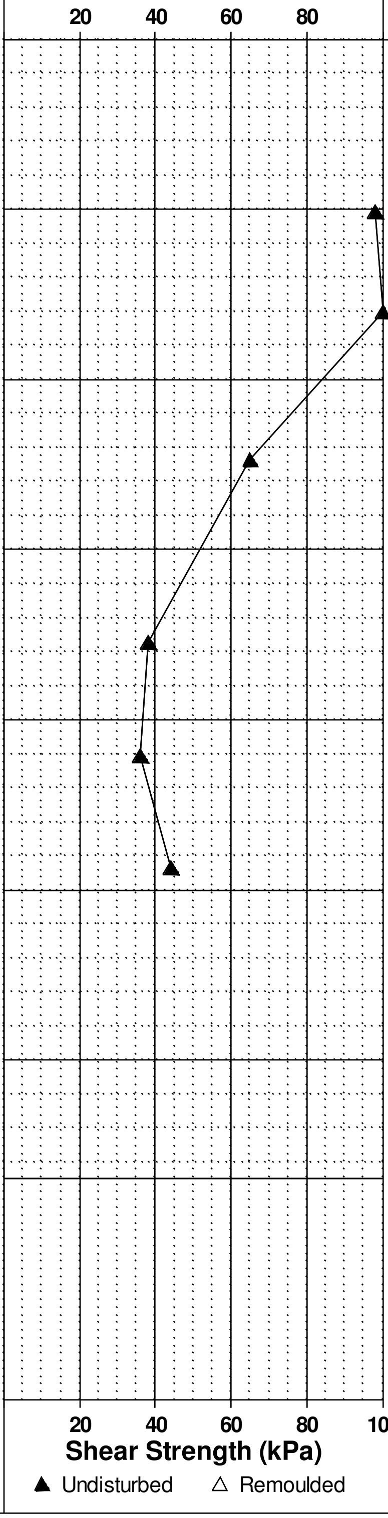
HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.04
TOPSOIL 0.38							
		G	1				
						1	91.04
		G	2				
Very stiff to stiff, brown **SILTY CLAY**						2	90.04
		G	3				
						3	89.04
- firm and grey by 3.4m depth		G	4				
						4	88.04
		G	5				
		G	6				
						5	87.04
6.00						6	86.04
Grey **CLAYEY SILT** with sand		G	7				
6.70							
End of Test Pit							
(TP dry upon completion)							

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

○ Water Content %

Piezometer Construction



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Hydraulic Shovel

DATE December 7, 2012

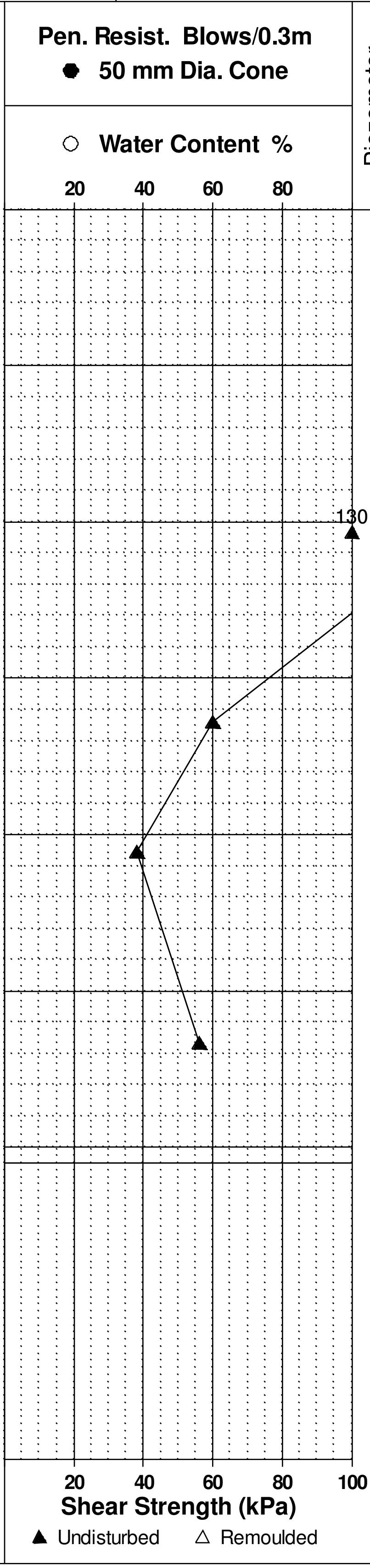
FILE NO. PG2306

HOLE NO. TP 3

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.20
FILL: Brown silty clay with gravel, cobbles, boulders	1.14
Very stiff to stiff, brown **SILTY CLAY** - firm and grey by 3.8m depth	5.80
Grey **CLAYEY SILT**	6.10
End of Test Pit (TP dry upon completion)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		
G	4		
G	5		

