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File: PG1716-LET.01

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

www.patersongroup.ca

Attention: **Mr. Roch Chevrier**

Subject: **Preliminary Geotechnical Investigation**
Proposed Residential Development - Foley Lands
March Road - Ottawa

Dear Sir,

Paterson Group (Paterson) was commissioned by Construction Junic to conduct a preliminary geotechnical investigation for the proposed residential development to be located along March Road, in the City of Ottawa, Ontario. The following letter report presents our findings and recommendations.

1.0 Field Observations

The subject site is currently vacant grass covered with several large trees bordering the property. The site slopes gradually downward from the west toward to the meandering creek located at the eastern portion of the subject site.

Eleven (11) test pits were excavated, using a hydraulic shovel and a rubber tired backhoe at selected locations across the proposed development. The approximate locations of the test pits are shown on Drawing PG1716-1 - Test Hole Location Plan attached to this letter.

Generally, the subsoil conditions at the test hole locations consist of topsoil underlain by very stiff brown silty clay or bedrock. Glacial till was encountered below the silty clay at TP's 1, 3, 4, 5, 9, 10 and 11 at depths varying between 1.1 m and 2.1 m below ground surface. Practical refusal to excavation was encountered from surface to 3.2 m below surface at all test hole locations.

Groundwater was encountered at TPs 1, 3, 4, 5, 9 and 10 varying in depths between 1.1 to 2.7 m during our field investigation. TP 2, 6, 7, 8 and 11 were dry at the time of excavation. Groundwater levels fluctuate seasonally and may be encountered at higher or lower levels during construction.

2.0 Preliminary Geotechnical Assessment

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

Site Preparation and Fill Placement

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

Fill used 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. 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 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.

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting. Prior to considering blasting, the blasting effects on the existing buildings and structures should be considered. As a general guideline, peak particle velocities should not exceed 50 mm/sec (measured at the structure) during the blasting program to reduce the risks of damages to the existing structures. Blasting close to freshly placed concrete should also be closely controlled.

The blasting operations should be carried out under the supervision of a licensed professional engineer who is also a blasting expert.

A pre-blast or preconstruction survey of the existing surrounding structures should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

Foundation Design

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** can be used for footings, up to 3 m wide, placed on an undisturbed, silty clay or glacial till bearing surfaces. Footings placed on a clean, weathered bedrock can be designed using a bearing resistance value at SLS of **500 kPa** and a factored bearing resistance value at ULS of **750 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance values 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.

A clean, weathered bedrock surface consists of one from which all topsoil, soils, deleterious materials and loose rock have been removed prior to concrete placement.

A maximum permissible grade raise of 2 m is available in soil bearing areas for the subject site.

Design for Earthquakes

The site class for seismic site response can be taken as Class C for the shallow foundations bearing on very stiff silty clay or glacial till at the subject site. The soils underlying the subject site are not susceptible to liquefaction. A site class for seismic site response can be taken as Class A or B (depending on testing results) will be applicable for the shallow foundations bearing on bedrock are considered at this site. Once the results of the shear wave velocity testing are available, an addendum letter will be issued. Reference should be made to the latest revision of the 2006 Ontario Building Code for a full discussion of the earthquake design requirements.

Basement Slab

With the removal of all topsoil within the footprint of the proposed building, the native soil surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction. An assessment of the existing fill material to determine suitability as an acceptable subgrade should be carried out at the time of construction, once the footing excavations are completed and a large portion of the fill is exposed.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of a 19 mm clear crushed stone material. All backfill materials within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers. The fill should be compacted to at least 98% of its SPMDD.

Pavement Structure

Car only parking areas and access lanes are anticipated at this site. The subgrade material will consist mostly of silty clay or bedrock for the majority of the subject site. The proposed pavement structures are shown in Tables 1 and 2.

Table 1 - Recommended Pavement Structure - Driveways

Thickness mm	Material Description
50	**WEAR COURSE -** HL-3 or HL3-Fine Driveway Grade Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil, fill or OPSS Granular B Type II material placed over in situ soil or fill.	

Table 2 - Recommended Pavement Structure - Local Residential Roadways	
Thickness (mm)	**Material Description**
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** 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

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 100% of the material's SPMDD using suitable compaction 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 its load carrying capacity.

The subgrade soil will consist predominantly of silty clay or bedrock. Consideration should be given to installing subdrains at each catch basin installed. These drains should be at least 3 m long and should extend in four orthogonal directions or longitudinally when placed along a curb. The clear stone surrounding the drainage lines or the pipe itself, should be wrapped with a suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

3.0 Design and Construction Precautions

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 mm 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. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose.

