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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Geological Engineering
Materials Testing
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November 25, 2013
File: PG2934-LET.01

**Ottawa Feed and Hardware Inc.**
**c/o Mar Gard Limited**
92 Bentley Avenue
Ottawa, Ontario
K2E 6T9

Attention: **Mr. Eric Cameron**

Subject: **Geotechnical Investigation**
**Proposed Commercial Development**
**4836 Bank Street - Ottawa**

Dear Sir,

Paterson Group (Paterson) was commissioned by Mar Gard Limited (Mar Gard) to conduct a geotechnical investigation for the proposed commercial development to be located at 4836 Bank Street in the City of Ottawa, Ontario. The following letter report presents our findings and recommendations.

Based on the conceptual drawing provided by Mar Gard Limited, it is understood that the proposed commercial development consists of two (2) commercial slab-on-grade buildings with associated asphaltic car parking, access lanes and landscaped areas.

## 1.0 Field Investigation

The fieldwork for our investigation was conducted on October 9, 2013, and consisted of extending a total of eight (8) test pits to a maximum depth of 4 m using a hydraulic excavator operated by a local contractor. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division.

The test hole locations were staked out in the field by personnel from Mar Gard and the approximate locations of the test holes are illustrated on Drawing PG2934-1 - Test Hole Location Plan attached to the present letter.

## 2.0 Field Observations

The ground surface across the subject site is relatively flat and slopes gradually down towards the east. An existing treed area is located within the west portion of the site and the south portion of the site is mostly grass covered. A commercial slab-on-grade building along with a paved parking area and a garden centre are located to the north of the proposed building locations.

The subsurface profile encountered at the test hole locations consists of a thin layer of topsoil and/or silty sand with organics overlying a compact to dense glacial till. The glacial till layer consists of a brown to grey silty sand to clayey silt mixed with gravel, cobbles and trace boulders to 4 m depth. Reference should be made to the Soil Profile and Test Data sheets attached to the present letter for specific details of the soil profile encountered at the test pit locations.

Based on available geological mapping, the site is located in an area where the bedrock consists of interbedded quartz sandstone, sandy dolostone and dolostone of the March formation at depths ranging from 3 to 5 m.

All test holes were noted to be dry upon completion, except TP 1 where water infiltration was noted at a 4 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

## 3.0 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed commercial development. It is expected that the proposed commercial slab-on-grade structures will be founded on conventional shallow footings placed over a compact glacial till bearing surface.

**Site Grading and Preparation**

Asphaltic concrete, 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. The fill 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 the 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 the 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 composite drainage system.

**Foundation Design**

Footings founded on an undisturbed, compact to dense glacial till bearing surface 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 **250 kPa**.

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.

Footings designed using the bearing resistance value at SLS provided will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. A geotechnical resistance factor of 0.5 was applied to the reported bearing resistance value at ULS.

**Lateral Support**

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a soil bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V, passes only through in situ soil or engineered fill of the same or higher capacity as the soil.

**Design for Earthquakes**

The proposed buildings at the subject site can be designed using a seismic site response **Class C** 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.

**Slab on Grade Construction**

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, the undisturbed native soil surface will be considered to be an acceptable subgrade 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, 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 an OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building addition should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

# 4.0 Design and Construction Precautions

### Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed buildings. 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.

### 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. 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 overburden materials should either be cut back at acceptable slopes 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 1.5H:1V or flatter. The flatter 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 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.

A trench box is recommended to be used at all times to protect personnel working in with steep or vertical sides. Services are expected to 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.

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

## 5.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ Sampling and testing of the concrete and fill materials used.
- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❏ Observation of all subgrades prior to backfilling.
- ❏ Field density tests to determine the level of compaction achieved.

Upon request, 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.

## 6.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. 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 Ottawa Feed and Hardware Inc, Mar Gard Limited or their agents is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Best Regards,

**Paterson Group Inc.**

Richard Groniger, C. Tech.


David J. Gilbert, P.Eng.