DEPTH (m)	ELEV. (m)
0	92.30
1	91.30
2	90.30
3	89.30
4	88.30
5	87.30
6	86.30



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

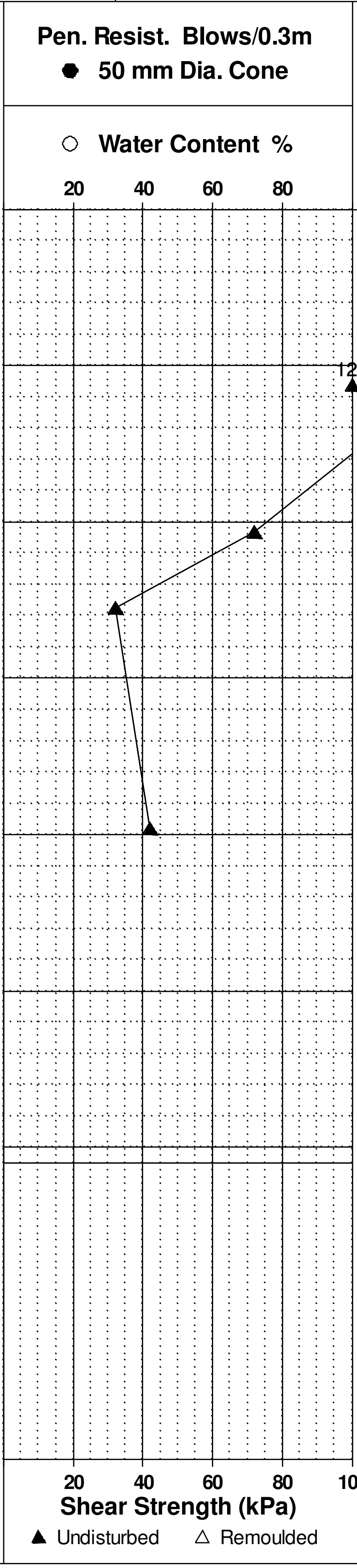
BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. **PG2306**

HOLE NO. **TP 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.15	
TOPSOIL 0.15								
		G	1					
Very stiff to stiff, brown **SILTY CLAY**						1	91.15	
- rootlets noted to 1.2m depth								
		G	2			2	90.15	
		G	3					
- firm and grey by 2.7m depth						3	89.15	
		G	4			4	88.15	
5.20						5	87.15	
Grey **CLAYEY SILT**		G	5					
6.10						6	86.15	
End of Test Pit								
(TP dry upon completion)								



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. **PG2306**

REMARKS

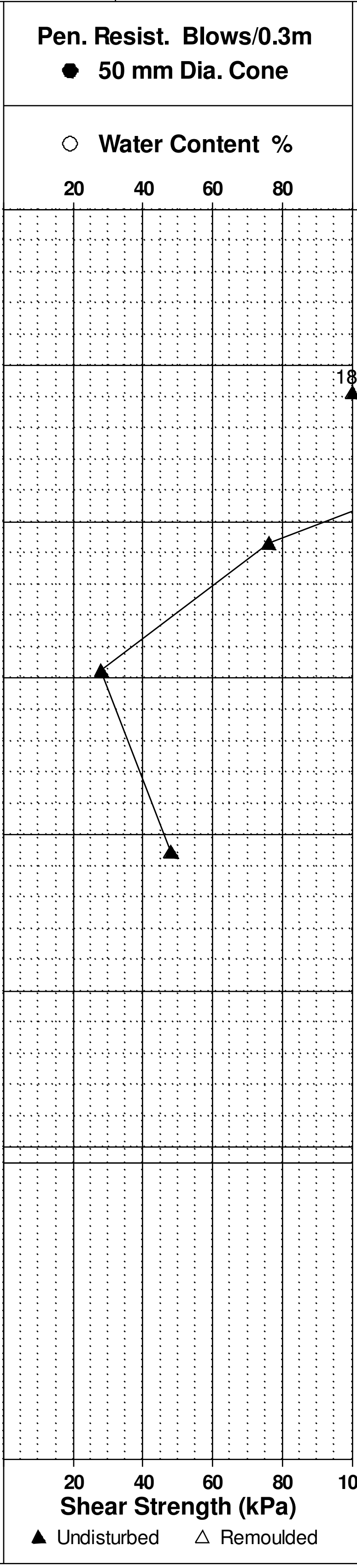
HOLE NO. **TP 5**

BORINGS BY Hydraulic Shovel

DATE December 7, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	Piezometer Construction
GROUND SURFACE						
TOPSOIL 0.25						
Very stiff to stiff, brown **SILTY CLAY** - roots noted to 1.3m depth - firm and grey by 2.8m depth 4.30		G G G	1 2 3			
Grey **CLAYEY SILT** with sand 6.10		G G	4 5			
End of Test Pit (TP dry upon completion)						