Protection of Footings Against Frost Action

Perimeter footings of heated structures should be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or insulation equivalent) should be provided in this regard. A minimum 2.1 m thick soil cover (or insulation equivalent) should be provided for other exterior unheated footings, such as those for isolated exterior piers.

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 Type 2 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.

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.

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 an non-aggressive to slightly aggressive corrosive environment.

4.0 Recommendations

It is a requirement for the design data provided herein to be applicable that an acceptable materials testing and observation program, including the aspects shown below, 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 and follow-up field density tests to determine the level of compaction achieved.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

Upon demand, a report confirming that these works have been conducted in general accordance with our recommendations could be issued following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

5.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available. Also, our recommendations should be reviewed when the project drawings and specifications are complete.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request that we be notified immediately in order to permit reassessment of our 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 Construction Junic.

Best Regards,

Paterson Group Inc.

Richard Groniger, Technologist.

Carlos P. Da Silva, P.Eng

Attachments

- ❏ Soil Profile and Test Data Sheets
- ❏ Analytical Testing Results
- ❏ Drawing PG1716-1 - Test Hole Location Plan

Report Distribution

- ❏ Construction Junic (3 copies)
- ❏ Paterson Group (1 copy)

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Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

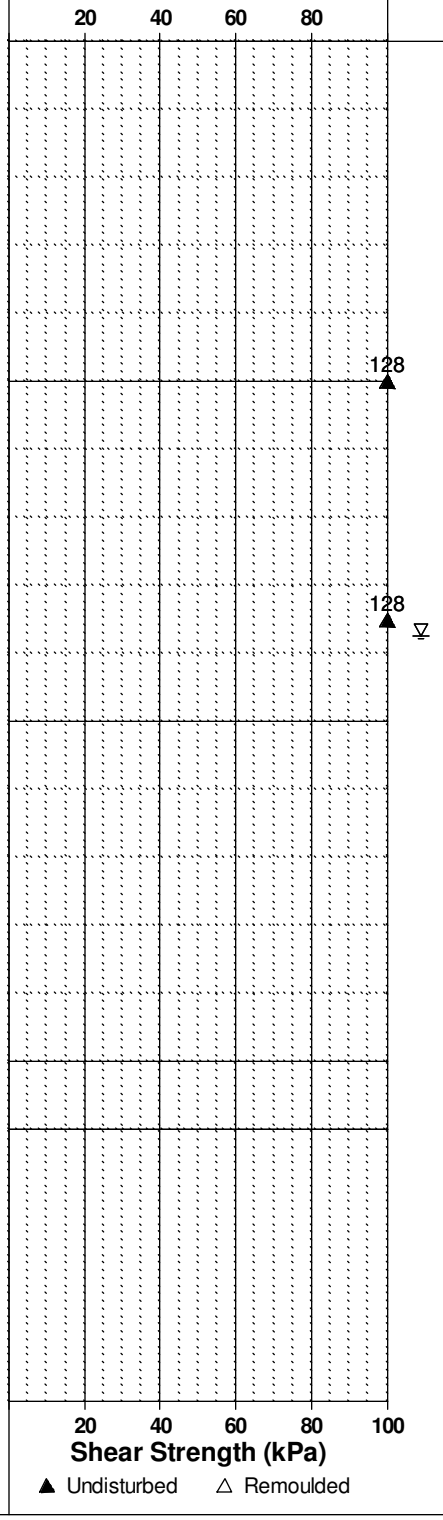
REMARKS

HOLE NO. TP 1

BORINGS BY Hydraulic Shovel **DATE** July 9, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.70
TOPSOIL							
0.25							
Very stiff, brown **SILTY CLAY**							
- grey by 0.5m depth						1	80.70
2.10							
GLACIAL TILL: Compact to dense grey silty clay, trace sand and gravel		G	1			2	79.70
						3	78.70
3.20							
End of Test Pit							
Practical refusal to excavation @ 3.20m depth							
(Open hole WL @ 1.75m depth)							

