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Supplemental Geotechnical Investigation Proposed Light Industrial Warehouse Development

4497 O'Keefe Court
Ottawa, Ontario

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Submitted to:

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Supplemental Geotechnical Investigation Proposed Light Industrial Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

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1.0 INTRODUCTION

This report presents the results of a supplemental geotechnical investigation carried for the proposed light industrial warehouse development at 4497 O'Keefe Court in Ottawa, Ontario.

The purpose of the investigation is to supplement existing site information by means of a limited number of additional test pits and, based on the factual information obtained, to provide engineering guidelines and recommendations on the geotechnical design aspects of the project, including construction considerations that could influence design decisions.

This report is subject to the Conditions and Limitations of This Report which follow the text of the report, and which are considered an integral part of the report.

2.0 BACKGROUND

2.1 Project Description

It is understood that the parcel of land at 4497 O'Keefe Court (herein referred to as the Site) has been zoned to permit construction of light industrial warehouses. Plans are now being prepared to submit an application to the City of Ottawa for Site Plan Approval for a proposed development consisting of a number of such structures at the Site.

Based on preliminary information provided by The Properties Group Management Ltd., GEMTEC understands that 3 warehouse structures are under consideration for the development. The warehouses will be slab on grade type structures (i.e., no basement).

A conceptual grading plan prepared by KWA Site Development Consulting Inc., dated April 2023 shows the proposed building locations with finished floor elevations at 109.1 metres elevation, 108.7 metres and 108.3 metres elevation. Further details of the structures are not available to GEMTEC at the time of preparing this report. Due to the uneven ground surface levels at the Site some cutting in the higher ground areas and filling in the lower ground areas will be required to achieve these levels. According to the drawing provided, the finished floor level of the northern most of the three structures is below the existing ground level (generally). The finished floor level for the central and southern structures is above the existing ground level.

A berm of (uncontrolled) fill material of unknown origin has been placed along the eastern and northern portions of the Site. The berms are up to about 4 to 5 metres above the rest of the Site. It is considered preferable, wherever possible, to maximize the reuse of existing soils on site for fill in the lower areas to achieve the proposed grades.

Vehicular access to the development will be provided from O'Keefe Court at the southern end of the Site. Surficial parking for light vehicles will be provided along the western side of the structures. The lands to the east of the structures will be surfaced to provide access to the warehouses for heavy vehicles / trailer traffic. The remaining portions of the Site will be landscaped and shaped to promote drainage to manage runoff and stormwater flows.

The buildings will be serviced by municipal water supply. Low Impact Development (LID) systems will be installed and a stormwater management pond may be constructed at the southeastern end of the Site. On-site treatment of wastewater is proposed using proprietary systems which will outlet to the stormwater management pond. A preliminary pond base level and outline of the pond perimeter has been provided but no further details of the stormwater management pond are not known at this time.

3.0 SUMMARY OF EXISTING INFORMATION

3.1 Site Geology

A review of geological resources indicate that the Site is located within an area where relatively thin deposits of glacial till overlying Paleozoic aged bedrock are mapped. Although not shown on the geology maps, these conditions have likely been changed to some extent and fill material from previous development of the Site should also be expected. This is discussed further in Sections 3.2 and 3.3 of this report.

A series of bedrock faults are shown in the area dividing the mapped upper bedrock units at the Site. The mapped bedrock is a combination of March Formation, Oxford Formation and Bobcaygeon Formation sedimentary rock types. These formations are described below:

- March Formation: Sandstone, dolomitic sandstone and dolostone;
- Oxford Formation: Dolostone with minor shale and sandstone;
- Bobcaygeon Formation: Limestone with minor shales in upper part.

Dolostone of the Oxford Formation is the predominant of the three formations mapped at the site.

3.2 Aerial Imagery

According to available online aerial imagery from maps.ottawa.ca, the Site has been used in the past for activities associated with a nearby quarry. This is discussed further in the report titled “Terrain Analysis and Hydrogeological Study, Proposed Commercial Development, Part 14, Lot 21, Concession 4 (R.F) Ottawa, (Nepean), Ontario”, prepared by Paterson Group Inc. and dated October 2006. The report states the lands on which the Site is located were previously used as a staging area for stockpiling and movement of materials from the quarry to the west.

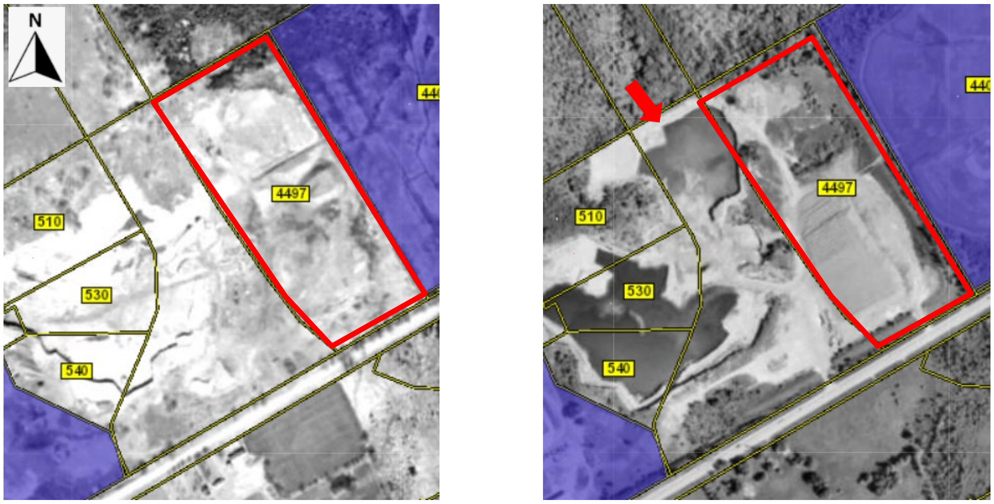
A series of historical images are provided below on Figure 3.1. For clarity, the approximate site boundary is shown in red outline. The dates of the imagery are provided below each photo.

The aerial imagery confirms the Site has been used previously for other activities which have changed the pre-existing (or naturally formed) conditions. The soil, and to a lesser extent the bedrock, have been ‘disturbed’ and soil and other materials have been placed on the Site. Groundwater conditions have likely also been altered. A summary of key observations from the imagery is provided below:

- Some uncontrolled filling has occurred on the Site, i.e. some soils (and possibly other materials) been placed on the Site by human activities, and the soils and materials were not placed in a manner intended for supporting structures. Uncontrolled fill may have been placed above the original ground level, and / or placed below original ground level within excavations.
- A significant body of water was present within an excavation area adjacent to and within the northern portion of the Site (see red arrow on 1991 aerial imagery). The waterbody has now been infilled, but the fill may be highly permeable, for instance a rock type fill. Water can flow quickly through the space between pieces of rock and a significant volume of water may still be present below the ground within the fill. It is understood that drainage works have also been installed the site.
- Other unusual subsurface conditions may also be encountered, i.e. a high degree of variability in the conditions is possible.
- Bedrock can be seen above the ground surface at or beyond the northwestern corner of the Site.

Please note, fill material in this report describes soils and other materials that have been placed by anthropogenic activities, either above or below the former ground surface and may have been placed:

- In a controlled manner (such as compacted pavement structural fill, engineered fill below structures, etc.); or
- In an uncontrolled manner (such as a waste material or loosely placed soil / fill). Uncontrolled fill material is expected to be highly heterogeneous and may contain deleterious materials.



Circa 1965

Circa 1991

Circa 2015

Circa 2021

Figure 3.1 – Aerial Imagery of Site (maps.ottawa.ca)

3.3 Previous Investigations at the Site

A series of previous investigations have been carried out at the Site by others. Records of previous investigations have been provided to GEMTEC via several geotechnical investigation reports, the most recent of which is titled “Geotechnical Investigation, Proposed Office / Warehouse Development, 4497 O’Keefe Court, Ottawa, Ontario” dated November 2015 prepared by Paterson Group Inc. This is Revision 2 of a previous version of the report prepared in April 2008. This report is referred to further as Paterson (2015).

Paterson (2015) summarises the previous investigations carried out at the site. Key points relating to the investigations are as follows:

- Records for 75 test pits and 4 boreholes (79 test holes in total) are provided in the report. More specifically:
  - TP1-08 to TP18-08 inclusive (18 No.) and TP21-08 to TP52-08 inclusive (32 No.).
  - TP1-07 to TP8-07, inclusive (8 No.)
  - BH1-06 to BH4-06, inclusive (4 No.)
  - TP1-06 to TP6-06, inclusive (6 No.)
  - TP/MW1 to TP/MW11, inclusive (11 No.)

- The test pits are not evenly distributed across the site. A higher concentration of test pits was carried out in the central western portion of the Site, possibly around some underground feature / anomaly at this location. This feature is described as a previously infilled trench, or which may be a stormwater drain, which originates to the west of the Site and may be transmitting water into / across the Site. The culverts associated with this drain may have been sealed off in 2015, however this has not been confirmed. The ground investigation points may also have been laid out around a previously proposed building(s) layout.
- Uncontrolled fill material was encountered from ground surface in many of the test pits. In many cases, excavation was carried out through the uncontrolled fill to reach the ‘native’ soils below or the bedrock level. The base of the fill material was not encountered in all instances, particularly in the northern portion of the site. The depth to bedrock was more frequently established in the western and southern portions of the site.
- Groundwater conditions in the test pits were variable, some test pits were dry and some encountered significant groundwater inflow. Significant groundwater may be encountered in the vicinity of the infilled trench feature, for instance in the vicinity of test pits 7-07 and 8-07.
- The test pits were loosely backfilled (i.e., the excavated material was loosely placed back into the excavation) and these test pit excavations now represents zones of disturbed ground which can affect future structures at the site.

The records of the ground investigation points from Paterson (2015) are provided in Appendix D with the associated Test Hole Location plan. It has not been verified if the locations of all the ground investigation points are shown on the Test Hole Location Plan provided in the report, or if the positions shown are accurate. It is noted that some test pit positions appear to have changed from previous reporting versions provided.

4.0 METHODOLOGY

The fieldwork for this supplemental investigation was carried out on June 23, 2023. At that time, 14 test pits numbered 23-01 to 23-12 inclusive, including 23-07A and 23-08A, were advanced at the locations shown on the Test Pit Location Plan, Figure A1 in Appendix A. The supplemental test pits were excavated predominantly in the eastern and northern portions of the site where less existing information was available, and where the berms of existing fill material are located. The positions were agreed with input from The Properties Group Management Ltd., and their representatives.

The test pits were advanced using a track-mounted hydraulic excavator (30 ton) supplied and operated by Dave Wright Excavating of Ottawa Ontario. The test pits were excavated to depths ranging from about 3.0 to 5.3 metres below the existing ground surface using a toothed bucket. The subsurface conditions in the test pits were determined based on visual and tactile examination of soils exposed on the sides and bottom of the excavations.

The fieldwork was observed by a member of our engineering staff who directed the excavation operations, observed the conditions in the test pits, and logged the samples and test holes. Following the fieldwork, the soil samples were returned to our laboratory for examination by a geotechnical engineer. Selected samples of the soil were tested for moisture content, Atterberg limits and grain size distribution testing.

The test pit locations were positioned at the site by GEMTEC relative to existing site features. The locations and ground surface elevations at the test pit locations were surveyed by GEMTEC using a high precision GPS survey instrument.

5.0 SUBSURFACE CONDITIONS

An overview of the subsurface conditions encountered in the test pits advanced as part of the GEMTEC supplemental investigation are presented in Table 5.1.

More detailed descriptions of the subsurface conditions logged in the test pits are provided on the Record of Test Pit Sheets in Appendix B. The results of the soil classification testing are provided in Appendix C and also on the Record of Test Pit Sheets.

Table 5.1 – Summary of Subsurface Conditions

Test Pit ID	Surface Elevation at Test Pit (metres)	Depth / Elevation to Base of Fill Material (metres)	Refusal Depth / Elevation (metres)
23-01	103.8	3.1 / 100.7	3.1 / 100.7
23-02	105.3	2.1 / 103.2	4.7 / 100.6
23-03	105.0	0.9 / 104.1	3.4 / 101.6
23-04	106.3	3.0 / 103.3	4.8 / 101.5
23-05	105.2	1.5 / 103.7	3.1 / 102.0
23-06	105.2	0.5 / 104.7	3.0 / 102.2
23-07	107.3	5.1 / 102.2	5.1 / 102.2
23-07A	107.8	3.0 / 104.8	5.3 / 102.5
23-08	109.0	4.9 / 104.2	4.9 / 104.2
23-08A	108.6	2.5 / 106.1	4.5 / 104.1
23-09	111.7	> 4.1 / < 107.6	N/A (in berm)
23-10	110.3	5.1 / 105.2	5.1 / 105.2
23-11	111.2	> 3.7 / < 107.5	N/A (in berm)
23-12	110.9	4.1 / 106.8	4.1 / 106.8

As a comparison, Paterson (2015) reports the following at the previous investigation points:

- Ground surface level ranging from about 104.6 to 111.9 metres elevation;
- Base of fill material (where established) ranging from 103.2 to 110.0 metres elevation;
- Refusal / Inferred bedrock level ranging from 99.7 to 109.1 metres elevation.

Further discussion of the subsurface conditions at the Site are provided in the subsections below.

5.1 Topsoil

A surficial layer of topsoil was encountered from ground surface at all of the test pit locations excluding test pit 23-03 from the GEMTEC supplemental investigation. The thickness of the topsoil layer ranges from about 100 to 300 millimetres. A similar surficial layer was not frequently reported in Paterson (2015).

5.2 Fill Material (Uncontrolled)

Fill material was encountered in all of test pits advanced at the site by GEMTEC and similarly was encountered in many of the test pits advanced by Paterson (2015). In the absence of any records of placement of the fill materials at the Site and based on the conditions encountered in the test pits the fill material is considered predominantly to be ‘uncontrolled’ fill.