**Attachments**

- ❑ Soil Profile and Test Data sheets
- ❑ Figure 1 - Key Plan
- ❑ Drawing PG2934-1 - Test Hole Location Plan

**Report Distribution**

- ❑ Mar Gard Limited (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**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453934; 5017432

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**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 | |
| **FILL:** Brown silty sand with organics | | G | 1 | | | | |
| 0.25 | | | | | | | |
| | | G | 2 | | | 1 | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | | | | | 2 | |
| 3.80 | | | | | | 3 | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 3 | | | 4 | |
| 4.05 | | | | | | | |
| End of Test Pit | | | | | | | |
| (Water infiltration at 3.95m depth) | | | | | | | |

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

20 40 60 80

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

Piezometer Construction

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## SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453918; 5017456

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 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 % | Piezometer Construction |
|---|---|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | G | 1 | | | 1 | | | |
| | | | | | | 2 | | | |
| 3.65 | | | | | | 3 | | | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 2 | | | | | | |
| 4.00 | | | | | | 4 | | | |
| End of Test Pit | | | | | | | | | |
| (TP dry upon completion) | | | | | | | | | |

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

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**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453865; 5017389

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 3

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | |
| **FILL:** Brown silty sand with organics, topsoil, trace gravel and cobbles | | G | 1 | | | | |
| 0.75 | | | | | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | G | 2 | | | 1 | |
| | | | | | | 2 | |
| 2.50 | | | | | | | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 3 | | | 3 | |
| 3.95 | | | | | | | |
| End of Test Pit | | | | | | | |
| (TP dry upon completion) | | | | | | | |

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

20 40 60 80

Piezometer Construction

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

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## SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453857; 5017417

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 4

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | |
| **FILL:** Brown silty sand with organics, topsoil, trace gravel 0.20 | | G | 1 | | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | G | 2 | | | 1 | |
| 1.85 | | | | | | | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | | | | | 2 | |
| | | | | | | 3 | |
| 4.00 | | G | 3 | | | 4 | |
| End of Test Pit | | | | | | | |
| (TP dry upon completion) | | | | | | | |

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

20 40 60 80

Piezometer Construction

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

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## SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453811; 5017419

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 5

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | |
| **FILL:** Brown silty sand with organics, topsoil, trace gravel and cobbles | | G | 1 | | | | |
| 0.25 | | | | | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | | | | | 1 | |
| | | G | 2 | | | 2 | |
| 3.20 | | | | | | 3 | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 3 | | | | |
| 4.00 | | | | | | 4 | |
| End of Test Pit | | | | | | | |
| (TP dry upon completion) | | | | | | | |

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

Piezometer Construction

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

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## SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453834; 5017419

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 6

| 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 | | | |
| **FILL:** Brown silty sand with organics, gravel, cobbles and boulders | | G | 1 | | | 1 | | | |
| 1.70 | | | | | | | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | G | 2 | | | 2 | | | |
| | | | | | | 3 | | | |
| 4.00 | | | | | | 4 | | | |
| End of Test Pit<br>(TP dry upon completion) | | | | | | | | | |

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

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**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 0453796; 5017456

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**HOLE NO.** TP 7

| SOIL DESCRIPTION | STRATA PLOT | SAMPLE TYPE | SAMPLE NUMBER | SAMPLE % RECOVERY | SAMPLE N VALUE or RQD | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| **GROUND SURFACE** | | | | | | 0 | |
| **FILL:** Brown silty sand with organics, gravel, cobbles, trace topsoil | | G | 1 | | | | |
| 0.80 | | | | | | | |
| | | G | 2 | | | 1 | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | | | | | 2 | |
| 3.00 | | | | | | 3 | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 3 | | | | |
| 4.00 | | | | | | 4 | |
| End of Test Pit | | | | | | | |
| (TP dry upon completion) | | | | | | | |

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

20 40 60 80

20 40 60 80 100

**Shear Strength (kPa)**

▲ Undisturbed △ Remoulded

Piezometer Construction

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## SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Commercial Development - 4836 Highway 31**
**Ottawa, Ontario**

**DATUM**

**REMARKS** GPS 18T 04538017; 5017455

**BORINGS BY** Backhoe **DATE** October 9, 2013

**FILE NO.** PG2934

**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 | |
| **FILL:** Brown silty sand with organics, trace topsoil and gravel | | G | 1 | | | | |
| 0.30 | | | | | | | |
| **GLACIAL TILL:** Compact to dense, brown sandy silt with gravel, cobbles and boulders | | G | 2 | | | 1 | |
| | | | | | | 2 | |
| 3.10 | | | | | | 3 | |
| **GLACIAL TILL:** Compact to dense, grey clayey silt with gravel, cobbles and boulders | | G | 3 | | | | |
| 4.00 | | | | | | 4 | |
| End of Test Pit | | | | | | | |
| (TP dry upon completion) | | | | | | | |

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

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

# SYMBOLS AND TERMS

## SOIL DESCRIPTION

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

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

The standard terminology to describe the 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<br>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