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



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

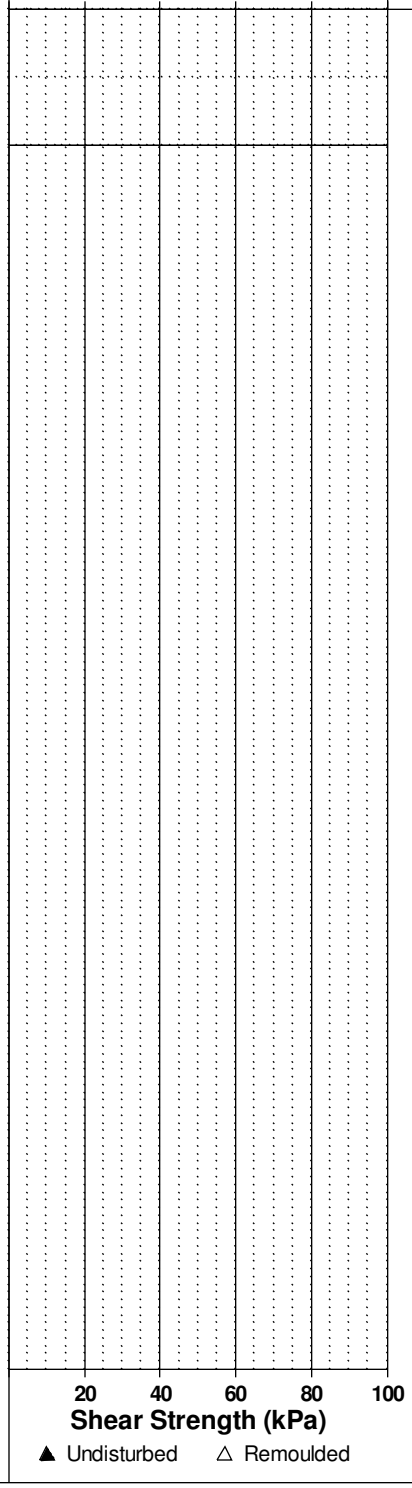
FILE NO. PG1716

REMARKS

HOLE NO. TP 2

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE						0	83.10		
TOPSOIL		G	1						
0.40									
End of Test Pit Practical refusal to excavation @ 0.40m depth									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

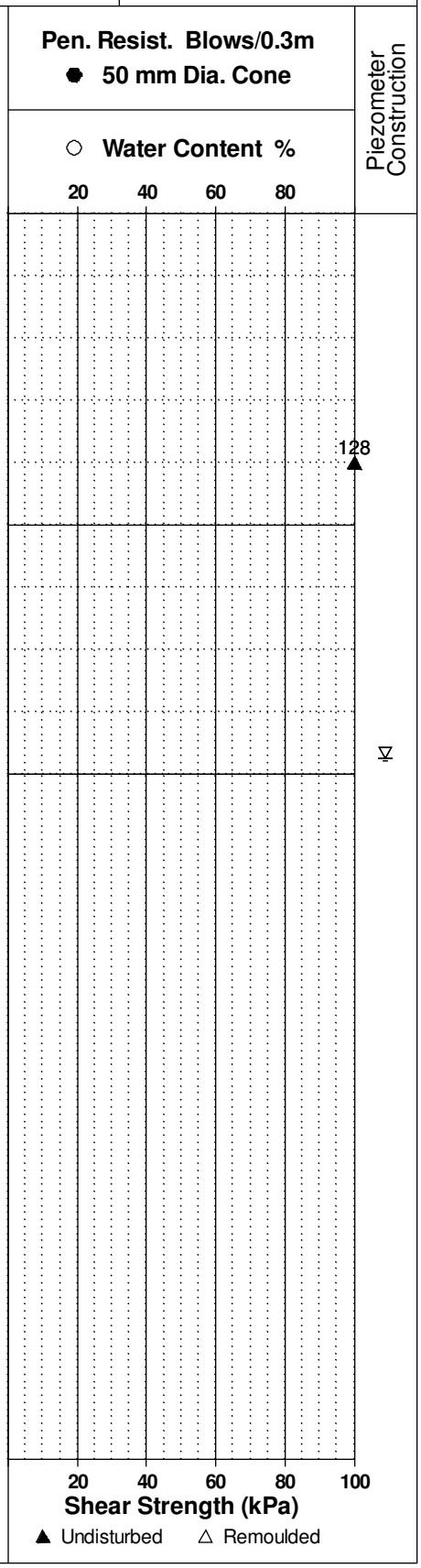
FILE NO. PG1716

REMARKS

HOLE NO. TP 3

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	83.80
TOPSOIL							
0.25							
Hard, brown **SILTY CLAY**		G	1				
1.10						1	82.80
GLACIAL TILL: Dense brown silty clay, trace gravel and cobbles		G	2				
1.80							
End of Test Pit Practical refusal to excavation on inferred bedrock surface @ 1.80m depth (Open hole WL @ 1.75m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