The fill material is comprised of both coarse-grained (i.e. sands, gravels) and fine-grained (i.e. silts and clays) soil types. A detailed description of the fill material is not warranted, due to the potential for variability, however the following general trends were noted;

- The composition of the fill material is variable. An upper, predominantly coarse-grained, layer of fill material was encountered at several locations. Finer grained fill material was encountered with depth. Paterson (2015) also identifies fill material comprised of layers of cobbles and boulders, and ‘blast rock’. These layers are inferred to be made up predominantly of large fragments of rock.
- The depth to the base of the fill material is variable. Fill material was present to bedrock in some locations. In other locations the fill material overlies native soils.
- Within the fill material, a range of deleterious materials was observed including hard material such as large fragments of rock, construction debris such as steel cabling, asphalt, reinforced concrete, refuse, fragments of wood and other organic mater. Voids were noted between fragments of rock and reinforced concrete.

For details of the conditions at specific locations refer to the test pit logs in Appendix D.

GEMTEC has considered the depths to the base of the fill material from the combined records of investigation carried out to date (i.e. by GEMTEC and as presented in Paterson (2015)). Assuming a similar system of survey was used for both investigations the distribution of elevation of the base of fill material is shown in Figure 5.1 below.

From the histogram, noting that the investigation points are not evenly distributed across the Site, it is evident that the elevation of the base of fill material is relatively widely and evenly distributed between a range of levels, from about 104 to 109 metres elevation.

The test pits previously advanced at the site through the various phases of investigation and infilled with the excavated soils are now considered zones of fill material.

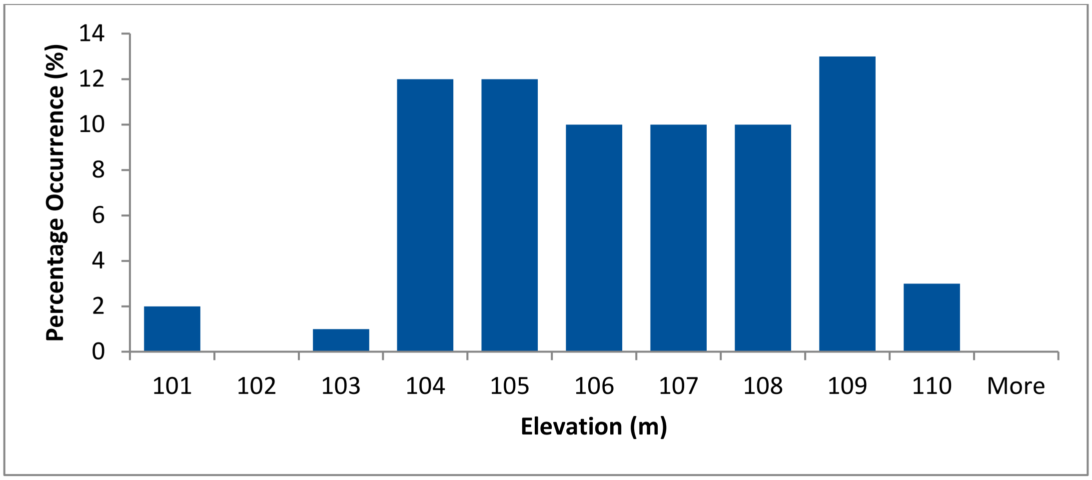


Figure 5.1 – Histogram showing Distribution of Estimated Base of Fill Elevations

A series of particle size distribution tests were performed by GEMTEC on samples of the fill material. The results of the testing are provided in Appendix C and summarized in Table 5.2 below.

Table 5.2 – Summary of Particle Size Distribution Testing, Fill Material

Test Pit ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-01	3	2.2 – 2.8	0.0	28	72 (combined)	
23-09	1	0.5 – 0.9	37	44	19 (combined)	
23-11	2	0.6 – 1.0	26	41	33 (combined)	
23-11	4	2.5 – 3.1	54	29	17 (combined)	
23-12	1	0.3 – 0.5	43	43	14 (combined)	

Moisture content testing on samples of the fill material returned values in the range of 4 to 36 percent by mass. The range of values likely reflects the variable nature of the fill material, with lower values likely indicating the presence of coarse-grained layers and higher values the presence of finer grained layers.

5.3 Former Topsoil Layer

A layer of (former or buried) topsoil was encountered below the fill material in numerous test pits from the GEMTEC supplemental investigation and the Paterson (2015) investigations.

Where it could be measured, the former topsoil layer ranges in thickness from about 100 to 150 millimetres. Refer to the test pit logs for details.

A moisture content test was carried out on a sample of the former topsoil layer which returned a value of about 57 percent. The (relatively high) value may be due to the presence of organic material within the layer, and the saturated condition of the layer at this location.

5.4 Silty Clay, Native

A native (i.e. naturally deposited) layer of silty clay was encountered in a relatively small number of test pits below the fill material and former topsoil layers. This unit was encountered in the test pits advanced by GEMTEC as part of the supplemental investigation and in the test pits documented in Paterson (2015).

Specific details of the consistency of the silty clay were not provided, although the silty clay is inferred to be weathered to a crust in general, which suggests that very soft of soft zones of silty clay are likely not present.

The silty clay unit does not appear to be present as a continuous layer throughout the site, but rather is inferred to be present in isolated locations.

One particle size distribution test was performed on a sample of the silty clay. The results of the testing are provided in Appendix C and summarized in Table 5.3 below.

Table 5.3 – Summary of Particle Size Distribution Testing, Silty Clay

Test Pit ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-03	4	2.1 – 3.0	2	34	64 (combined)	

The results of Atterberg limit testing carried out on a sample of the silty clay are provided on Plasticity Chart in Appendix C and summarized in Table 5.4. Moisture content testing on samples of the silty clay returned values in the range of 12 to 52 percent by mass.

Table 5.4 – Summary of Atterberg Limit Testing, Silty Clay

Test Pit ID	Sample Number	Sample Depth (metres)	Water Content (%)	LL (%)	PL (%)	PI (%)
23-07 A	4	3.1 – 3.3	12	21	13	8

5.5 Glacial Till, Native

A native deposit of glacial till was encountered in several of the test pits advanced by GEMTEC and Paterson (2015), below either the fill material and former topsoil, the silty clay or in a few instances below topsoil.

Glacial till is a heterogeneous mixture of all grain sizes; however, at this site the glacial till can generally be described as brown sand with varying amounts of silt and gravel. Cobbles and boulders are frequently encountered in the glacial till.

Similar to the silty clay deposits, the glacial till unit does not appear to be present as a continuous layer throughout the site, but rather is present in isolated locations, albeit at increased frequency.

Two particle size distribution tests were performed on samples of the glacial till. The results of the testing are provided in Appendix C and summarized in Table 5.5. Moisture content testing on samples of the glacial till returned values in the range of 9 to 22 percent by mass.

Table 5.5 – Summary of Particle Size Distribution Testing, Glacial Till

Test Pit ID	Sample Number	Sample Depth (metres)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
23-02	4	2.5 – 3.0	32	49	19 (combined)	
23-06	4	2.1 – 2.4	13	41	46 (combined)	

5.6 Silty Sand

A layer of silty sand was identified in a low number of test pits documented in Paterson (2015). Similar layers were not identified in the GEMTEC supplemental investigation. It is possible that this layer is part of the glacial till unit, given that it is noted to contain gravel, cobbles and occasionally boulders.

Standard penetration tests (SPT) carried out in the silty sand layers from Paterson (2015) indicate dense or very dense state in general. These values are also typically more representative of glacial till.

5.7 Refusal / Inferred Bedrock

Bedrock levels at the Site have been generally inferred from either refusal to further excavation of the test pits, or in a few instances from the depth of auger advancement refusal in the boreholes.

GEMTEC has considered the refusal depths from the combined records of investigation carried out to date, i.e. by GEMTEC and as presented in Paterson (2015). Assuming a similar system of survey was used for both investigations the distribution of elevations to refusal is shown in Figure 5.2 below. From the histogram, noting that the investigation points are not evenly distributed across the Site, the reported refusal elevation shows a high degree of variability, i.e. the bedrock level at the site is variable. It is possible that the bedrock levels (and bedrock conditions) have been affected by the faulting mapped in the area of the Site.

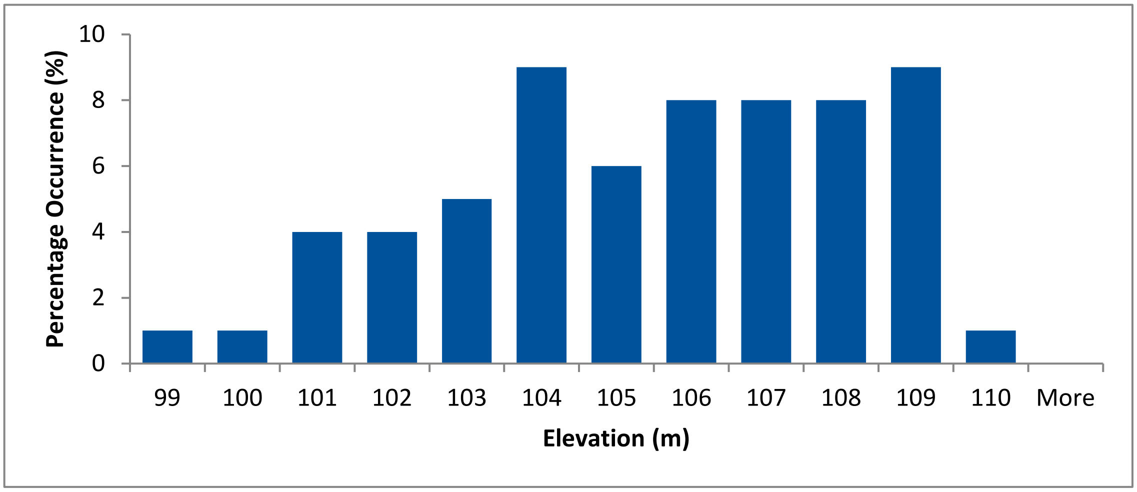


Figure 5.2 – Histogram showing Distribution of Refusal Levels

5.8 Groundwater

Groundwater inflow was observed in a number of test pits. Table 5.6 provides a summary of the location and depths at which groundwater was encountered in the GEMTEC supplemental investigation. Groundwater inflows were frequently observed from apparently perched water levels within the fill material (i.e. where coarse-grained soils overlie lower permeability fine-grained soils and groundwater collects within the upper soil layer). The groundwater inflow rates were highest at the location of test pit 23-03, located in a portion of the site where surface water was present.

The depth to groundwater reported in Paterson (2015) ranges from near surface to below the level of excavation (i.e. the test pit was dry). The highest level at which groundwater was noted is at 109.4 metres elevation. Particularly high inflow rates were noted in test pits 7-07 and 7-08 located in the central western portion of the site close to the assumed buried drainage feature (albeit that other test pits in same area did not encounter similar inflow / seepage conditions).

The groundwater levels are expected to vary seasonally and may be higher during wet periods of the year such as the early spring or following periods of precipitation. Water levels at the site may also be influenced by the existing of drainage features.

Table 5.6 – Summary of Groundwater Observations

Test Pit ID	Groundwater depth / elevation	Seepage / Inflow Rate	Refusal Depth / Elevation
23-01	2.0 / 101.8	Slow	3.1 / 100.7
23-02	3.0 / 102.4	Slow	4.7 / 100.6
23-03	1.1 / 103.9	Moderate	3.4 / 101.6
23-04	0.5 / 105.8	Slow	4.8 / 101.5
23-05	Dry	N/A	3.1 / 102.1
23-06	3.0 / 102.2	Slow	3.0 / 102.2
23-07	3.5 / 103.8	Slow	5.1 / 102.2
23-07A	3.0 / 104.8	Slow	5.3 / 102.5
23-08	4.0 / 105.0	Slow	4.9 / 104.2
23-08A	3.0 / 105.6	Slow	4.5 / 104.1
23-09	Dry	N/A	N/A
23-10	Dry	N/A	5.1 / 105.2
23-11	Dry	N/A	N/A
23-12	4.1 / 106.8	Slow	4.1 / 106.8

6.0 RECOMMENDATIONS AND GUIDELINES

6.1 Grade Raise Restrictions

As previously indicated a cut / fill program is anticipated at the Site. In fill areas, based on the conditions encountered in the test pits, no practical limit on grade raise filling applies to the site from a geotechnical perspective, noting that the existing fill material and buried former topsoil will experience some settlement over time if left in place.

6.2 Seismic Site Class and Potential for Liquefaction

Based on the results of this investigation, it is recommended that seismic Site Class C be used for the design of the structure, based in part on the assumption of reasonably shallow bedrock at the site.

A higher Site Class may be achieved if additional testing by geophysical methods is carried out. GEMTEC can carry out an MASW survey, if requested, to achieve the higher value which may have significant savings for the structural design.

There is no potential for soil liquefaction at this site. Instability of the test pit walls was triggered by groundwater inflow, and the sand layers were noted to contain lenses with increased fine-grained soil content. Further, the existing fill material layer require remediation, or the structures will be isolated from these materials.

6.3 Proposed Structure Foundation Alternatives

Due to the presence of uncontrolled fill material at the Site, the following approaches may be considered for the support of the proposed structures:

- Excavation and compaction / replacement of the fill material and zones of disturbed ground, and support the structures on spread footing (pad and strip) foundations with conventional frost walls; or,
- Implementation of ground improvement measures in combination with spread footing foundations without removal of the existing fill material and zones of disturbed ground; or,
- Support the structures on deep (or pile) foundations in combination with structural floor slabs.

These approaches are described in the subsections below. In assessing the preferred foundation construction approach, attention should be given to;

- The range of levels identified for the base of fill material as shown on Figure 5.1,
- The range of bedrock elevation levels as shown on Figure 5.2, and
- The variable nature and presence of boulders and other waste materials within the fill.

Figure 5.1 indicates that the level of the base of fill material can vary significantly; that is, there is uncertainty around the required excavation depths which can affect cost, schedule, and construction approach where excavation and replacement with spread footing foundations are used. Also, a range of refusal /bedrock levels have been reported across the site which can similarly affect deep foundation systems. The presence of boulders and other waste materials can also affect deep foundation systems. It is noted that the figure considers all of the ground investigation points; if a reduced area were considered the variability may be reduced. This approach could be adopted to select the preferred positions of the structures.