DEPTH (m)	ELEV. (m)
0	91.89
1	90.89
2	89.89
3	88.89
4	87.89
5	86.89
6	85.89



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

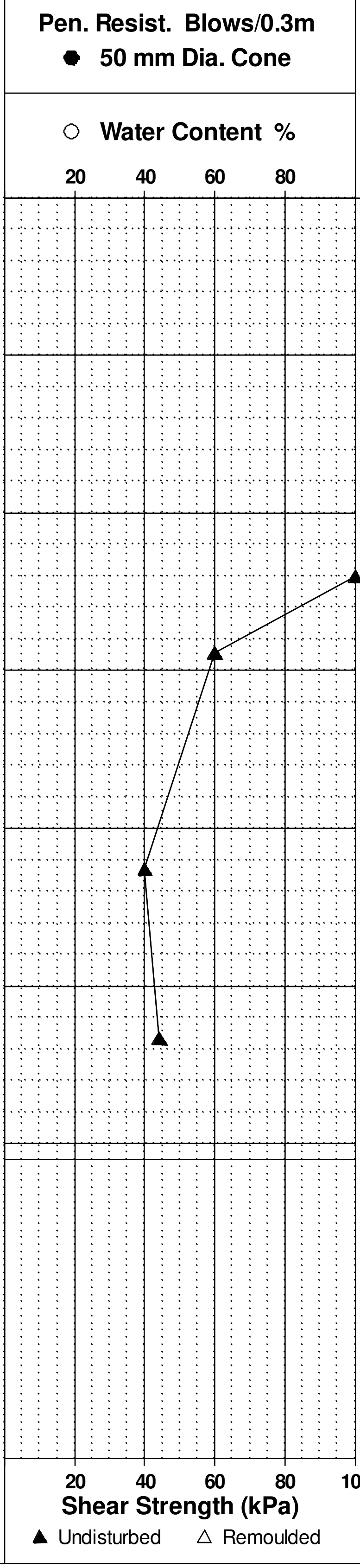
BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. PG2306

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.31
TOPSOIL 0.20							
FILL: Brown silty clay, trace sand, gravel, cobbles, brick 1.52		G	1			1	92.31
Very stiff to stiff, brown **SILTY CLAY** - firm and grey by 3.8m depth 6.10		G G G G	2 3 4 5			2 3 4 5 6	91.31 90.31 89.31 88.31 87.31
End of Test Pit (TP dry upon completion)							