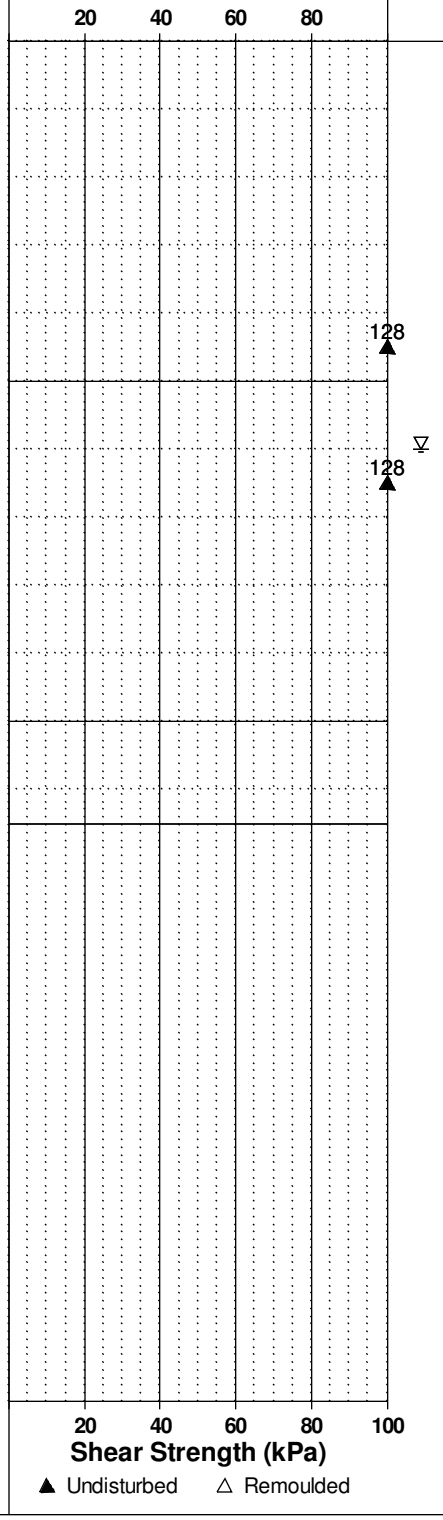
REMARKS

HOLE NO. TP 4

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	86.20
TOPSOIL							
0.30							
Hard, brown **SILTY CLAY**						1	85.20
1.55							
GLACIAL TILL: Brown-grey silty clay, some sand and cobbles		G	1			2	84.20
2.30							
End of Test Pit							
Practical refusal to excavation @ 2.30m depth							
(Open hole WL @ 1.2m depth)							

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



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SOIL PROFILE AND TEST DATA

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Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

REMARKS

HOLE NO. TP 5

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE						0	86.80		
TOPSOIL									
0.23									
Very stiff, brown **SILTY CLAY**		G	1			1	85.80		▽
1.60									
GLACIAL TILL: Compact to dense grey-brown silty clay, some gravel and cobbles		G	2			2	84.80		
2.50									
End of Test Pit									
Practical refusal to excavation @ 2.50m depth									
(Open hole WL @ 1.1m depth)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

REMARKS

HOLE NO. TP 6

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE						0	90.70		
TOPSOIL 0.30									
End of Test Pit Practical refusal to excavation on bedrock surface @ 0.30m depth									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

REMARKS

HOLE NO. TP 7

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE						0	89.40		
TOPSOIL 0.15									
GLACIAL TILL: Silty sand with gravel, cobbles and boulders 0.54									
BEDROCK: Weathered limestone						1	88.40		
1.35 End of Test Pit									
(TP dry upon completion)									

Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Foley Lands
Ottawa, Ontario

DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

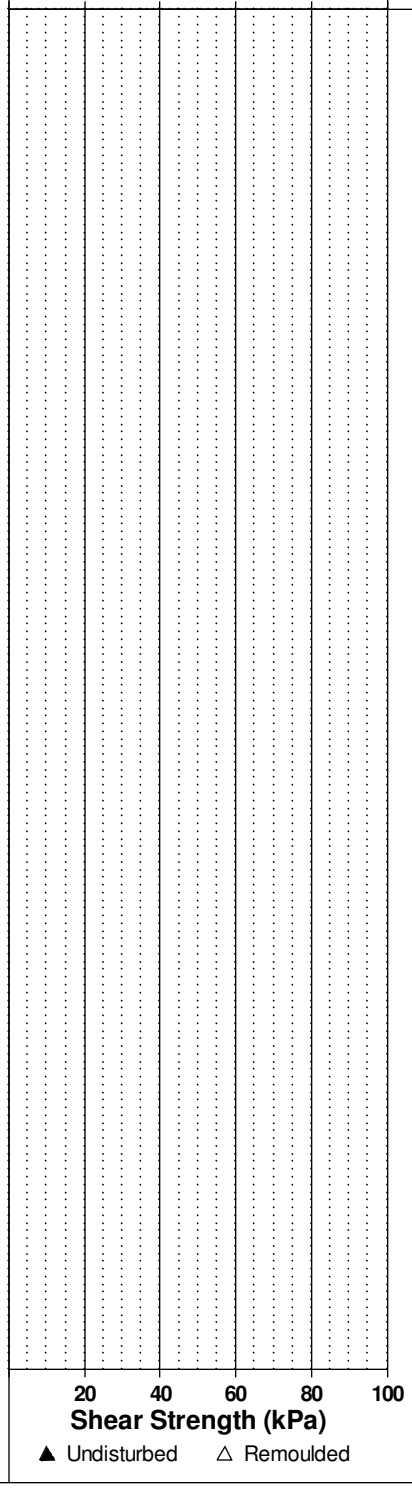
FILE NO. PG1716

REMARKS

HOLE NO. TP 8

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE									
Bedrock at surface						0	88.80		



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FILE NO. PG1716

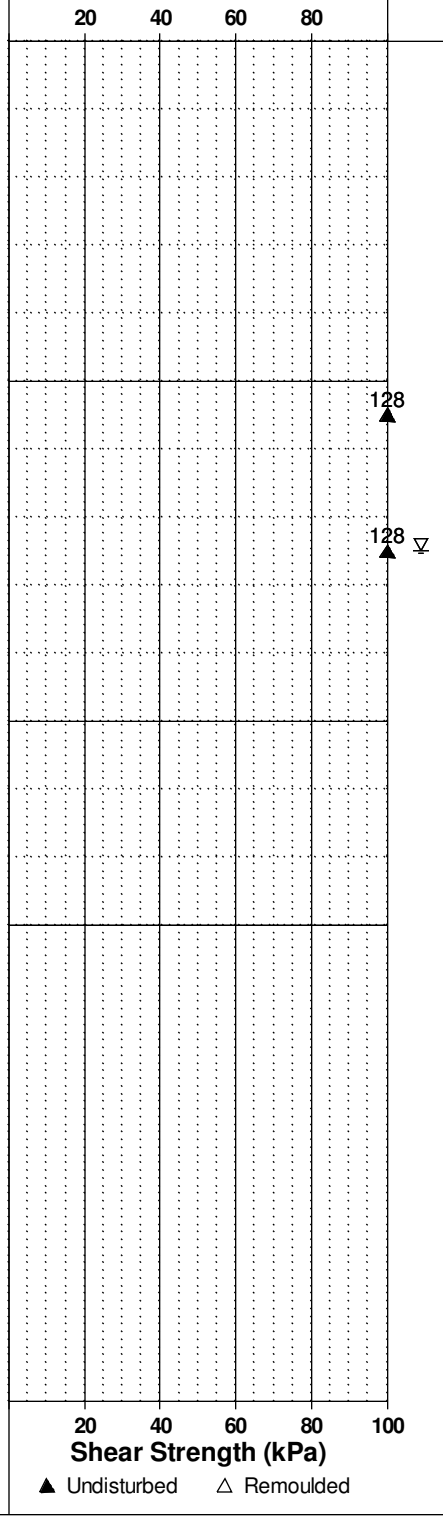
REMARKS

HOLE NO. TP 9

BORINGS BY Hydraulic Shovel **DATE** July 9, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	81.90
TOPSOIL							
0.30							
Very stiff, grey-brown **SILTY CLAY**		G	1			1	80.90
1.60							
GLACIAL TILL: Compact to dense brown-grey silty clay, trace gravel, cobbles and boulders						2	79.90
2.60		G	2				
End of Test Pit							
Practical refusal to excavation @ 2.60m depth							
(Open hole WL @ 1.5m depth)							