The position of the infilled trench / stormwater drain in the central portion of the site should be considered when selecting the layout of structures at the site. To avoid additional complications, it is recommended that structures are positioned so that the zone of influence of foundations, defined by a line extending down and out at 1 horizontal to 1 vertical from the foundation edge, does not intersect with edge of this feature. Alternatively, this feature should be excavated and remediated.

A cost benefit assessment of each approach should be carried out, considering further stakeholder considerations beyond those related to the geotechnical discipline.

6.3.1 Excavation and Replacement

The (uncontrolled) fill material in its current condition and former topsoil layers are not considered suitable for the support of the structural foundations and should be excavated from below the zone of influence of the foundations.

Complete sub-excavation of existing soils to the surface of the bedrock should be anticipated in some instances, due to the depth of fill present.

In areas where sub-excavation of disturbed material is required, the grade could be raised with compacted granular material (engineered fill) to the underside of foundation level. To provide adequate spread of load beneath the footings, the engineered fill should extend horizontally at least 0.5 metres beyond the footings and then down and out from this point at 1 horizontal to 1 vertical, or flatter. The excavations should be sized to accommodate the placement of engineered fill materials.

Below the foundations and within the foundation zone of influence the engineered fill should consist of granular material meeting Ontario Provincial Standard Specifications (OPSS) requirements for Granular B Type II and should be compacted in maximum 200 millimetre thick lifts to at least 98 percent of the standard Proctor maximum dry density.

As an alternative to using OPSS imported granular materials it may be possible to re-use acceptable site-won materials below the foundations, subject to the approval of the geotechnical representative. Refer to Section 6.6 for further details.

6.3.2 Spread Footing Design

A range of native soil types and bedrock may be encountered following sub-excavation. Spread footing foundations should be sized using the net geotechnical reactions at Serviceability Limit State (SLS) and factored net geotechnical resistances at Ultimate Limit States (ULS) provided in Table 6.1.

Provided that all loose or disturbed soil is removed from the bearing surfaces and the engineered fill material is prepared as described above, the post construction total and differential settlement of the footings at SLS should be less than 25 and 20 millimetres respectively. Settlement of foundations on a pad of engineered fill over bedrock, or on bedrock will be minimal.

However, given the variability of the depths to the base of the fill, and to avoid increased differential settlements where transitions occur between different soil types and / or bedrock, it is recommended that the foundations be supported solely on a uniform pad of engineered fill with a minimum thickness of 300 millimetres. Structural reinforcement of foundation walls may also be required at transition points.

Table 6.1 – Foundation Bearing Values

Subgrade Material	Net Geotechnical Reaction at SLS (kilopascals)	Factored Net Geotechnical Resistance at ULS (kilopascals)
Native, undisturbed Silty Clay	100	250
Native, undisturbed Glacial Till (Compact or Better) or Compacted Engineered Fill over Native Soils	150	300
Bedrock Surface	500	n/a
Compacted Engineered Fill over Bedrock	200	300

6.3.3 Deep Foundations, Micropiles / Caissons

To avoid excavation of the existing fill materials it may be preferable to install pile foundations. The piles would be advanced to the surface of, or socketed within, the bedrock, however piles will have difficulty penetrating the boulders in the fill material and the glacial till (where present). Difficult piling conditions may also be encountered due to the presence of faulted bedrock.

Due to the presence of rock fill, the use of driven piles (displacement) or augered piles is not suggested. Possible pile systems that may be considered to address the presence of rock fill / frequent boulders include:

- Steel pipe micropiles; and,
- Rotary bored caissons.

Micropiles are cast-in situ reinforced concrete / grout piles, similar to caissons, but with diameter less than about 300 millimetres. The benefits of micropiles include:

- Micropile equipment can be configured to advance through cobbles and boulders (using different cutting tools / hammers);
- Micropiles can be constructed in a variety of ways, including a cased section to bedrock and uncased below;
- The overall length of piles may be increased where shallow bedrock is present by socketing the piles into the bedrock; and,
- Smaller equipment is required for installation of micropiles than for caisson foundations.

If micropiles are proposed, the piling contractor should consider the presence of frequent cobbles and boulders as well as variable bedrock depth in selecting the pile installation equipment. The contractor should propose in their method statement verifiable means to ensure that the piles are terminated on or socketed into bedrock, as the design requires, and not mistakenly in boulders over bedrock. This may require core drilling in representative pile holes to confirm bedrock, construction of rock sockets at all pile locations, or other means.

Higher pile resistances may be achieved using rotary bored caissons, particularly if the base of the caisson can be adequately cleaned and inspected, resulting in smaller number of larger diameter piles. Note that if caissons are to be considered steel casings or slurry support of the bores in the overburden will be required as the granular soils are not likely to be self-supporting. Installing casings through the rock fill and any glacial till (which likely contains a high frequency of boulders) will be challenging but is feasible. Frequent use of chisels, churn, or drilling (or other approaches) will be required which will slow production and increase costs for caisson foundations. The casings will likely have to be seated into the bedrock surface which may be uneven. Similar contractual requirements should be put in place for caissons so that unexpected pile termination on boulders is avoided.

6.3.4 Axial Pile Capacity

For preliminary design purposes, the capacity of socketed micropiles / caissons that derive support only in shear within the bedrock should be calculated using the following formula:

$$Q_s = \phi \pi B_s L_s q_s$$

Where,

Q_s = Factored geotechnical resistance at ULS (kilonewtons);
ϕ = Geotechnical resistance factor (0.4 for compression);
π = 3.14;
B_s = Diameter of socket (metres);
L_s = Length of socket (metres); and,

q_s = Average shear resistance along the rock socket (2,000 kilopascals, preliminary to be confirmed).

The average shear resistance value is a preliminary estimate, for sockets below fractured / weathered bedrock zones (i.e. in rock with RQD value of 75% or greater). The value should be confirmed as the design progresses.

Socketed caissons that derive support by side shear within the bedrock should have a nominal socket length to diameter ratio of at least two in competent (i.e. slightly weathered to fresh) limestone / dolostone bedrock. The value of shear resistance along the socket assumes that the side walls of the socket will be cleaned of any cuttings or smeared material.

To consider end-bearing, the minimum diameter of the caisson should be selected to facilitate inspection of the conditions at the base, or base resistance may not be included. To inspect the base, dewatering of the pile bore will likely be required which is difficult to achieve in practice. Therefore, inclusion of base resistance should be done with caution, and it may be pragmatic to design the piles according to shaft resistance alone in rock sockets. If this approach is to be considered further additional commentary / preliminary values of end bearing resistance can be provided.

The concrete strength for piles / caissons should be appropriate for the loads. This should be verified by a structural engineer.

The geotechnical resistance at SLS will be greater than the factored geotechnical resistance at ULS; as such, ULS conditions will govern for piles socketed within bedrock, provided that the bottom and sides of the sockets are cleaned of all soil, cuttings, and disturbed bedrock and that no significant discontinuities exist with the bedrock socket. In wet conditions, concrete placement should be carried out using tremie techniques.

6.3.5 Ground Improvement

Ground improvement by densification of the in-situ soils may be considered for the Site using for instance, Rapid Impact Compaction (RIC) or Dynamic Compaction (DC).

RIC uses dynamic energy imparted by dropping a large weight from a controlled height onto a foot plate which can be operated using a track mounted excavator. Following removal of the topsoil, the Site could first be prepared by cutting the materials from the upper (southern and eastern) portions, placing this material on the lower portions, and impacting the materials by RIC to achieve the required density. The depth of influence of RIC would typically be about 4 metres below the ground surface, possibly greater depending on the contractor’s equipment, which would likely be considered sufficient at this Site.

Dynamic compaction involves using a crane to drop a heavy tamper onto the ground surface from a height of up to 25 metres. The depth of treatment by DC can exceed that of RIC.

Further alternatives that may be considered include installation of rammed aggregate piers or rigid inclusions which would stiffen the soil mass. Construction of rammed aggregate piers involves removal or displacement of weaker soils which are then relaced with columns of dense stone fill. The installation may also cause some densification of the surrounding soils between the piers. Foundations (and floor slabs) can be constructed over the piers. Rigid inclusions are similar in concept to pile foundations, however the inclusions are overlain by a pad of engineered (granular) approved fill material and the structures are supported with shallow spread footings bearing upon the pad.

The suitability of the site for particular ground improvement measures may be limited by the composition of the fill material and the presence of boulders / other hard strata within the fill material. A specialist contractor should review the subsurface conditions and confirm that the proposed ground improvement approach would be successful at this site, noting that some ground improvement contractors provide proprietary systems.

6.3.6 Spread Footing Design

Where ground improvement measures are applied, the SLS bearing resistance of the improved soils will depend on the type of improvement applied, but values of 150 kilopascals or higher are likely achievable. The SLS and ULS values of the improved soils should be assessed by the ground improvement contractor. The recommended bearing resistance for foundation design is subject to verification by the geotechnical practitioner at the time of construction to ensure that the founding surface exposed at the excavation base are consistent with the design bearing resistance value provided.

6.4 Backfill and Drainage

To avoid frost adhesion and possible heaving, foundation walls should be backfilled with imported, free-draining, non-frost susceptible granular material such as that meeting OPSS Granular B Type I or II requirements. Similarly, for backfill to exterior pile caps and grade beams, if used. Alternatively, site-won material may be used, refer to Section 6.6 for further details.

Where the backfill will ultimately support areas of hard surfacing (pavement, sidewalks or other similar surfaces), the Granular B Type I or II backfill should be placed in maximum 200 millimetre thick lifts and should be compacted to at least 95 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

Light, walk behind compaction equipment should be used next to foundation walls to avoid excessive compaction induced stress on the foundation walls.

Where future landscaped areas will exist next to the proposed structures and if some settlement of the backfill is acceptable, the backfill could be compacted to at least 90 percent of the standard Proctor maximum dry density value.

Where areas of hard surfacing (pavement etc.) abut the proposed structures, a gradual transition should be provided between those areas of hard surfacing underlain by non-frost susceptible granular wall backfill and those areas underlain by existing frost susceptible material to reduce the effects of differential frost heaving. It is suggested that granular frost tapers be constructed from 1.5 metres below finished grade to the underside of the granular subbase material for the hard surfaced areas. The frost tapers should be sloped at 1 horizontal to 1 vertical, or flatter.

6.4.1 Drainage

Perimeter foundation drainage is not considered necessary for the structures, provided that the floor slab level is above the finished exterior ground surface level, which is anticipated to be the case.

Where perimeter drainage is installed (should the above condition not be met or for other reasons) it should either be drained by gravity to a storm sewer or connected to a sump pit equipped with a pump to discharge the water to a storm sewer.

6.5 Concrete Floor Slab – Heated Areas

It is understood that the top of floor slab levels will likely be above the exterior grade and that the buildings will be heated during the winter months. Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior ground surface level.

A number of construction options could be considered to achieve predictable performance of the floor slabs, similar to the support of the foundations. These include;

- Removal and replacement of the fill material and former topsoil layers from below the floor slabs and replacement with approved suitable site won materials / imported materials;
- Use of ground improvement measures without removal of the soils; or
- Construction of a structural slab supported on deep pile foundations.

These approaches are described in the subsections below, from a geotechnical perspective.

6.5.1 Excavation and Replacement of Unsuitable Materials

Under this approach all fill material, organic material and any waste or deleterious material should be removed from below the slab area to the level of the native soils, or where necessary to the level of the bedrock.

Following removal of the fill material, organic soils, and any disturbed soil, inspection of the subgrade should be carried out. The subgrade surface in soils should be proof-rolled under the supervision of the geotechnical engineer, using suitable compaction equipment for the size of excavation.

The grade could then be raised, where necessary, using material meeting OPSS Granular B Type II requirements. The base for the floor slab should consist of at least 300 millimetres of OPSS Granular A. The Granular B and A materials should be compacted in suitable lift thicknesses to at least 95 percent of the standard Proctor maximum dry density value.

As an alternative to using OPSS granular materials it may be possible to re-use acceptable site-won materials below the floor slab, subject to the approval of the geotechnical representative. Refer to Section 6.6 for further details.

It may not be necessary to remove all of the fill material from below the slab, provided the risk of potential deflection of the slab is acceptable. The adequacy of the existing fill material could be assessed during excavation by a geotechnical practitioner, and subject to inspection and testing it may be possible to leave some of the fill material in place. However, for preliminary design and costing purposes, allowance should be made for full removal of the existing fill material below the slabs on grade.

6.5.2 Ground Improvement

Possible ground improvement approaches have been discussed under Section 6.3.5 of this report.

Following implementation of one of these approaches the floor slabs could be supported on a base layer of at least 300 millimetres of OPSS Granular A, compacted in suitable lift thicknesses to at least 95 percent of the standard Proctor maximum dry density value.

6.5.3 Structural Floor Slab

To isolate the floor slabs from settlement of the underlying soils the floor slab could be constructed as a structural (or suspended) slab. This would require installation of additional piles within the building footprint. A structural engineer should be consulted if this option is preferable.

6.6 Reuse of Existing Materials on Site

6.6.1 General

Some of the construction activities at the site will generate materials which could be considered for re-use (i.e. site won materials). As an alternative to using OPSS Granular B Type I or II material, engineered fill material below foundations and floor slabs may consist of suitable site won materials, subject to acceptance by a geotechnical practitioner.

The excavated materials will likely be a combination of coarse-grained and fine-grained soils, and will contain frequent cobble and boulder sized fragments of rock. Former topsoil layers, waste material and other deleterious materials are also likely to be encountered which are not suitable for reuse except potentially in landscaped areas. In addition, the potential for reuse of excavated materials may be impacted by the presence of contamination, which has not been addressed by GEMTEC in this report.

Where reuse of site won materials is proposed, some screening, sorting, blending, stockpiling and moisture conditioning will likely be required and the practicality of carrying out these activities in combination with site construction and staging should be considered. These activities may require additional space to spread and dry soils, and / or the use of water bowsers to increase moisture content of soils at the time of compaction. The contractor's site set up should account for these space requirements, and the schedule should include for sufficient time to allow soils to dry sufficiently.