Piezometer Construction

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. PG2306

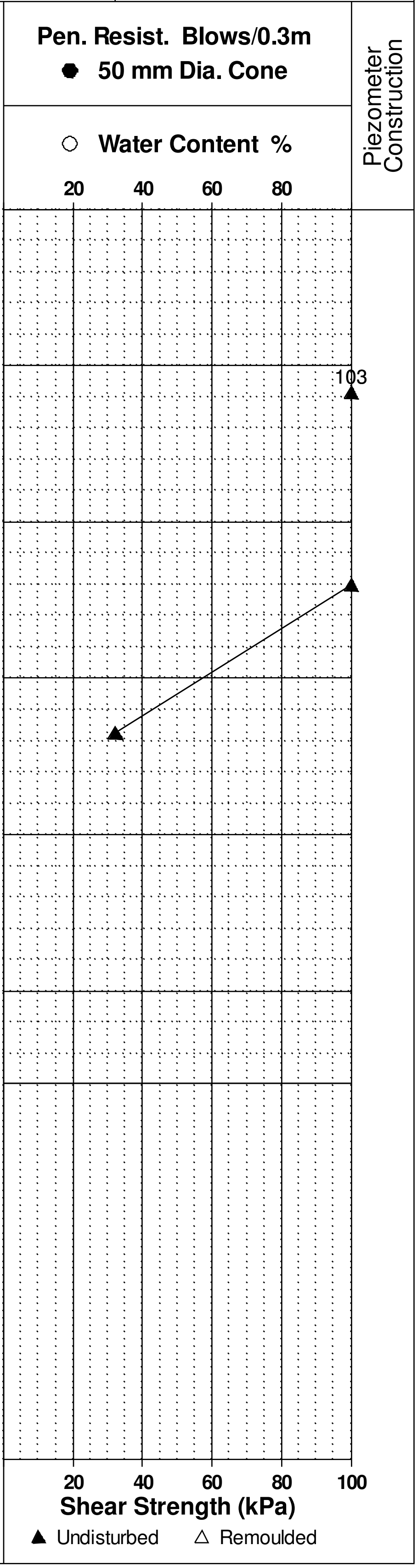
HOLE NO. TP 7

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.14
TOPSOIL — 0.36						
Very stiff to stiff, brown **SILTY CLAY**	G	1			1	91.14
- rootlets noted to 1.2m depth	G	2			2	90.14
- firm and grey by 3.2m depth	G	3			3	89.14
— 4.30	G	4			4	88.14
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders — 5.59	G	5			5	87.14

End of Test Pit

Practical refusal to excavation at 5.59m depth.

(TP dry upon completion)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
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DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

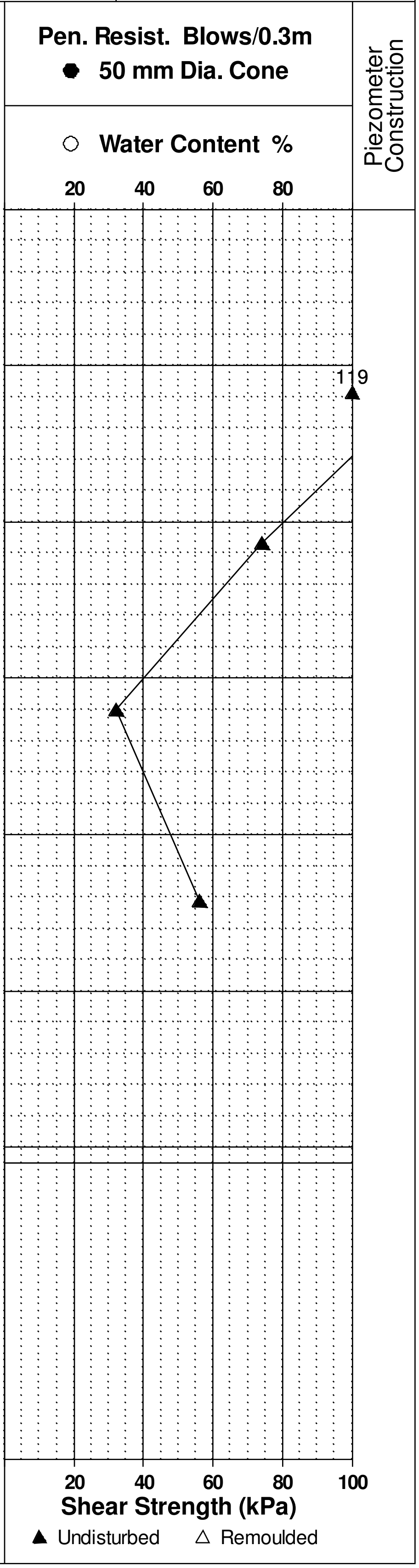
BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. **PG2306**

HOLE NO. **TP 8**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.20
TOPSOIL 0.18	■						
	▨	G	1				
	▨					1	91.20
Very stiff to stiff, brown **SILTY CLAY**	▨	G	2			2	90.20
- firm and grey by 2.9m depth	▨						
	▨					3	89.20
	▨					4	88.20
4.90	▨						
	▨	G	3			5	87.20
Grey **CLAYEY SILT**	▨						
6.10	▨					6	86.20
End of Test Pit (TP dry upon completion)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