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



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SOIL PROFILE AND TEST DATA

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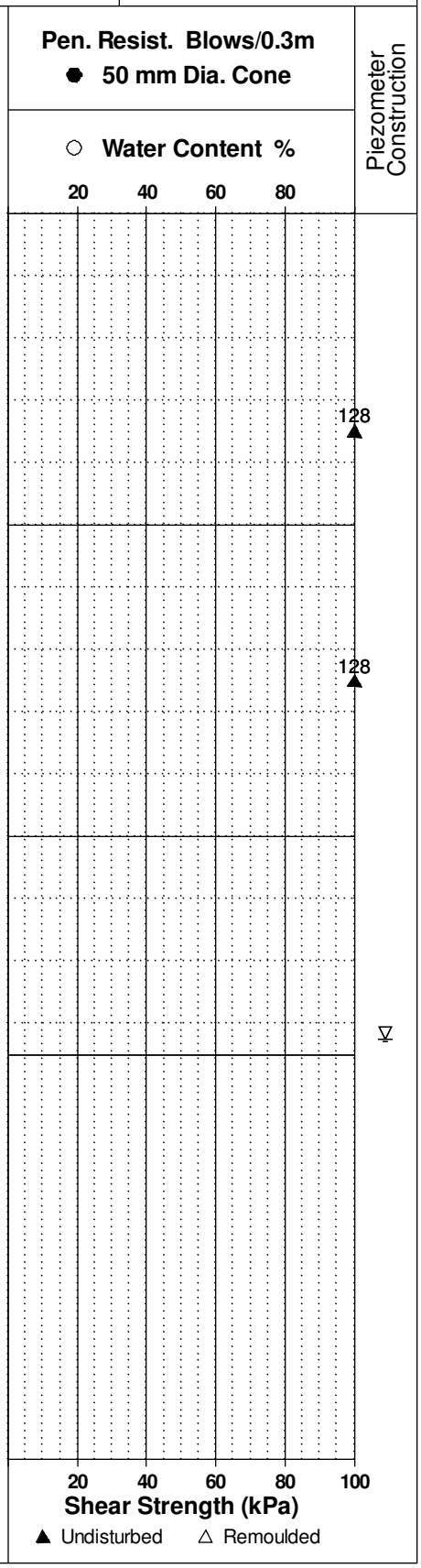
FILE NO. PG1716

REMARKS

HOLE NO. TP10

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

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 %	Piezometer Construction
GROUND SURFACE						0	88.40		
TOPSOIL									
0.35									
Very stiff, brown **SILTY CLAY**						1	87.40		
1.60									
GLACIAL TILL: Brown-grey silty clay, some gravel and cobbles						2	86.40		
2.70									
End of Test Pit Practical refusal to excavation @ 2.70m depth (Open hole WL @ 2.65m depth)									



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SOIL PROFILE AND TEST DATA

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DATUM TBM - Centreline of March Road, adjacent to the north property limit, assumed geodetic elevation = 82.00m.

FILE NO. PG1716

REMARKS

HOLE NO. TP11

BORINGS BY Rubber Tired Backhoe **DATE** July 9, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.50
TOPSOIL							
0.25							
Very stiff, brown **SILTY CLAY**						1	88.50
1.20							
GLACIAL TILL: Dense brown-grey silty clay, trace gravel and cobbles - boulders at 1.7m						2	87.50
2.00							
End of Test Pit Practical refusal to excavation @ 2.00m depth (TP dry upon completion)							

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

20 40 60 80

128

128

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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

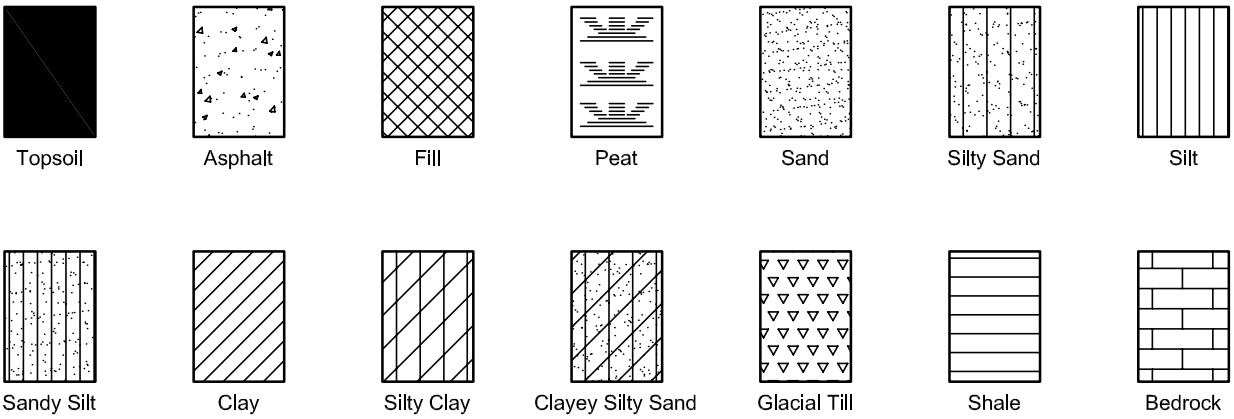
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void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