Where re-use of site won fill material is proposed, the following should be carried out:

- Compaction strips should be performed to establish the compaction protocol and sufficient number of nuclear density testing should be carried out on each fill lift to verify that compaction to the required density is achieved;

- The moisture content of the material should be maintained within ± 2 percent of the optimum moisture content for standard compaction. Management of the excavated soil moisture content will be required to achieve this;

- The material should be free of fragments of rock larger than 150 millimetres, and any waste, organic or otherwise deleterious materials;

- The surface on which accepted material is placed and compacted shall be kept free of water. The material should be compacted to the required density values using compaction equipment appropriate for the soil type i.e. sheepsfoot / padsfoot or smooth drum roller etc;

- The excavation, placement and compaction of the materials should be carried out under the full-time supervision of a geotechnical practitioner.

Potential applications for reuse of the excavated soils are described below. An assessment of the composition of the material should be made by a geotechnical practitioner at the time of construction.

6.6.2 Potential Applications for Soil Units

The following is a preliminary assessment of potential reusable material, and actual reusability can only be confirmed during construction. An accurate assessment of the volumes of each type of soil is not possible at this time. It should be noted that soils encountered during the GEMTEC

(2023) investigation do not generally meet the grading requirements for OPSS Granular A, or B materials due in part to an excess of fine-grained soils. It is anticipated that the majority of soils encountered would require some processing as described previously to be acceptable for this purpose.

- Well graded, non-cohesive, coarse-grained soils may be suitable for reuse as fill to support foundations and floor slabs provided the actions described in Section 6.6.1 are completed.
    - Fine-grained cohesive soils and intermediate to highly plastic materials are not suitable for reuse as fill to support foundations and floor slabs due to the high-water content and potential to induce long-term and differential settlement below the building foundation. As indicated by the descriptions on the test pit logs, a significant proportion of fill material encountered in the GEMTEC (2023) investigation would not be suitable for reuse below foundations and floor slabs due to an excess of fine-grained (cohesive) soil.
    - Where there is a deficit of suitable materials, the site-won materials should be used in the lower portions of the filling operations and surfaced with imported granular materials.
    - The potential for frost heaving / frost adhesion to occur should be considered.
- Excavated soils could be considered for foundation wall backfill provided that a suitable bond break is applied to the surface of the foundations to prevent frost jacking. A suitable bond break could consist of at least 2 layers of 6 MIL polyethylene sheeting or a proprietary plastic drainage medium.

- The majority of the fill materials at the site may be used for grade raise filling below pavement areas, trench fill, and also in landscape areas.

- Excavated rock fill and larger rock fragments / boulders are likely to be variable in terms of size and would require crushing and grading for reuse.

6.6.2.1 Effects of Precipitation

Re-use of the existing materials on site carries additional risk of delays during construction. To reduce (not eliminate) the potential for delays excavation, placement and compaction of soils should be scheduled for the drier times of the year. Precipitation (rainfall) will likely lead to suspension of earthworks during and for some time afterwards. Rainfall may also cause stockpiles of soils which have not been adequately protected to become wet and unsuitable for reuse without further drying out. Materials which have been placed and compacted may also become loosened / softened if exposed to rainfall. Where the subgrade is exposed to rainfall, the surface of the subgrade (including erosion gullies or wash outs that may be developed) should be cleaned and allowed to dry prior to placement of subsequent layers of material.

Depending on the weather conditions at time of construction, the specified densities may not be possible to achieve. Consideration could be given to implementing the following measures to reduce the effects of post construction settlement;

- Reuse any wet materials in the lower part of utility trenches backfilling and make provision to defer final paving above trenches for 6 months, or longer, to allow some the trench backfill settlement to occur and thereby improve the final roadway appearance.

- Reuse any wet materials outside hard surfaced areas or otherwise settlement sensitive areas and where post construction settlement is less of a concern (such as landscaped areas).

6.7 Frost Protection

All exterior footings in unheated portions of the proposed structures or slabs should be provided with at least 1.5 metres of earth cover for frost protection purposes.

Isolated, unheated exterior footings adjacent to surfaces that are cleaned of snow cover during the winter months should be provided with a minimum of 1.8 metres of earth cover.

The required depth of frost protection can be reduced by the thickness of any non-frost susceptible engineered fill beneath the foundations. Alternatively, the required frost protection could be provided by means of a combination of earth cover and extruded polystyrene insulation. An insulation detail could be provided upon request.

If any areas of the buildings are to remain unheated during the winter period, thermal protection of the slab on grade may be required. Further details on the insulation requirements could be provided, if necessary.

6.8 Excavation

6.8.1 Overburden

The excavations for the structure will be carried out through fill material, topsoil and former topsoil layers, and possibly through the native soil layers for foundation elements.

These soil units should be excavatable using conventional hydraulic excavation equipment, noting that fill material can contain more problematic material such as construction debris boulders, or other hard material. Excavation of remnants of the previous structure which may include former floor slabs and foundations may also be required. Excavation of reinforced concrete elements will be slower and require increased excavation effort.

Boulders may also be encountered within the native sand layer which may increase excavation effort and cause over-excavation (both laterally and in depth). Additional engineered fill material may be required to fill any voids left from the removal of boulders (i.e., below foundations, floor slabs or in utility trench excavations). For workers safety, the excavation side slopes should be inspected for potentially hazardous boulders or other construction debris that should be removed from the excavation side slopes.

The sides of the excavations should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Occupational Health and Safety Act. According to the Act, the shallow soils at this site can be classified as Type 3 soils. If excavation below the groundwater level is carried out the soils can be classified as Type 4. Therefore, for design purposes, allowance should be made for 1 horizontal to 3 vertical, or flatter, excavation slopes, or where possible the depth of excavation should be limited and in this instance steeper slopes may be possible.

6.8.2 Bedrock

Based on the available subsurface records and proposed building positions significant zones of bedrock excavation are not anticipated. However, shallow bedrock is present at the northern portion of the site, and depending on the final configuration some bedrock excavation may be required. Further details can be provided if required.

6.8.3 Groundwater Pumping and Management

Variable groundwater conditions are likely to be encountered. Zones of significant groundwater inflows could be encountered particularly within the fill material.

Where practical, excavation in the vicinity of the infilled trench / stormwater drain in the central portion of the site should be avoided. It is unknown if this feature is hydraulically connected to a significant volume of water, or if the feature can reasonably be dewatered using sump pumps or other measures. It is noted that the culvert to the drain were reported to be sealed in 2015, however, this may not have been successful, or there may be a significant body of water stored with the drain between the sealed sections.

Groundwater inflow into the base (and sides of) the excavations through the native deposits of silty clay, glacial till or bedrock could likely be handled by pumping from within the excavations using sump pumps – noting the above commentary regarding the infilled trench / stormwater drain. In soils the sump pumps should be installed in perforated casings surrounded by graded granular sand to reduce the potential for loss of fines into the sump.

Where possible, excavation works should be scheduled for the drier parts of the year – and relatively small test excavations could be opened to assess dewatering requirements initially and if necessary pumping could be carried out in advance of site wide excavations to lower the groundwater level.

It is suggested that an excavation and groundwater management plan be submitted for review and approval as part of the contract. The plan should address the infilled trench / stormwater drain in the central portion of the site.

It is not expected that temporary groundwater pumping during excavation will have a significant effect on nearby structures and services (i.e., settlements are not a concern).

6.9 Access Roadway and Parking Areas

Details of proposed traffic loadings on the access roadways and parking areas were not available at the time of preparing this report. As such the pavement structures provided below should be considered preliminary and the design of the pavement should be reviewed as the design progresses.

As with the building areas, a program of cut / fill is anticipated in the roadway areas, with cutting occurring predominantly in the northern portion of the site, and along the length of the western and eastern portion of the site. Filling is proposed in other areas.

To reduce (but not eliminate) the risks of future settlements consideration could be given to construction of the roadways and parking areas in the eastern portion of the site where the existing soil stockpiles will have preloaded the soils to a certain extent.

6.9.1 Subgrade Preparation

In preparation for roadway construction, all vegetation, surficial topsoil, and any soft, wet, disturbed, or deleterious materials should be removed from the proposed roadways.

It is not considered necessary to remove all of the fill material and buried former topsoil below the pavement subgrade level from within the roadway / parking areas provided that some future settlement of the surface and pavement cracking can be tolerated. It is, however, suggested that;

- Topsoil and other vegetation be stripped from areas in which filling is to be carried out;
- Any exposed fill material or former topsoil which contains an abundance of organic material or otherwise deleterious material be sub-excavated and replaced with suitable earth borrow.

Any fill areas or sub-excavated areas could be filled with compacted approved site won fill, or imported fill material such as that meeting OPSS specifications for Select Subgrade Material, Granular B Type I or II, or well shattered and graded rock fill.

The approved fill material should be placed in suitable thick lifts and compacted to at least 95 percent of the standard Proctor maximum dry density value using suitably sized vibratory compaction equipment. Rock fill if used should also be placed in thin lifts and suitably compacted either with a large drum roller, the haulage and spreading equipment, or a combination of both.

Prior to placing granular material for the roadways, provided in the subsection below, the subgrade should be heavily proof rolled under suitable (dry) conditions and inspected and approved by a geotechnical practitioner. Any soft areas evident from the proof rolling should be sub-excavated and replaced with approved fill material to the satisfaction of the geotechnical practitioner. The final subgrade should be shaped and crowned to promote drainage of the roadway granular materials.

6.9.2 Effects of Subgrade Disturbance

Truck traffic should be avoided on the soil subgrade within the roadways especially under wet conditions to prevent disturbance.

If the subgrade surface becomes disturbed or wetted due to construction operations or precipitation, or the granular pavement materials are to be used by construction traffic, the granular subbase thicknesses provided above may not be adequate and it may be necessary to increase the thickness of the granular subbase. The contractor should be responsible for providing suitable access for construction equipment.

The required thickness of the subbase materials will depend on a number of factors, including contractor workmanship and schedule, contractor methodology, soil types and weather conditions, and should be assessed by a geotechnical practitioner at the time of construction. The recommended approach for subgrade preparation from a geotechnical point of view is to:

- Proof roll the subgrade conditions at the time of construction under the supervision of an experienced geotechnical practitioner; and,
- Adjust the thickness or type of the subbase material and if applicable, include a woven geotextile separator, as required. Unit rate allowances should be made in the contract for sub-excavation and replacement with OPSS Granular B Type II (as required).

6.9.3 Pavement Structure (Preliminary)

The following minimum pavement structure is suggested for access roadways which will not be used by a significant volume of heavy traffic:

- 80 millimetres of hot mix asphaltic concrete (40 millimetres of Superpave 12.5 Traffic Level B over 40 millimetres of Superpave 19 Traffic Level B), over
- 150 millimetres of OPSS Granular A base, over
- 375 millimetres of OPSS Granular B subbase

For access roadway which will be subject to heavy truck traffic, or which will be used as fire access routes, the suggested minimum pavement structure is:

- 100 millimetres of hot mix asphaltic concrete (40 millimetres of Superpave 12.5 (Traffic Level B) over 60 millimetres of Superpave 19.0 (Traffic Level B), over
- 150 millimetres of OPSS Granular A base over
- 450 millimetres of OPSS Granular B, Type II subbase

6.9.4 Asphaltic Cement

Performance Grade PG 58-34 asphaltic cement should be specified.

6.9.5 Granular Material Compaction

The pavement granular materials should be compacted in maximum 300 millimetre thick lifts to at least 99 percent of standard Proctor maximum dry density using suitably sized vibratory compaction equipment.

6.9.6 Transition Treatments

In areas where the new pavement structure will abut existing pavements, the depths of the granular materials should taper up or down at 5 horizontal to 1 vertical, or flatter, to match the depths of the granular material(s) exposed in the existing pavement.

Any undermining or broken edges resulting from the construction activities should be removed by saw cut. All milled surfaces and butt joints should be properly tack coated prior to asphalt placement.

6.9.7 Pavement Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long-term performance of the pavement at this site.

Adequate drainage of the pavement granular materials and subgrade is important for the long term performance of the pavement at this site. The subgrade surfaces should be crowned and shaped to drain to the ditches and/or catch basins to promote drainage of the pavement granular materials.

Catch basins should be provided with minimum 3 metre long perforated stub drains which extend in at least two directions from each catch basin at pavement subgrade level. Where ditches are used, the bottom of the OPSS Granular B Type II should be at least 0.3 metres above the bottom of the ditch and the granular material should extend to the ditch slopes.

6.10 Utility Installations

The details of any proposed utility installations were not available at the time of preparation of this report and therefore this aspect of the works has not been described in detail.

As preliminary guidance, the commentary provided in Section 6.8 Excavation should be considered.

Fill material should be anticipated at the base of the utility trenches. Subject to inspection, the fill can likely remain below the utilities, however, some self-weight settlement should be expected. To reduce (not eliminate) the potential for long term settlement in gravity pipes and other settlement-sensitive ducting through the fill material we recommend that:

- The exposed subgrade surface at the base of the trench be well compacted under the supervision of a geotechnical specialist, this will improve material near the compactor but not at significant depth below. The size of compaction equipment may be limited by the dimensions of the trench excavation;
- A 300-millimetre layer of compacted sub-bedding be installed below the pipe bedding, consisting of OPSS Granular B Type II.
- Prior to placement of any sub-bedding material, a geotechnical practitioner, should approve the material. Where unsuitable material (e.g., organic material, water softened soils, etc.) is present below the subgrade level, the disturbed / unsuitable material should be removed and replaced with an increased sub-bedding layer.
- In areas where the subgrade transitions from fill material to native subgrade, a taper of sub-bedding material could be included to minimize the potential for differential settlement of pipes founded over native and fill materials. The taper and subexcavation requirements should be assessed at the time of construction by geotechnical personnel.

Further details can be provided as the design develops further. In the instance that ground improvement works are carried out by compaction this may also reduce the risk of settlement affecting underground utilities.