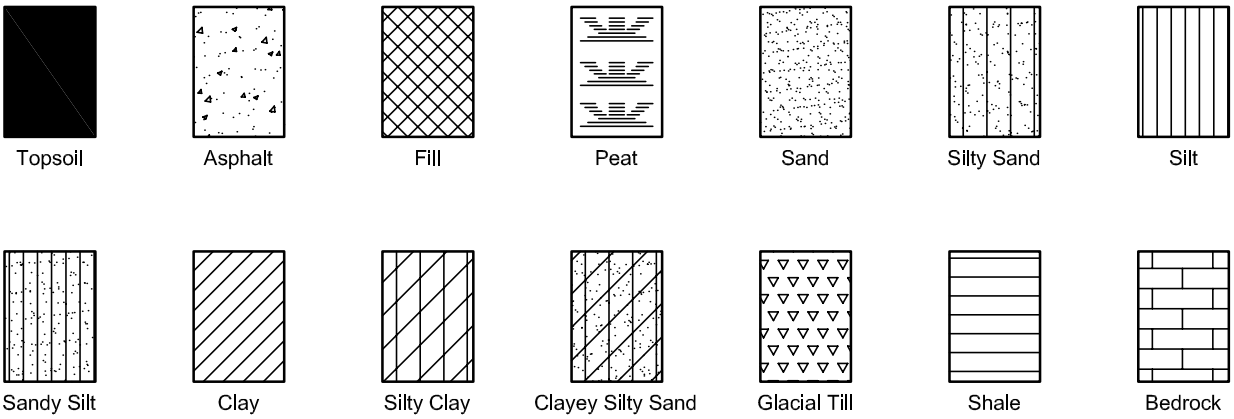
| | | |
|---|---|---|
| $p'_o$ | - | Present effective overburden pressure at sample depth |
| $p'_c$ | - | Preconsolidation pressure of (maximum past pressure on) sample |
| Ccr | - | Recompression index (in effect at pressures below $p'_c$) |
| Cc | - | Compression index (in effect at pressures above $p'_c$) |
| 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. |

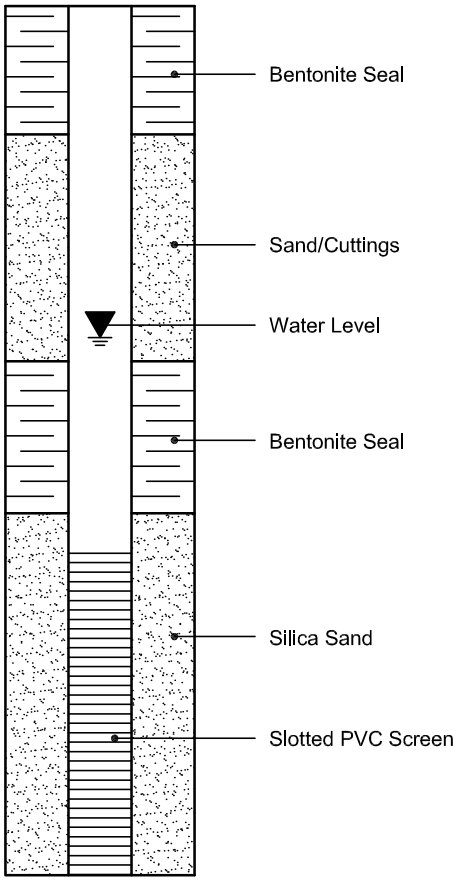
# SYMBOLS AND TERMS (continued)