FILE NO. PG2306

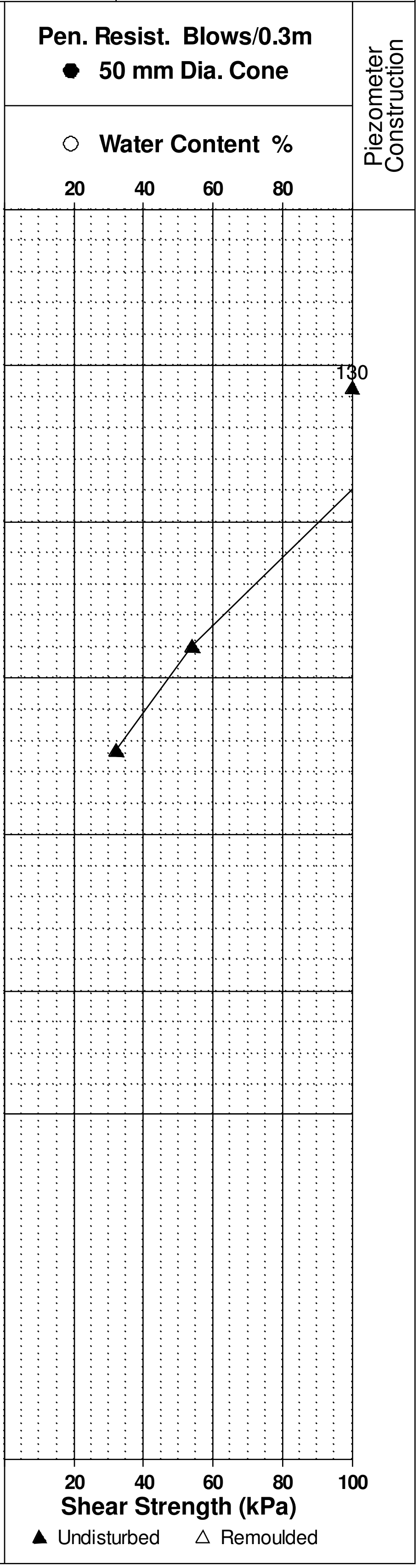
REMARKS

HOLE NO. TP 9

BORINGS BY Hydraulic Shovel

DATE December 7, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.15
TOPSOIL 0.23	■						
Very stiff to stiff, brown **SILTY CLAY** - rootlets noted to 1.2m depth	▨	G	1				
						1	91.15
		G	2			2	90.15
		G	3			3	89.15
- firm and grey by 3.2m depth		G	4				
		G	5			4	88.15
5.00							
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	^^^	G	6			5	87.15
5.79							
End of Test Pit Practical refusal to excavation at 5.79m depth (TP dry upon completion)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Mountshannon Drive
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Limited.

REMARKS

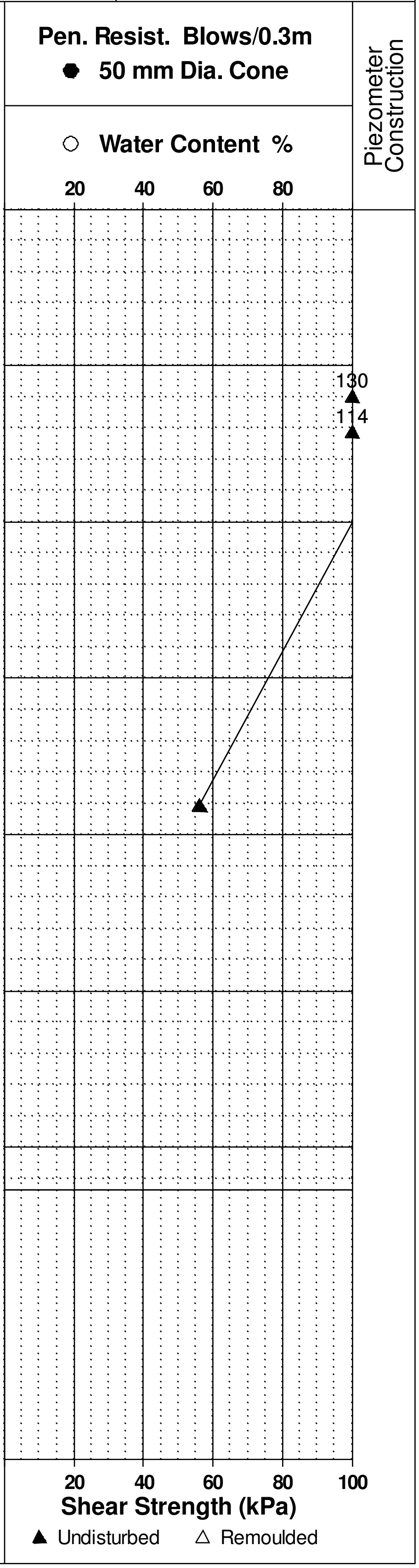
BORINGS BY Hydraulic Shovel

DATE December 7, 2012

FILE NO. PG2306

HOLE NO. TP10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.45
TOPSOIL 0.20							
FILL: Brown silty clay 0.70		G	1				
		G	2			1	91.45
		G	3			2	90.45
Very stiff to stiff, brown **SILTY CLAY**							
						3	89.45
						4	88.45
- firm and grey by 4.3m depth		G	4				
						5	87.45
5.50		G	5				
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders						6	86.45
6.27							
End of Test Pit							
(TP dry upon completion)							



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)