6.11 Corrosion of Buried Concrete and Steel

Soil samples were not submitted for assessment for corrosion of buried concrete and steel as part of this supplemental investigation.

Paterson (2015) reports that concrete in contact with the soils could be batched with Type 10 Portland Cement (or General Use Cement). However, the effects of freeze thaw in the presence of de-icing chemical (sodium chloride) use onsite should be considered in selecting the air entrainment and the concrete mix proportions for any concrete.

The chloride content and pH of the 2 samples tested gave results which indicate a slightly aggressive to very aggressive corrosive environment towards unprotected steel.

It should be noted that the corrosivity of the soil/groundwater could vary throughout the year due to the application sodium chloride for deicing.

If additional testing of the soil aggressivity is required testing can be carried out at a later date upon request.

6.12 LID Features

6.12.1 Preliminary Hydrogeological Site Characterization

A preliminary hydrogeological site characterization has been prepared based on a review of published information and records of current and previous investigations at the site.

The hydrogeological conditions have been investigated previously by others, with findings presented in the following reports:

- Terrain Analysis and Hydrogeological Study, Proposed Commercial Development Part 14, Lot 21, Concession 4 (R.F.) Ottawa (Nepean), Ontario, prepared by Paterson Group Inc. dated October 2006;
- Addendum No. 1 to Terrain Analysis and Hydrogeological Study Report, Proposed Gateway Industrial Centre, 4497 O'Keefe Court, Ottawa, Ontario, prepared by Paterson Group Inc. dated September 2008;
- Hydrogeological Overview, 4497 O'Keefe Court, Ottawa, Ontario, (letter) prepared by prepared by Paterson Group Inc. dated October 2015;
- Additional correspondence relating to commentary on reporting submissions, prepared by Paterson Group Inc.

The subsurface conditions encountered various phases of investigations at this site consist of layers of (uncontrolled) fill material of variable composition (fine and coarse grained) and condition (density / strength) over discontinuous layers of former topsoil, and native deposits of fine-grained silty clay, coarse-grained silty sand and coarse-grained glacial till, over limestone bedrock. The upper portion of the limestone bedrock is likely more fractured / weathered than the lower rock layers. The depth to bedrock is variable, but relatively shallow. Some of the native soils are absent in portions of the site (i.e. the uncontrolled fill material is present to the surface of the bedrock).

Within the soil units, shallow perched groundwater levels are present where coarser soils overly finer grained soils. Groundwater within the central portion of the site (and possibly the wider area) may also be influenced by the buried drainage feature which has been reported by others to consist of a channel excavated through the bedrock and subsequently infilled with lower permeability soils. The channel may receive water from on and off-site sources and at times cause saturation of soils and flooding on the site. Groundwater is also present within the native soil layers as indicated by groundwater inflow in the test pits and water level measurements within the standpipe piezometers. Two aquifers have been identified in the limestone bedrock.

As such a primary feature of the hydrogeological site characterization is variability in the soil units and groundwater levels within the soil units.

6.12.2 Estimates of Hydraulic Conductivity – Soil Units

In-situ hydraulic conductivity testing was not carried out by GEMTEC as part of the supplemental investigation. Similarly, GEMTEC is not aware of the results of in-situ hydraulic conductivity testing in the soil units during the previous investigations at the site. The previous documents focus on the buried drainage feature and the bedrock aquifers.

Accurate estimation of hydraulic conductivity values in the soil units is complicated by the variability of the subsurface conditions at the site. A wide range of values are likely applicable, from low permeability soil conditions (i.e. silts and clay with typical values of $1x10^{-7}$ metres per second or lower) to high or very high permeability soils (i.e., coarse fill or rock fill with typical values of 1×10^{-3} metres per second or greater).

6.12.3 Estimates of Infiltration Rates – Soil Units

Soil infiltration rates can be estimated based on the approximate relationship between infiltration rate and hydraulic conductivity. However, given the wide range of hydraulic conductivity values that may apply, and the uncertainty in estimation of hydraulic conductivity values for the soil units described above, such correlations are not likely to be reliable for conditions at this site and therefore have not been considered further.

In-situ infiltration testing (e.g., Guelph Permeameter) has not been carried out at the site but could be performed to obtain specific information on the infiltration rates for the in-situ soil units at specific locations at this site. However, in planning such testing and assessing the validity of the results for the proposed LID features, the following should also be considered:

- The potential for conditions to change at the site as a result of site development (i.e. if fill material in a test area is to be excavated and replaced);
- The position of the groundwater level (or levels) in the soil and bedrock units at the test location, and the potential for seasonal variation to occur;
- The effects of the existing buried drainage channel or potential site flooding by other means.

6.12.4 Preliminary Infiltration Potential Assessment

The potential for soil and groundwater variability complicates the assessment of this site for the successful application of Low Impact Development (LID) features. In-situ testing using a Guelph Permeameter apparatus could be carried out at specific locations to assess potential infiltration rates, noting the previous commentary on the application of this testing.

Storm Water Management (SWM) Design Guidelines (MOE, 2003) for LID features require that a minimum separation distance of 1.0 metre be present between the bottom of the LID features and bedrock surface. This is likely achievable, depending on final grading and the type of LID features proposed. Deep LID features may not be suitable (e.g., buried infiltration chambers).

A minimum separation distance of 1.0 metre is also required between the bottom of the LID features and the seasonally high groundwater level (which likely occurs during the spring). The seasonally high-water level should be confirmed by groundwater level measurements at the proposed LID locations. The presence of a high groundwater level at this site may prevent the successful application of LID features. Consideration should also be given to the potential effects of the buried drainage feature and any potential hydraulic connectivity between it and the LID features.

6.13 Stormwater Management Pond

Details of the stormwater management pond were not available at the time of preparing this report beyond the pond base level shown at 103 metres elevation, and top of pond at 104.5 metres elevation.

6.13.1 Pond Liner

The decision to provide the proposed stormwater management pond with a pond liner, the appropriate liner type (consisting of natural materials or prefabricated materials), and any addition underdrainage works is the responsibility of the pond designer. Where a prefabricated liner is used, the liner manufacturer should be consulted for construction requirements particular to the liner. The following commentary is provided from a geotechnical / hydrogeological perspective for consideration by the pond designer (in combination with other important considerations) to assist in the assessment of a liner requirement:

- All uncontrolled fill material and buried former topsoil should be sub-excavated from below the pond. Depending on the condition of these soils it may also be necessary to excavate from the side slopes of the pond also.

- The base of the pond is likely to be in a combination of materials of variable permeability, consisting of a mixture of uncontrolled fill material, former topsoil, and relatively thin layers of silty clay and glacial till over bedrock. Preliminary estimates of hydraulic conductivity for these units can be provided but should be confirmed by testing in-situ. Refusal to further excavation in the test pits in the area of the proposed pond occurred at between 100.7 to 101.7 metres elevation. The bedrock surface is not anticipated to be encountered within the likely depth of excavation for the pond, based on the available information.

- The pond base appears to be above the groundwater level at the time of the geotechnical investigations, albeit marginally. Longer term seasonal groundwater level monitoring is recommended to establish the seasonal variation in groundwater levels. Longer term groundwater level measurements would allow more detailed assessment of the range of groundwater levels that may occur within the soil units. The potential for groundwater inflow to the pond (either dry or wet) should be considered. Ongoing inflow of groundwater to the pond may cause groundwater lowering to occur in the surrounding areas.

- The water level in the bedrock is unknown, as is the general direction of groundwater seepage, i.e. downward groundwater seepage from the soil units to the bedrock or vice versa.

6.13.2 Further Considerations

Some of the native soil deposits at this site are susceptible to erosion from flowing water. The slopes should be provided with protection either by means of vegetation or other systems as soon as practical. Depending on the anticipated flow velocities in the pond, some form of erosion control measures may be required.

Groundwater management will be required during construction. The groundwater and any surface water inflow may be controlled throughout the excavation by pumping from several sumps within the excavation. Notwithstanding, some disturbance and loosening /softening of the subgrade materials should be expected. Appropriate permitting for groundwater management activities should be obtained in advance of construction.

Some of the soils anticipated at the base of the pond are sensitive to disturbance from ponded water, vibration and construction traffic. Construction of haul roads and working platforms within the pond or staging / benching of the excavation will likely be required. It is suggested that final trimming to subgrade level be carried out using a hydraulic shovel equipped with a flat blade bucket. Cobbles and boulders should be anticipated in the glacial till. As such, allowance should be made for removal of boulders during excavation, which may cause over-excavation both laterally and vertically. Additional engineered fill material may be required to fill any voids left from the removal of boulders at the base of the excavation.

In addition, the design of the pond should consider the provision of a suitable access route and pavements for maintenance works to be carried out over the design life of the pond. This may include for instance provision of a trafficable surface around the pond perimeter, to key infrastructure locations and to the base of the pond. Recommendations can be provided as the design progresses. As preliminary guidance, refer to Section 6.8 of this report. If the pond base needs to be accessible placement of a rip-rap layer, concrete blocks or similar proprietary system may be required. Geotextile reinforcement may also be required.

From a geotechnical perspective any excavated soils generated during construction of the pond may be considered for reuse as site won fill, subject to acceptance by a geotechnical practitioner.

The side slopes to the pond should be constructed at an inclination of 3 horizontal to 1 vertical, or flatter, which is considered suitable to prevent erosion of material from the surface of the berm with normal surface protection. The slopes of the berm could be vegetated or covered with a proprietary erosion protection system.

6.13.3 Impact on Nearby Sensitive Receivers

Please note that a detailed hydrogeological study / model for the site and the surrounding areas has not been prepared by GEMTEC at the time of preparing this report. An assessment of the potential effect of the pond on nearby sensitive receivers, water extraction points, and potential sources of contamination (that may be mobilised by the operation of the pond, in particular if ongoing inflow to the pond is likely to occur) may influence the design approach for the pond.

7.0 ADDITIONAL CONSIDERATIONS

7.1 Effects of Construction Induced Vibrations

Some of the construction operations (such as excavation, granular material compaction, ground improvement etc.) will cause ground vibration on and off site. The vibration effects are usually minor and localized. The vibrations will attenuate with distance from the source but may be felt at nearby structures.

Assuming that any excavating is carried out in accordance with the guidelines in this report, the magnitude of the vibrations will be much less than that required to cause damage to the nearby structures or services in good condition but may be felt at the nearby structures.

7.2 Disturbed Ground

The test pits represent areas of disturbed ground. Any test pits which are within building footprints, pavement areas or other settlement sensitive structures should be subexcavated and backfilled with engineered fill material as described previously in this report. The sides of the sub-excavated test pits should be sloped at 1 horizontal to 1 vertical, or flatter, to avoid potential issues with differential frost heaving.

7.3 Winter Construction

If construction is required during freezing temperatures, the native soil subgrade below the footings should be protected immediately from freezing using straw, propane heaters and insulated tarpaulins, or other suitable means. The frost susceptibility potential of the bedrock should be assessed by a geotechnical practitioner to determine if frost protection is required for bedrock subgrades.

Any service trenches should be opened for as short a time as practicable and the excavations should be carried out only in lengths which allow all of the construction operations, including backfilling, to be fully completed in one working day. The materials on the sides of the trenches should not be allowed to freeze. In addition, the backfill should be excavated, stored and replaced without being disturbed by frost or contaminated by snow or ice.

7.4 Limitations of Liability

The information used to prepare this report was, in part, obtained by others and was relied upon by GEMTEC as the basis for geotechnical guidelines and recommendations provided in this report. GEMTEC accepts no responsibility for inaccuracies, errors, or omissions in the data which GEMTEC has relied upon for these purposes.

8.0 CLOSURE

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report, please do not hesitate to contact our office.

Daire Cummins

Daire Cummins M.Sc.
Geotechnical Specialist

Lauren Ashe, M.Sc., P.Eng.
Senior Geotechnical Engineer

L. E. ASHE
100218516
08 Sep 2023

DC/LA/AP

Enclosures
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CONDITIONS AND LIMITATIONS OF THIS REPORT

1. **Standard of Care:** GEMTEC has prepared this report in a manner consistent with generally accepted engineering or environmental consulting practice in the jurisdiction in which the services are provided at the time of the report. No other warranty, expressed or implied is made.
2. **Copyright:** The contents of this report are subject to copyright owned by GEMTEC, save to the extent that copyright has been legally assigned by us to another party or is used by GEMTEC under license. To the extent that GEMTEC owns the copyright in this report, it may not be copied without our prior written agreement for any purpose other than the purpose indicated in this report. The methodology (if any) contained in this report is provided to the Client in confidence and must not be disclosed or copied to third parties without the prior written agreement of GEMTEC. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests.
3. **Complete Report:** This report is of a summary nature and is not intended to stand alone without reference to the instructions given to GEMTEC by the Client, communications between GEMTEC and the Client and to any other reports prepared by GEMTEC for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. GEMTEC cannot be responsible for use of portions of the report without reference to the entire report.
4. **Basis of Report:** This Report has been prepared for the specific site, development, design objectives and purposes that were described to GEMTEC by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this report expressly addresses the proposed development, design objectives and purposes. Any change of site conditions, purpose or development plans may alter the validity of the report and GEMTEC cannot be responsible for use of this report, or portions thereof, unless GEMTEC is requested to review any changes and, if necessary, revise the report.
5. **Time Dependence:** If the proposed project is not undertaken by the Client within 18 months following the issuance of this report, or within the timeframe understood by GEMTEC to be contemplated by the Client, the guidance and recommendations within the report should not be considered valid unless reviewed and amended or validated by GEMTEC in writing.
6. **Use of This Report:** The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without GEMTEC's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, GEMTEC may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process.

   Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.
7. **No Legal Representations:** GEMTEC makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
8. **Decrease in Property Value:** GEMTEC shall not be responsible for any decrease, real or perceived, of the property or site's value or failure to complete a transaction, as a consequence of the information contained in this report.
9. **Reliance on Provided Information:** The evaluation and conclusions contained in this report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations. information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of misstatements, omissions,

misrepresentations. or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

10. **Investigation Limitations:** Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions but even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions.