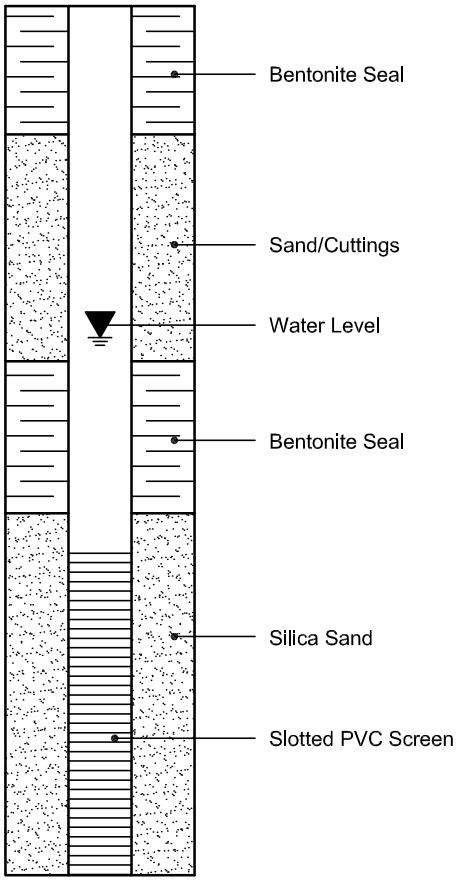
SYMBOLS AND TERMS (continued)

STRATA PLOT

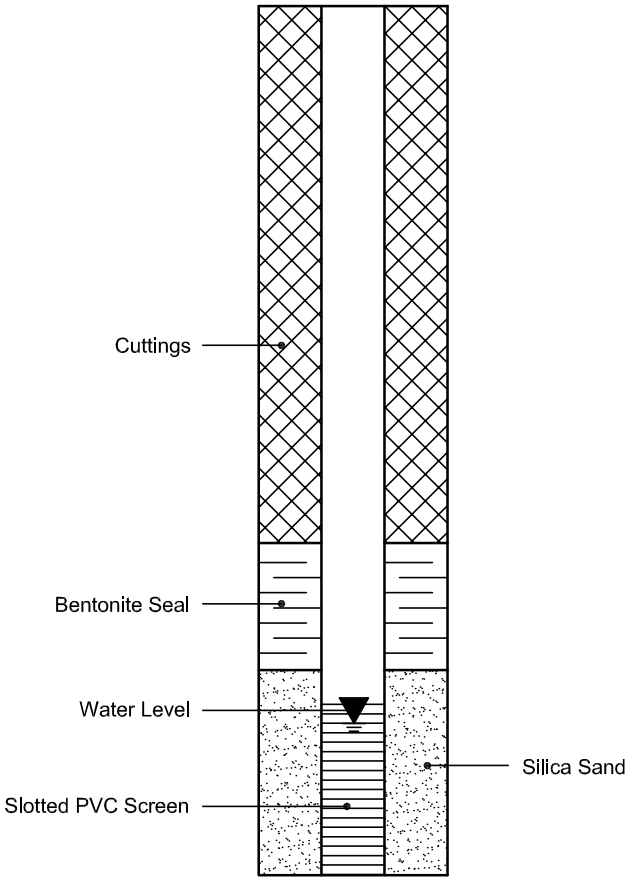


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PARACEL LABORATORIES LTD.