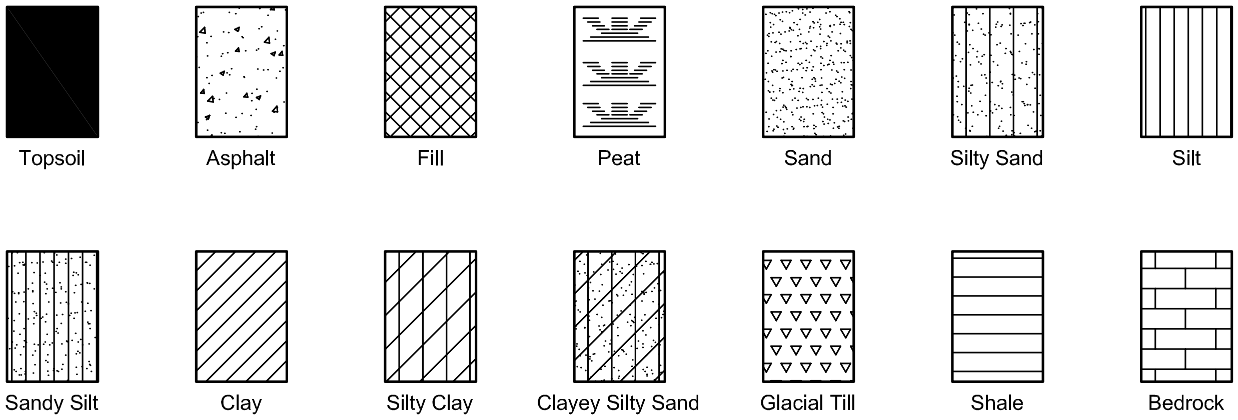
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

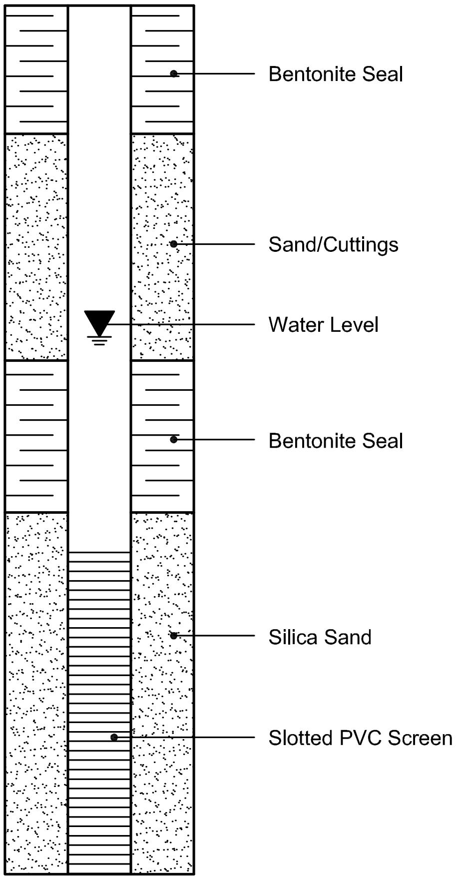
SYMBOLS AND TERMS (continued)

STRATA PLOT

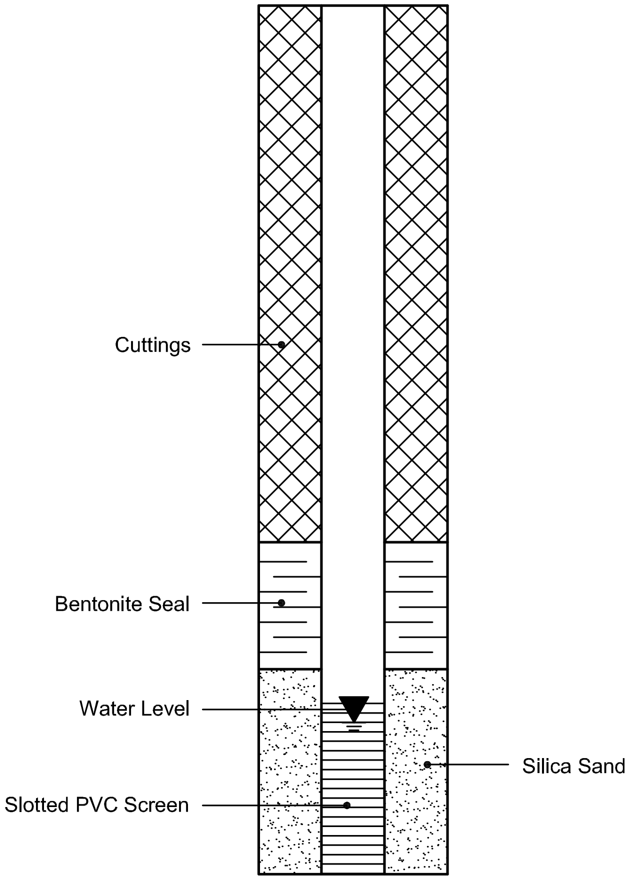


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: **Paterson Group Consulting Engineers**