    The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies. Accordingly, GEMTEC does not warrant or guarantee the exactness of of the subsurface descriptions.

    Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

    In addition, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

11. **Sample Disposal:** GEMTEC will dispose of all uncontaminated soil and/or rock samples 60 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fill materials or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

12. **Follow-Up and Construction Services:** All details of the design were not known at the time of submission of GEMTEC's report. GEMTEC should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of GEMTEC's report.

    During construction, GEMTEC should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of GEMTEC's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in GEMTEC's report. Adequate field review, observation and testing during construction are necessary for GEMTEC to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, GEMTEC's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

13. **Changed Conditions:** Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEMTEC be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that GEMTEC be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

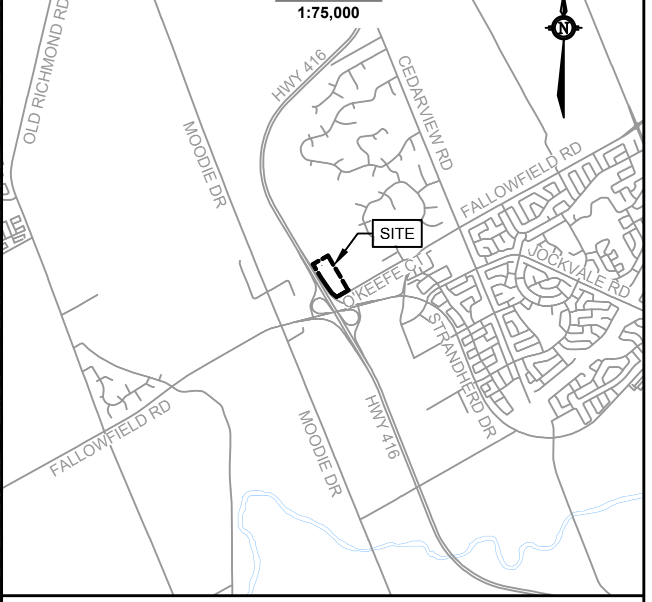
14. **Drainage:** Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. GEMTEC takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A

Test Pit Location Plan, GEMTEC (2023)

KEY PLAN

1:75,000



LEGEND

TP # ← TEST PIT ID
XX.XX ← GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

▣ TEST PIT LOCATION (current investigation by GEMTEC)

— — APPROXIMATE SITE BOUNDARY

— APPROXIMATE BERM LOCATION, REFERENCE PATERSON GROUP INC. ESA, 2006.

REFER TO APPENDIX D OF THE GEOTECHNICAL REPORT AND RECORDS OF PREVIOUS GEOTECHNICAL INVESTIGATIONS BY OTHERS

GENERAL NOTE(S)

1. Coordinate system: NAD83, UTM ZONE 18
2. Contains information licensed under the Open Government Licence – Ontario.
3. Maps Data: Google, @2023 CNES / Airbus, First Base Solutions, Maxar Technologies
4. Geographic dataset source: Ontario GeoHub.

SCALE

1:2000

0 40 80 120m

DRAWING

TEST PIT LOCATION PLAN

CLIENT

THE PROPERTIES GROUP MANAGEMENT LTD.

PROJECT

SUPPLEMENTAL GEOTECHNICAL INVESTIGATION
4497 O'KEEFE COURT
OTTAWA, ONTARIO

DRAWN BY C.Z.	CHECKED BY C.C.
PROJECT NO. 102669.001	REVISION NO. 0
DATE JULY 2023	FIGURE NO. FIGURE A.1

GEMTEC
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ottawa@gemtec.ca

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APPENDIX B

Record of Test Pit Logs, GEMTEC (2023)
List of Abbreviations and Symbols

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS	auger sample
CA	casing sample
CS	chunk sample
BS	Borros piston sample
DO	drive open
MS	manual sample
RC	rock core
ST	slotted tube
TO	thin-walled open Shelby tube
TP	thin-walled piston Shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Resistance, N

The number of blows by a 63.5 kg hammer dropped 760 millimetre required to drive a 50 mm drive open sampler for a distance of 300 mm. For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

Dynamic Penetration Resistance

The number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter, 60° cone attached to ‘A’ size drill rods for a distance of 300 mm.

WH

Sampler advanced by static weight of hammer and drill rods.

WR

Sampler advanced by static weight of drill rods.

PH

Sampler advanced by hydraulic pressure from drill rig.

PM

Sampler advanced by manual pressure.

SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	sieve and hydrometer analysis
U	unconfined compression test
Q	undrained triaxial test
V	field vane, undisturbed and remoulded shear strength

SOIL DESCRIPTIONS

Relative Density	‘N’ Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	over 100

LIST OF COMMON SYMBOLS

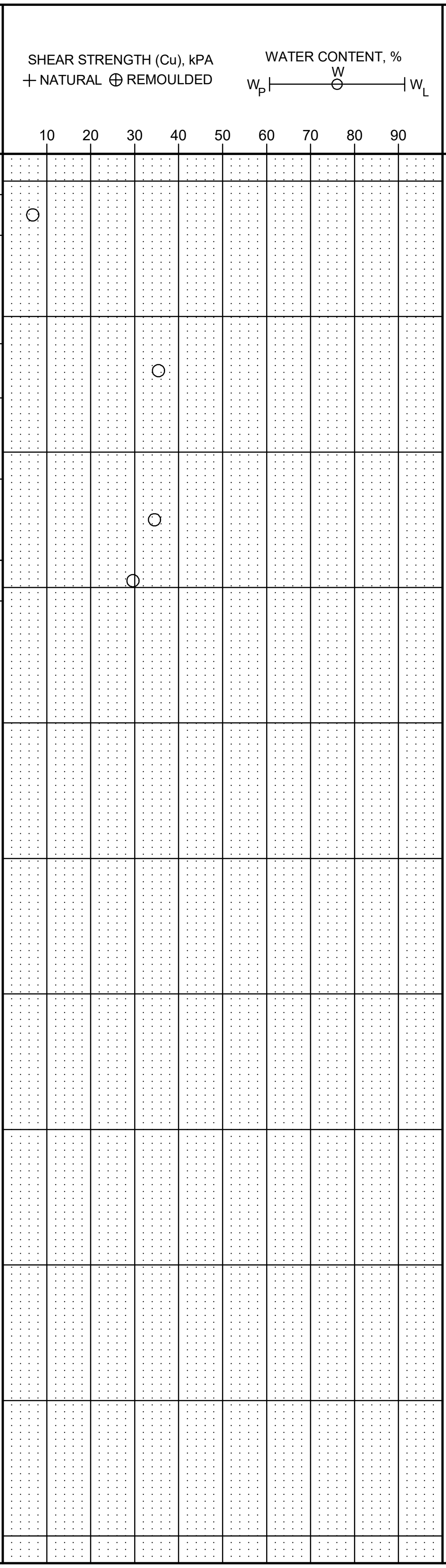
c_u	undrained shear strength
e	void ratio
C_c	compression index
c_v	coefficient of consolidation
k	coefficient of permeability
I_p	plasticity index
n	porosity
u	pore pressure
w	moisture content
w_L	liquid limit
w_P	plastic limit
ϕ^1	effective angle of friction
γ	unit weight of soil
γ^1	unit weight of submerged soil
σ	normal stress

RECORD OF TEST PIT 23-01

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	103.8				
	TOPSOIL					Test pit loosely backfilled with excavated material
	Brown sand and gravel, trace to some silt / clay, frequent cobbles and boulders (FILL MATERIAL)	0.1	1	GS		
1	Dark grey silty sand, some clay and gravel (FILL MATERIAL)	102.7 1.1	2	GS		
2	Grey brown sandy clayey silt, frequent cobbles and boulders (FILL MATERIAL)	101.8 2.0	3	GS	MH	
			4	GS		
3	End of test pit Refusal on probable bedrock Groundwater observed at 2.0 mbgs; estimated slow inflow rate	100.7 3.1				
4						
5						
6						
7						
8						
9						
10						



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Consulting Engineers and Scientists

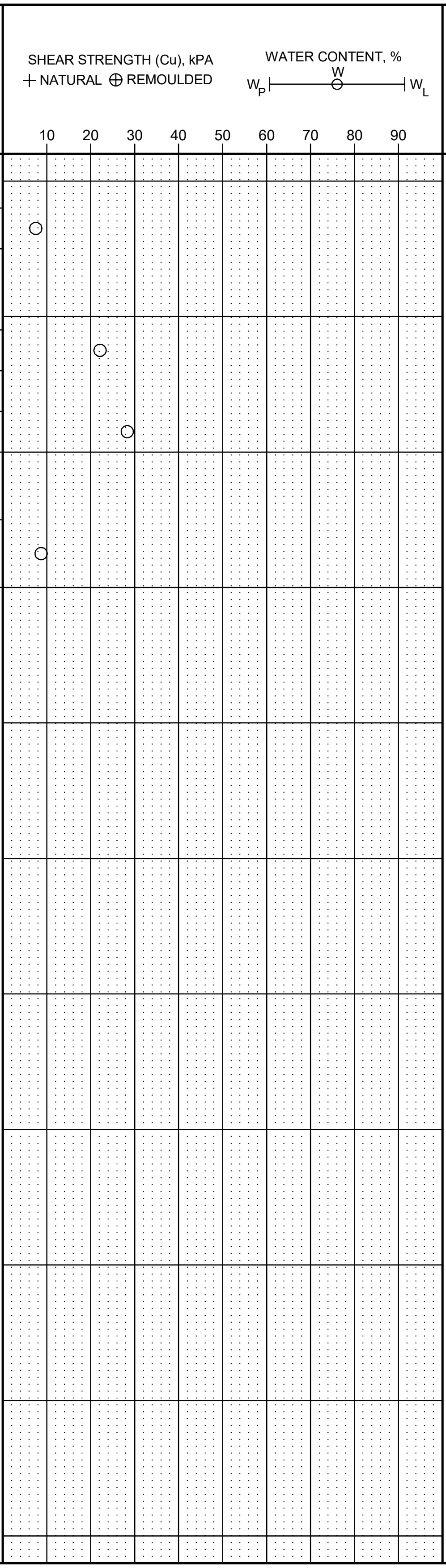
LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-02

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
Ground Surface	105.3				
TOPSOIL					Test pit loosely backfilled with excavated material
Brown, gravelly silty sand, frequent cobbles and boulders (FILL MATERIAL)	0.2	1	GS		
Grey silty sand, some clay, trace gravel (FILL MATERIAL)	104.4 0.9	2 3	GS GS		
Grey brown gravelly sand, some silt / clay, frequent cobbles and boulders (POSSIBLE GLACIAL TILL)	103.2 2.1	4	GS	M	
End of test pit Possible refusal on bedrock Groundwater observed at 3.0 mbgs; estimated slow inflow rate	100.6 4.7				



DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

GEO - TESTPIT LOG 102669.001_TP_LOGS_2023-07-05.GPJ GEMTEC 2018.GDT 7/27/23

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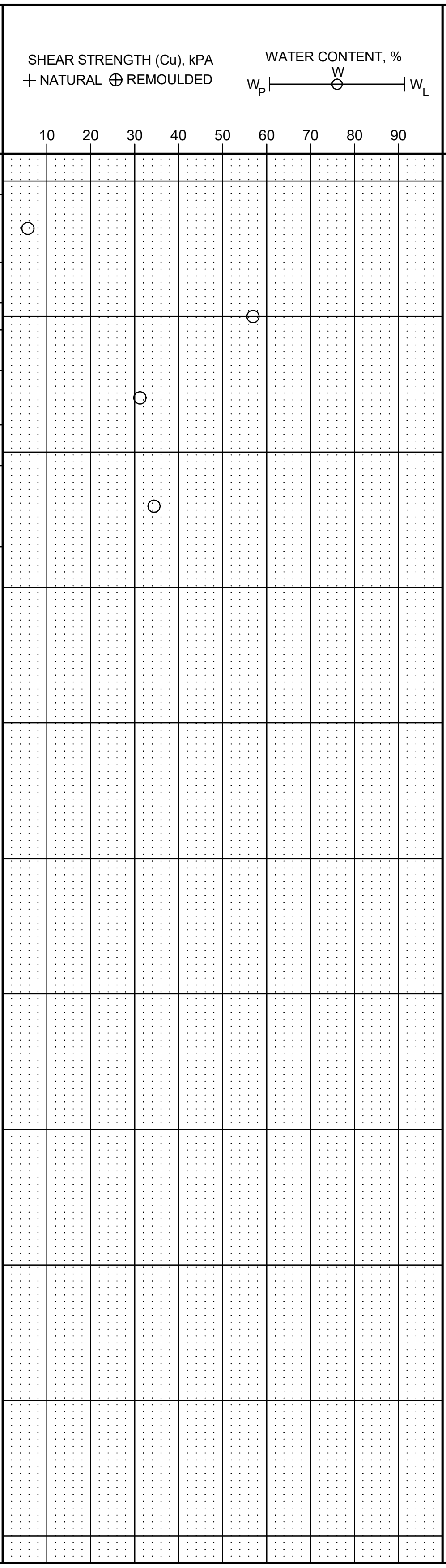
CHECKED: WAM

RECORD OF TEST PIT 23-03

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	105.0				
	Brown silty sand and gravel, frequent cobbles and boulders (ROCK FILL)		1	GS		Test pit loosely backfilled with excavated material
1	FORMER TOPSOIL	0.9 103.9	2	GS		
	Grey brown sandy clayey silt, trace gravel, cobbles and boulders observed (WEATHERED CRUST)	1.1	3	GS		
2			4	GS	MH	
3	End of test pit Refusal on possible bedrock Groundwater observed at 1.1 mbgs; estimated moderate inflow rate.	101.6 3.4				