Order #: 0828132

Certificate of Analysis

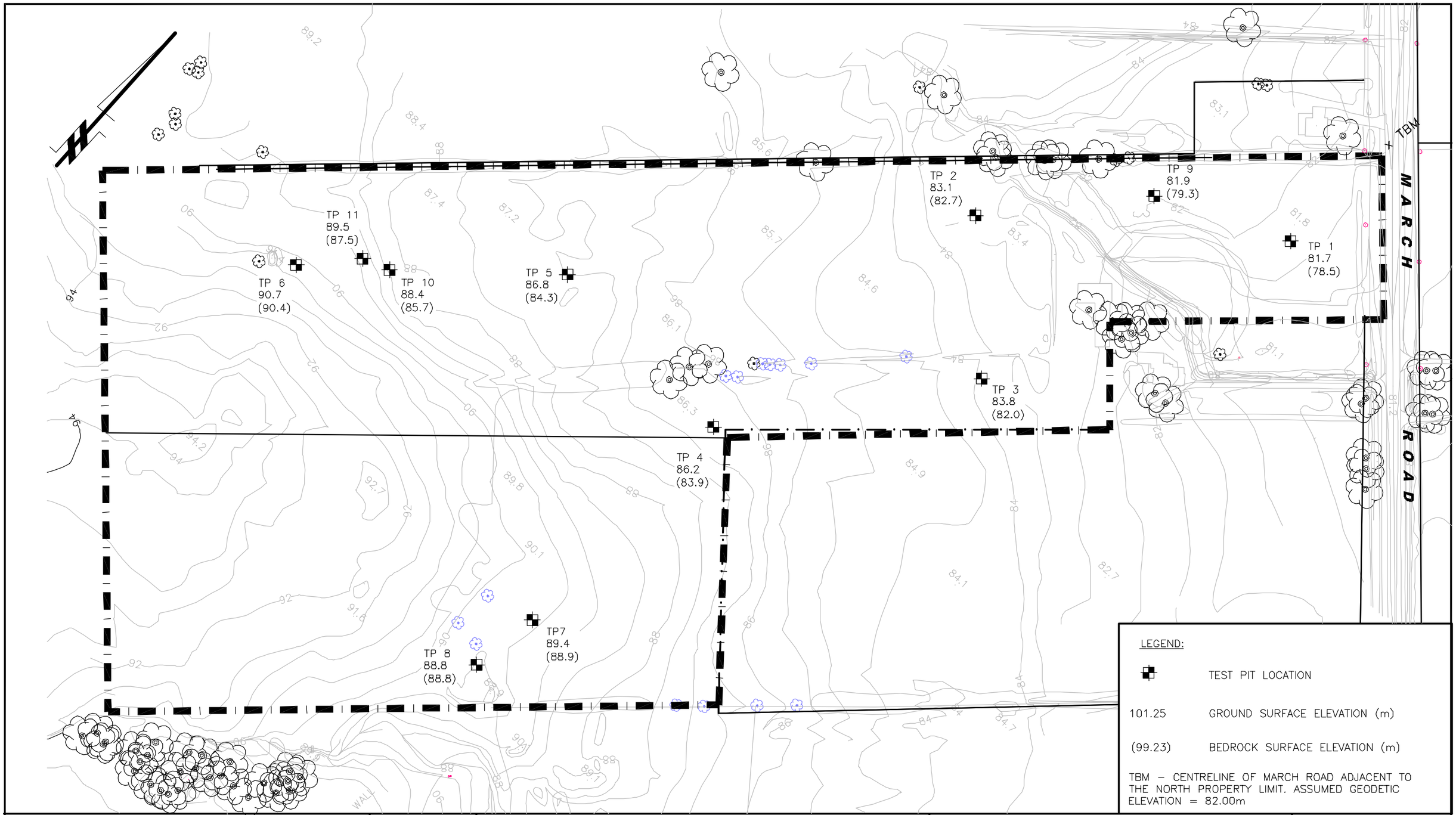
Report Date: 15-Jul-2008
Order Date:10-Jul-2008

Client: **Paterson Group Consulting Engineers**

Client PO: 6979

Project Description: PG1716

	Client ID:	TP5-G1	-	-	-
	Sample Date:	09-Jul-08	-	-	-
	Sample ID:	0828132-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	69.7	-	-	-
General Inorganics					
pH	0.05 pH Units	7.89	-	-	-
Resistivity	0.10 Ohm.m	112	-	-	-
Anions					
Chloride	5 ug/g dry	9	-	-	-
Sulphate	5 ug/g dry	174	-	-	-



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

Scale:	1:2000
Des.:	ML
Dwn:	MH
Chkd:	CDS

CONSTRUCTION JUNIC

PROPOSED RESIDENTAIL DEVELOPMENT
FOLEY LANDS – MARCH ROAD
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. PG1716-1
Report No.: PG1716-1
Date: 07/2008