Report Date: 24-Jan-2013

Order Date:21-Jan-2013

Client PO: 13707

Project Description: PG2306

	Client ID:	BH1-G4	-	-	-
	Sample Date:	07-Dec-12	-	-	-
	Sample ID:	1304050-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	63.2	-	-	-
General Inorganics					
pH	0.05 pH Units	7.14 [1]	-	-	-
Resistivity	0.10 Ohm.m	40.7	-	-	-
Anions					
Chloride	5 ug/g dry	<5 [1]	-	-	-
Sulphate	5 ug/g dry	53 [1]	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2306-1 - TEST HOLE LOCATION PLAN

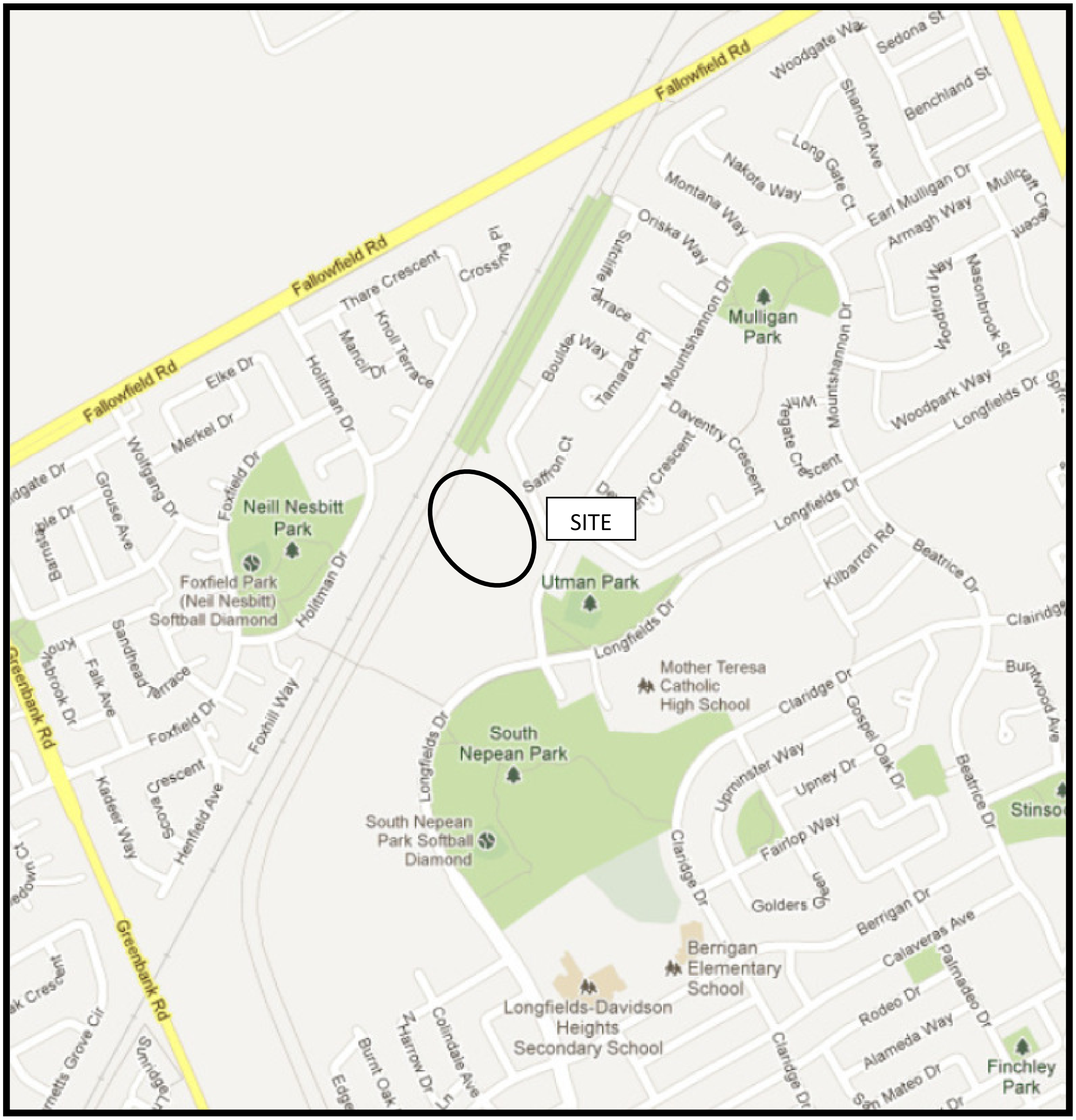