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LOGGED: CC

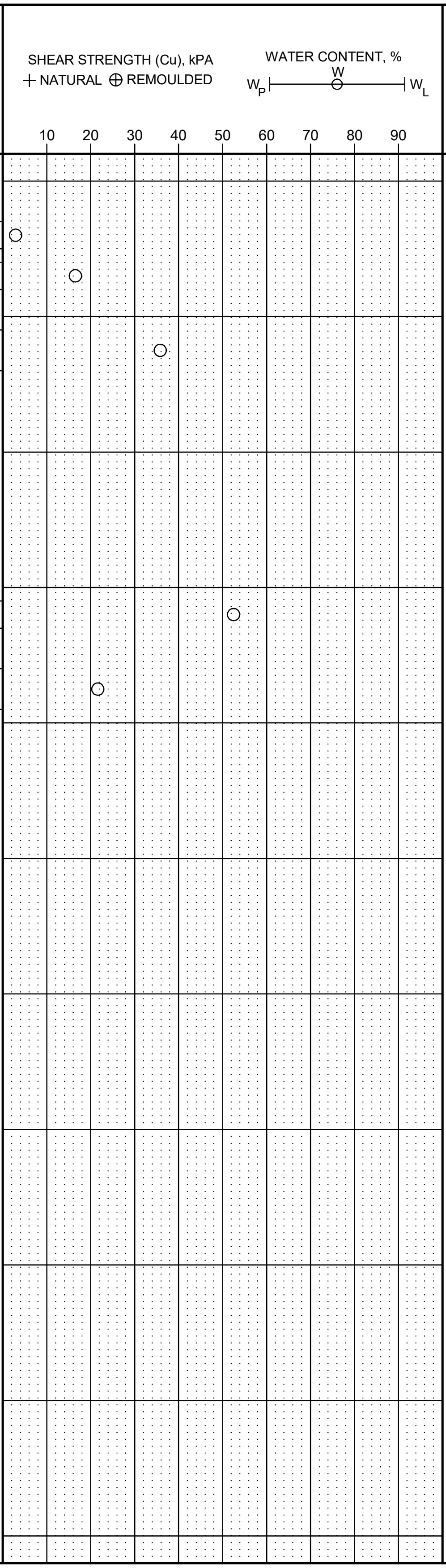
CHECKED: WAM

RECORD OF TEST PIT 23-04

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		106.3				
	TOPSOIL						Test pit loosely backfilled with excavated material
	Brown, gravelly silty sand, frequent cobbles and boulders (FILL MATERIAL)		0.2	1	GS		
	Grey sandy silt, some clay, trace gravel, frequent cobbles and boulders (FILL MATERIAL)		105.7 0.6	2	GS		
1				3	GS	MH	
	Silty sand and gravel (FILL MATERIAL)		104.8 1.5				
2							
3	Grey brown silty clay (WEATHERED CRUST)		103.3 3.0	4	GS		
	Grey SILTY CLAY, some sand, with occasional sand seams		102.8 3.5	5	GS		
4							
5	End of test pit Refusal on probable bedrock Groundwater observed at 0.5 mbgs		101.5 4.8				
6							
7							
8							
9							
10							



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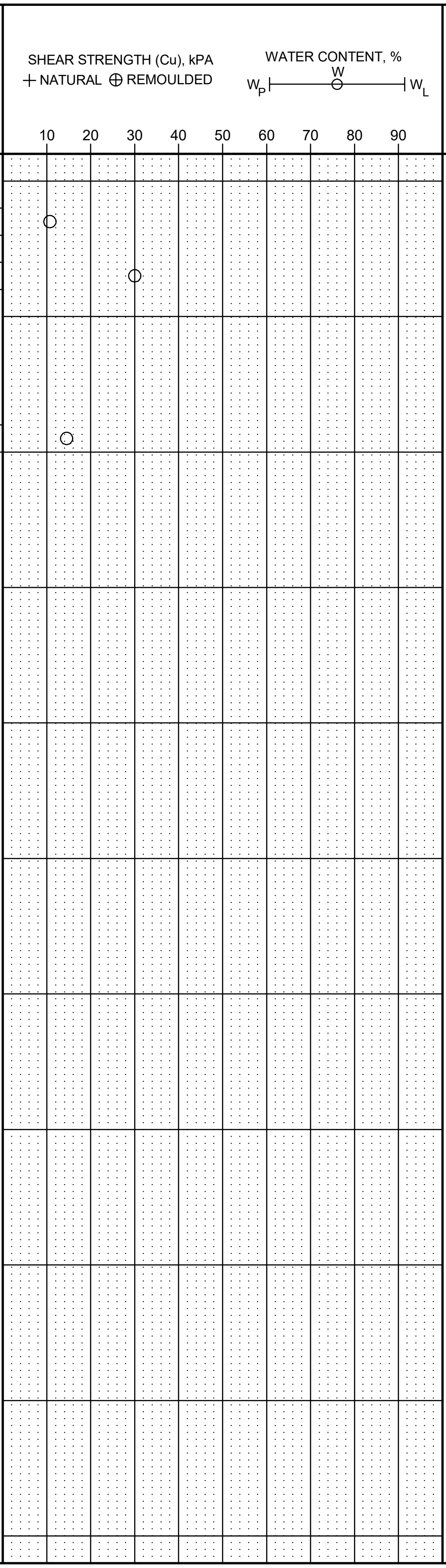
CHECKED: WAM

RECORD OF TEST PIT 23-05

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	105.2				
	TOPSOIL					Test pit loosely backfilled with excavated material
	Grey sand and gravel, trace to some silt / clay, frequent rootlets, cobbles and boulders (FILL MATERIAL)	0.2	1	GS		
	Grey brown sand and gravel, trace to some silt and clay (FILL MATERIAL)	104.7 0.5	2	GS		
1						
	Grey brown silty sand, some gravel, trace to some clay, frequent cobbles and boulders (POSSIBLE GLACIAL TILL)	103.7 1.5	3	GS		
2						
3	End of test pit Refusal on probable bedrock Groundwater observed at 1.0 mbgs; estimated slow inflow rate	102.1 3.1				
4						
5						
6						
7						
8						
9						
10						



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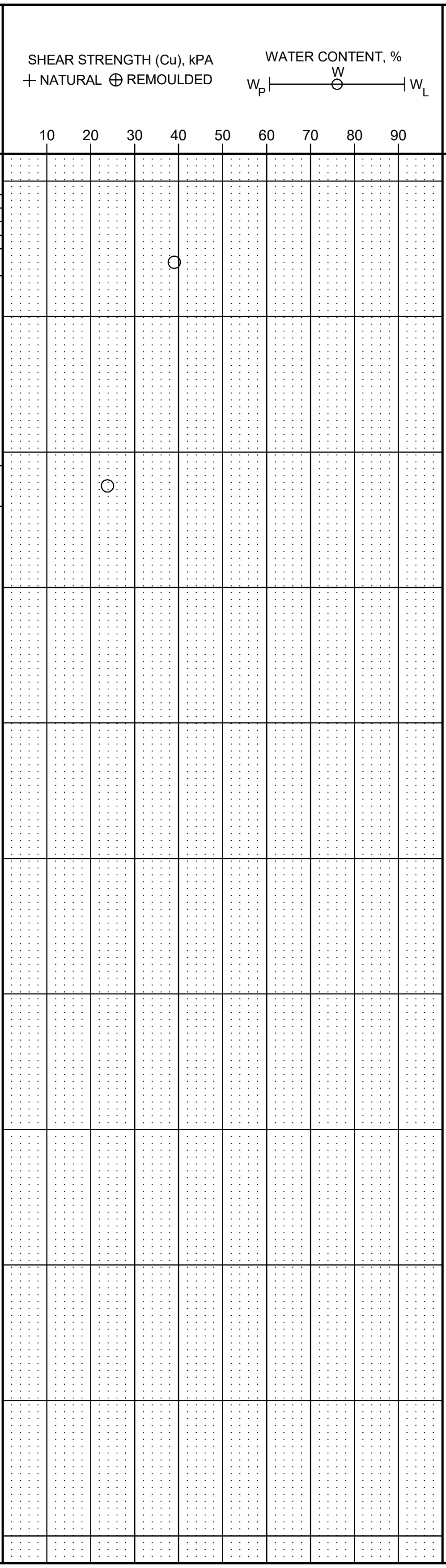
CHECKED: WAM

RECORD OF TEST PIT 23-06

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	105.2				
	TOPSOIL		1	GS		Test pit loosely backfilled with excavated material
	Grey silty sand (FILL MATERIAL)	0.3	2	GS		
	Grey brown silty clay (WEATHERED CRUST)	104.7 0.5	3	GS		
1						
2	Grey silty clayey sand, some gravel, frequent cobbles and boulders (POSSIBLE GLACIAL TILL)	103.2 2.0	4	GS	MH	
3	End of test pit Refusal on probable bedrock Groundwater observed at approximately 3.0 mbgs; estimated slow inflow rate	102.2 3.0				
4						
5						
6						
7						
8						
9						
10						



LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-07

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED 10 20 30 40 50 60 70 80 90 / WATER CONTENT, % W_P W W_L	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		107.3					
	TOPSOIL		0.1					Test pit loosely backfilled with excavated material
	Grey brown silty sand and gravel, frequent cobbles and boulders (FILL MATERIAL)		106.7 0.6	1	GS			
1	Grey and brown sand and gravel, trace to some silt and clay, frequent cobbles, boulders, concrete, and asphalt, frequent voids, occasional roots (FILL MATERIAL)		104.8 2.5	2 3	GS GS			
3	Grey silty sand and gravel, trace clay, frequent cobbles, boulders, concrete and asphalt, frequent voids (FILL MATERIAL)		102.2 5.1	4	GS			
5	End of test pit Refusal on probable bedrock Groundwater observed in the test pit at approximately 3.5 mbgs; estimated slow inflow rate Instability of the test pit walls observed during investigation							
6								
7								
8								
9								
10								

GEMTEC
Consulting Engineers and Scientists

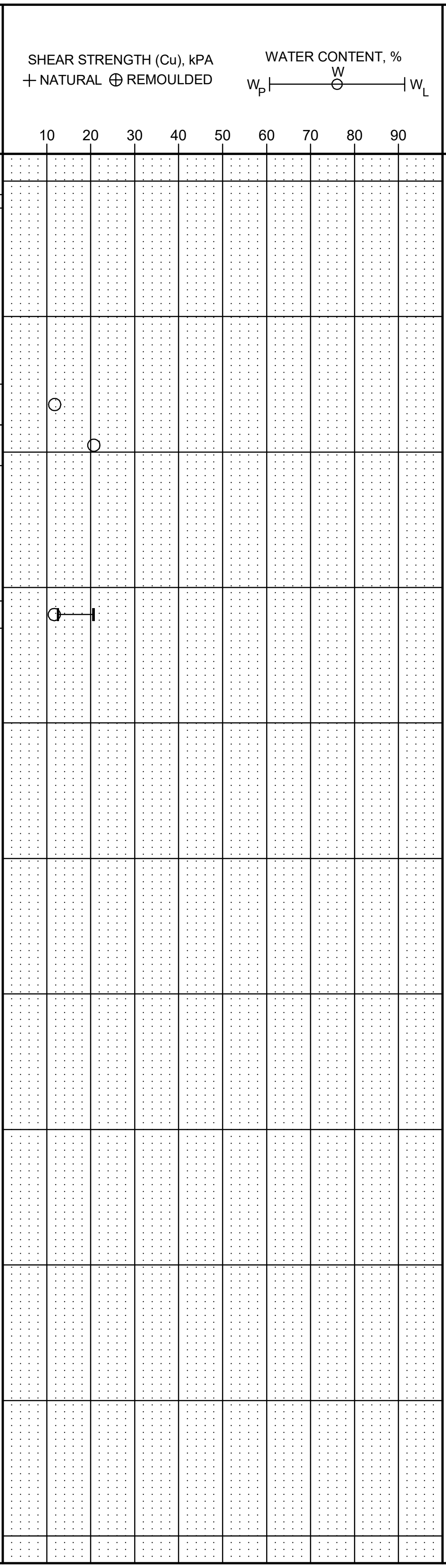
LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-07 A

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	107.8				
	TOPSOIL					
	Brown silty sand and gravel, frequent cobbles and boulders, steel cable (FILL MATERIAL)	107.7 0.1	1	GS		Test pit loosely backfilled with excavated material
1						
	Grey silt and sand, some gravel (FILL MATERIAL)	106.3 1.5	2 3	GS GS		
2						
3	Grey brown silty clay, some sand (POSSIBLE WEATHERED CRUST)	104.8 3.0	4	GS		
4						
5	End of test pit Refusal on probable bedrock groundwater observed at approximately 3.0 mbgs; estimated slow inflow rate	102.5 5.3				
6						
7						
8						
9						
10						



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LOGGED: CC
CHECKED: WAM

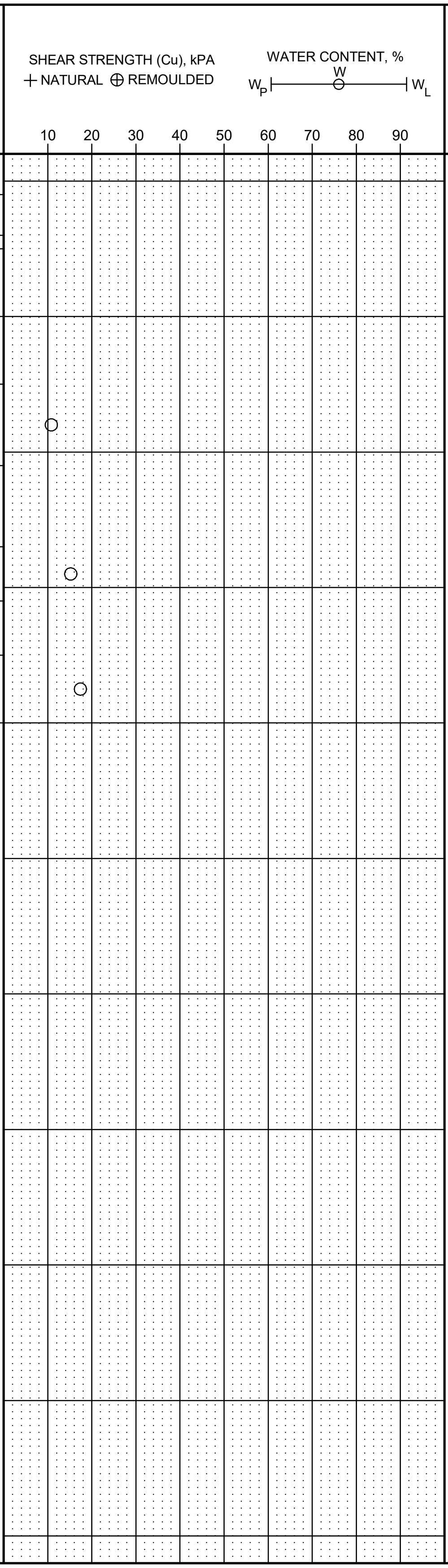
GEO - TESTPIT LOG 102669.001_TP_LOGS_2023-07-05.GPJ GEMTEC 2018.GDT 7/27/23