## STRATA PLOT

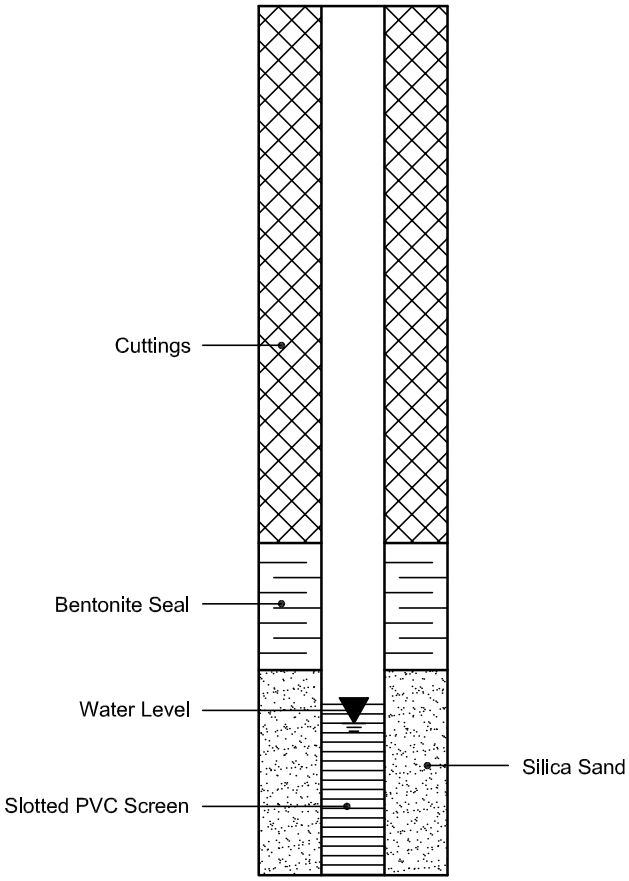



## MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION




PIEZOMETER CONSTRUCTION



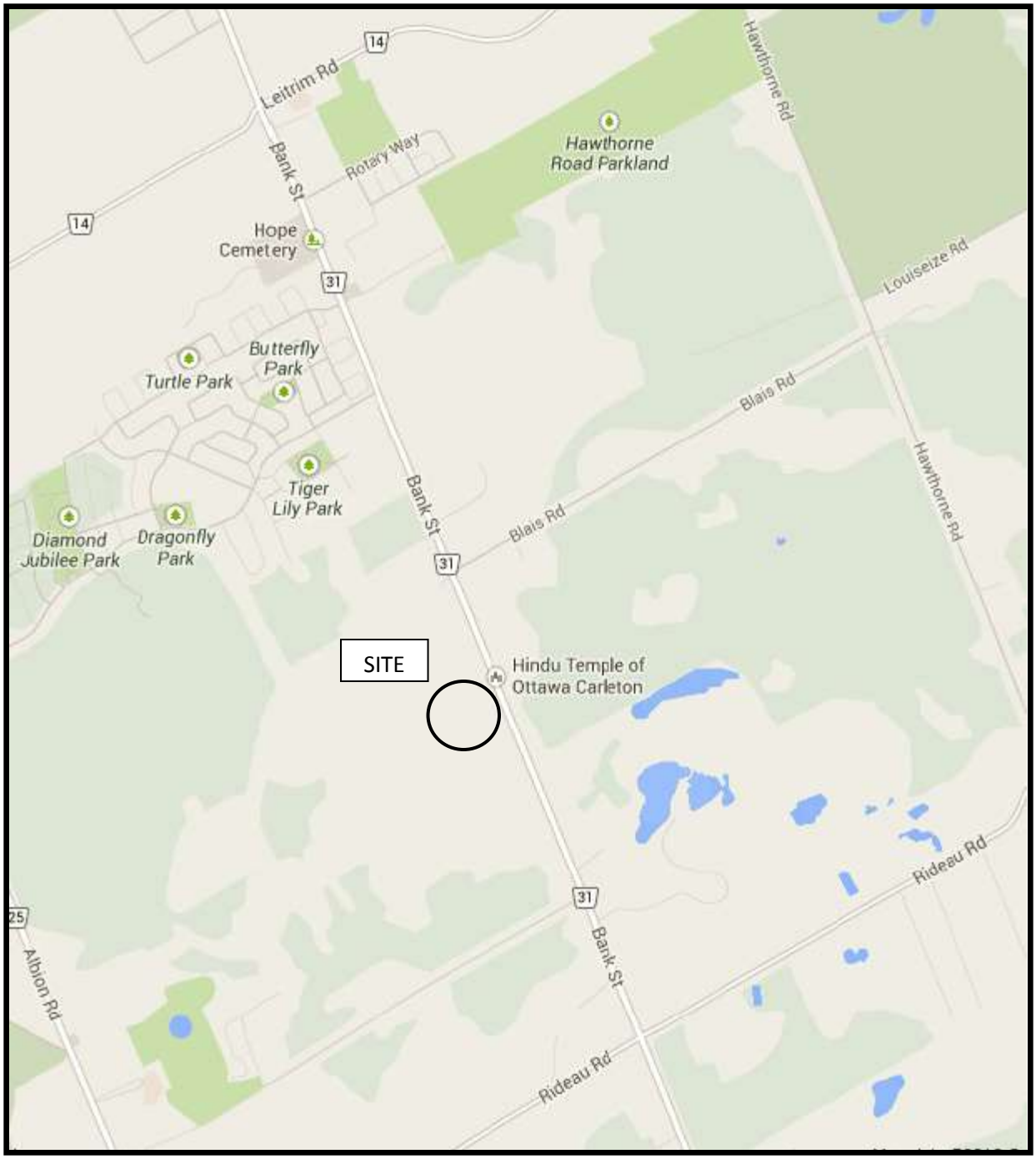
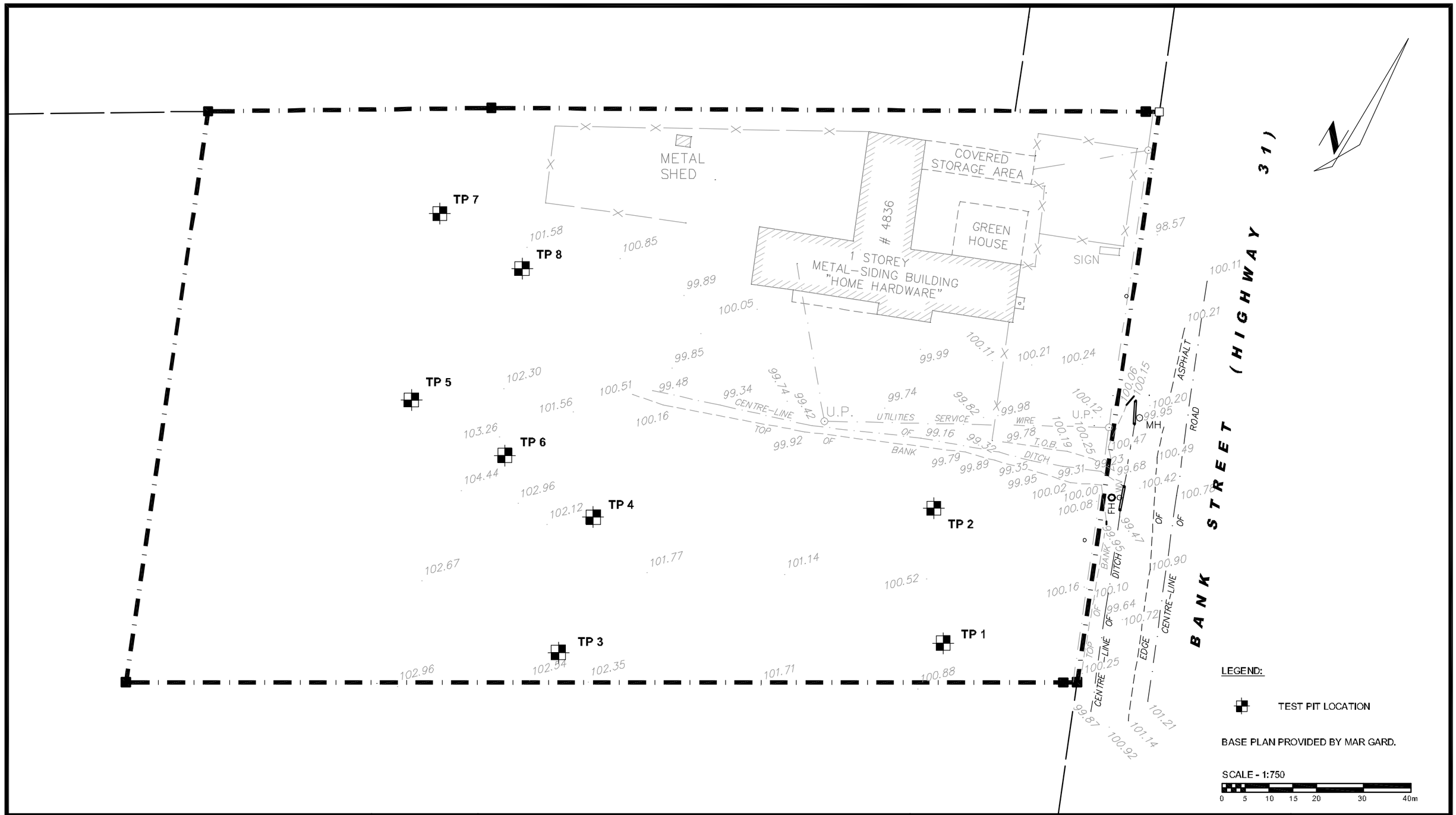



FIGURE 1

# KEY PLAN




| | | | |
|---|---|---|---|
| **paterson group**<br>consulting engineers<br>154 Colonnade Road South, Ottawa, Ontario K2E 7J5 | Scale: 1:750<br>Des.: RG<br>Dwn: MPG<br>Chkd: DG | MAR GARD<br>GEOTECHNICAL INVESTIGATION<br>PROP. COMMERCIAL DEVELOPMENT - 4836 HIGHWAY 31<br>OTTAWA, ONTARIO | **TEST HOLE LOCATION PLAN** | Dwg. No. **PG2934-1**<br>Report No.: PG2934-1<br>Date: 10/2013 |

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