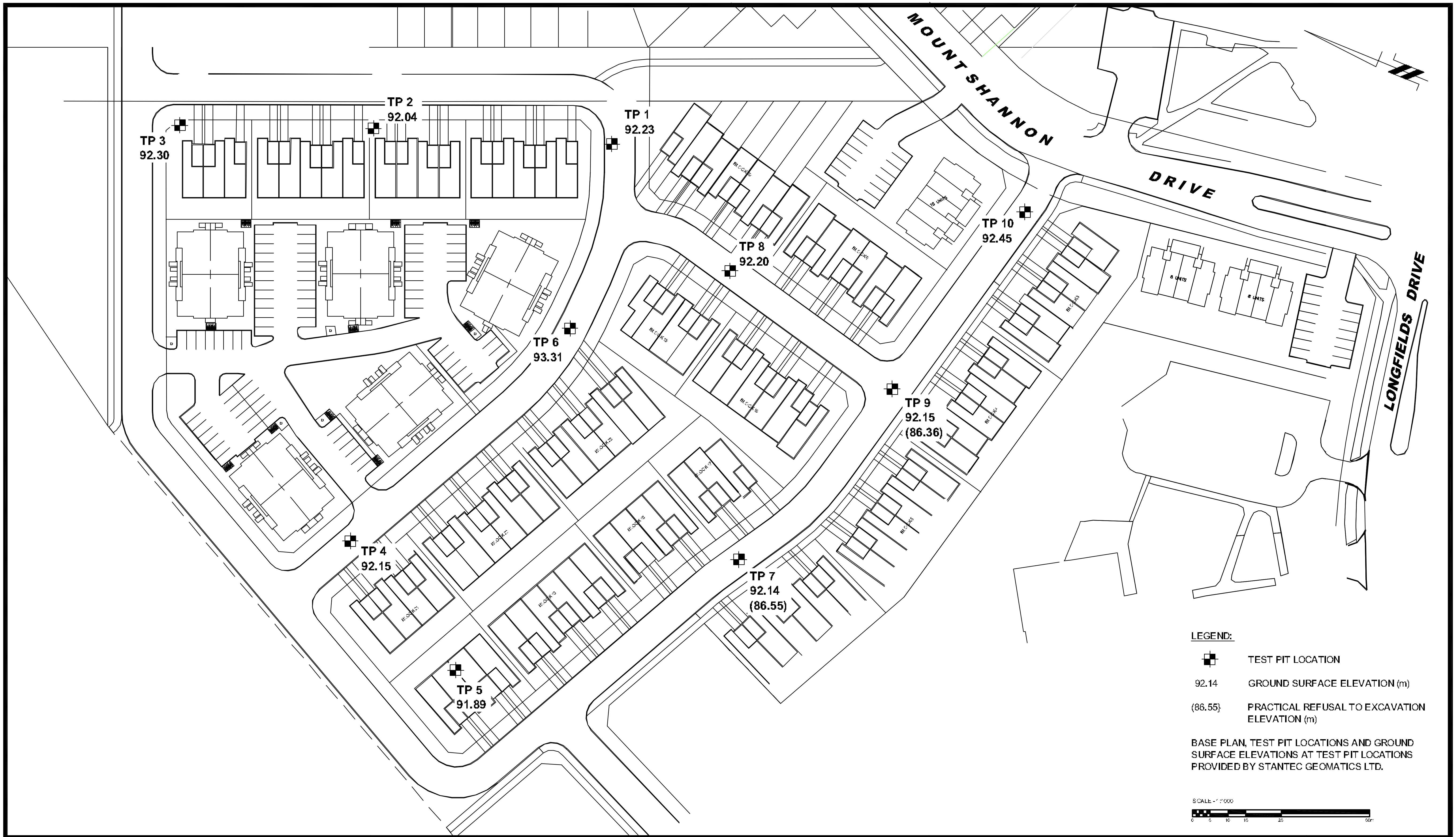


FIGURE 1

KEY PLAN



BASE PLAN, TEST PIT LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST PIT LOCATIONS PROVIDED BY STANTEC GEOMATICS LTD.

paterson group
consulting engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Scale: 1:1000
Des.: SB
Dwn: MPG
Chkd: DG

MATTINO DEVELOPMENTS
GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - MOUNTSHANNON DR.
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. **PG2306-1**
Report No.: PG2306-1
Date: 01/2013

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