RECORD OF TEST PIT 23-08

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	109.0				
	TOPSOIL					Test pit loosely backfilled with excavated material
	Brown silty sand, frequent cobbles and boulders, occasional wood fragments, rootlets and voids observed (FILL MATERIAL)	0.1	1	GS		
			2	GS		
1						
	Grey silty sand, frequent cobbles and boulders, occasional voids (FILL MATERIAL)	107.5 1.5	3	GS		
2						
3			4	GS		
			5	GS		
4						
5	End of test pit Refusal on probable bedrock Groundwater observed at approximately 4.0 mbgs; estimated slow inflow rate Strong hydrocarbon odour observed at approximatey 1.8 metres depth.	104.2 4.9				
6						
7						
8						
9						
10						



GEO - TESTPIT LOG 102669.001_TP_LOGS_2023-07-05.GPJ GEMTEC 2018.GDT 7/27/23

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-08 A

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED WATER CONTENT, % W_P ⊢ W ○ ⊣ W_L 10 20 30 40 50 60 70 80 90	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface		108.6					
	TOPSOIL		108.4 0.3					Test pit loosely backfilled with excavated material
1	Brown gravelly silty sand, frequent cobbbles and boulders (FILL MATERIAL)		107.1 1.5	1	GS			
2	Grey silty sand and gravel (FILL MATERIAL)		106.1 2.5	2	GS			
3 4	Grey brown, silty sand and gravel, frequent cobbles and boulders (POSSIBLE GLACIAL TILL)		104.1 4.5	3	GS			
5 6 7 8 9 10	End of test pit Refusal on probable bedrock Groundwater observed at approximately 3.0 mbgs; estimated slow inflow rate							

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LOGGED: CC

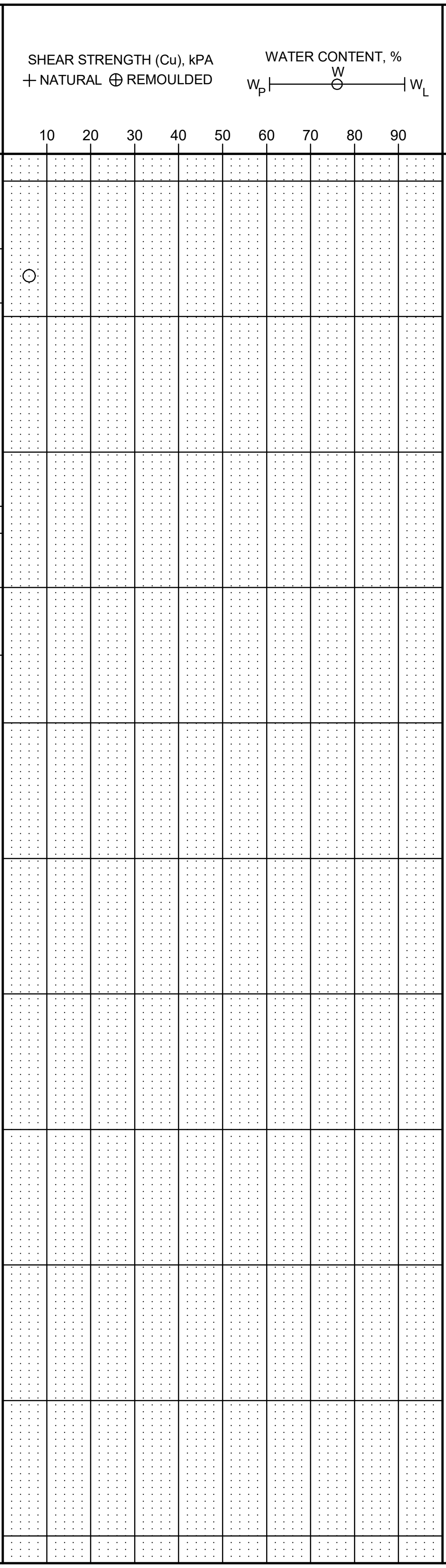
CHECKED: WAM

RECORD OF TEST PIT 23-09

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	111.7				
	TOPSOIL					Test pit loosely backfilled with excavated material
	Brown sand and gravel, some silt and clay, frequent cobbles and boulders (FILL MATERIAL)	0.2	1	GS	M	
2	Grey to brown silty sand, some gravel, some clay, frequent cobbles and boulders (FILL MATERIAL)	109.5 2.2	2	GS		
3			3	GS		
4	End of test pit Excavation below base of berm was not carried out. No groundwater observed in test pit	107.6 4.1				



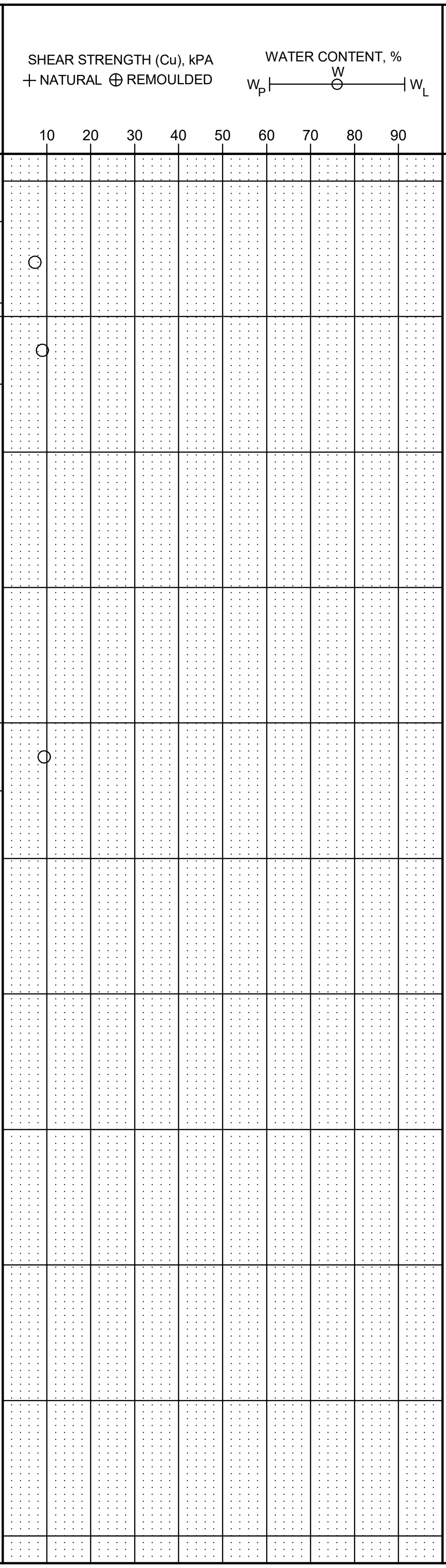
LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-10

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	110.3			
	TOPSOIL	110.1			Test pit loosely backfilled with excavated material
	Brown, gravel and sand, trace to some silt and clay, frequent cobbles and boulders, occasional rootlets (FILL MATERIAL)		1	GS	
1	Brown sandy gravel, some to trace silt, frequent cobbles and boulders, occasional debris (FILL MATERIAL)	109.3 1.0	2	GS	
4			3	GS	
5	End of test pit Refusal on probable bedrock No groundwater observed in test pit	105.2 5.1			



ADDITIONAL LAB. TESTING

LOGGED: CC
CHECKED: WAM

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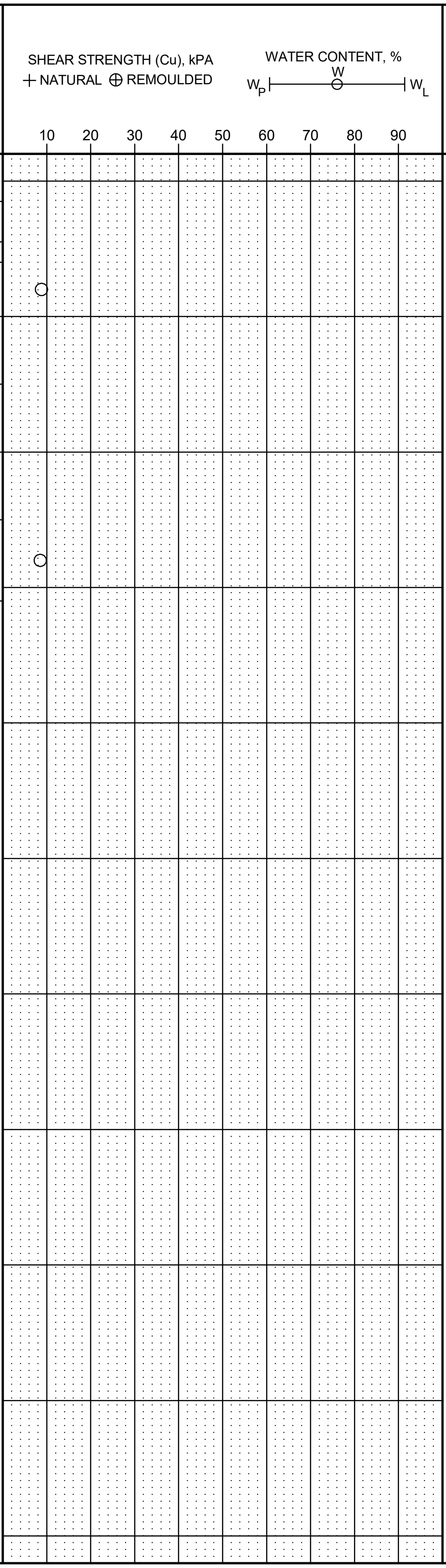
Consulting Engineers and Scientists

RECORD OF TEST PIT 23-11

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 23 2023

DEPTH SCALE METRES	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	111.2				
	TOPSOIL	111.1				Test pit loosely backfilled with excavated material
	Brown, gravelly silty sand, frequent cobbles and boulders, occasional rootlets (FILL MATERIAL)		1	GS		
			2	GS	M	
1	Brown sandy gravel, some silt and clay, frequent cobbles and boulders (FILL MATERIAL)	110.2 1.0				
			3	GS		
2						
			4	GS	M	
3						
	End of test pit Test pit terminated approximatley 2.0 metres below below base of berm No groundwater observed in test pit	107.5 3.7				
4						
5						
6						
7						
8						
9						
10						



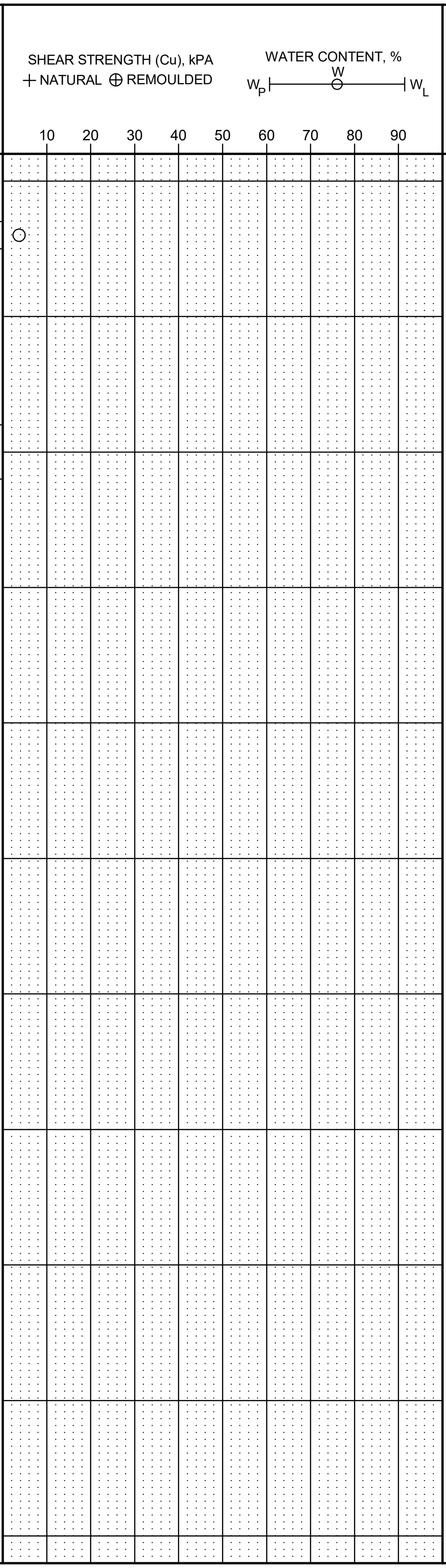
LOGGED: CC
CHECKED: WAM

RECORD OF TEST PIT 23-12

CLIENT: The Properties Group Management Ltd.
PROJECT: Geotechnical Investigation, 4997 O'keefe Court, Ottawa, ON
JOB#: 102669.001
LOCATION: See Figure A.1, Test Pit Location Plan

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Jun 26 2023

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	SAMPLE TYPE	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
0	Ground Surface	110.9				
	TOPSOIL	110.7				Test pit loosely backfilled with excavated material
	Brown sand and gravel, some silt and clay, occasional rootlets (FILL MATERIAL)		1	GS	M	
1	Brown silty sand, frequent cobbles and boulders (FILL MATERIAL)	109.9 1.0	2	GS		
4	End of test pit Refusal on probable bedrock Groundwater observed at 4.1 mbgs; estimated slow inflow rate	106.8 4.1				



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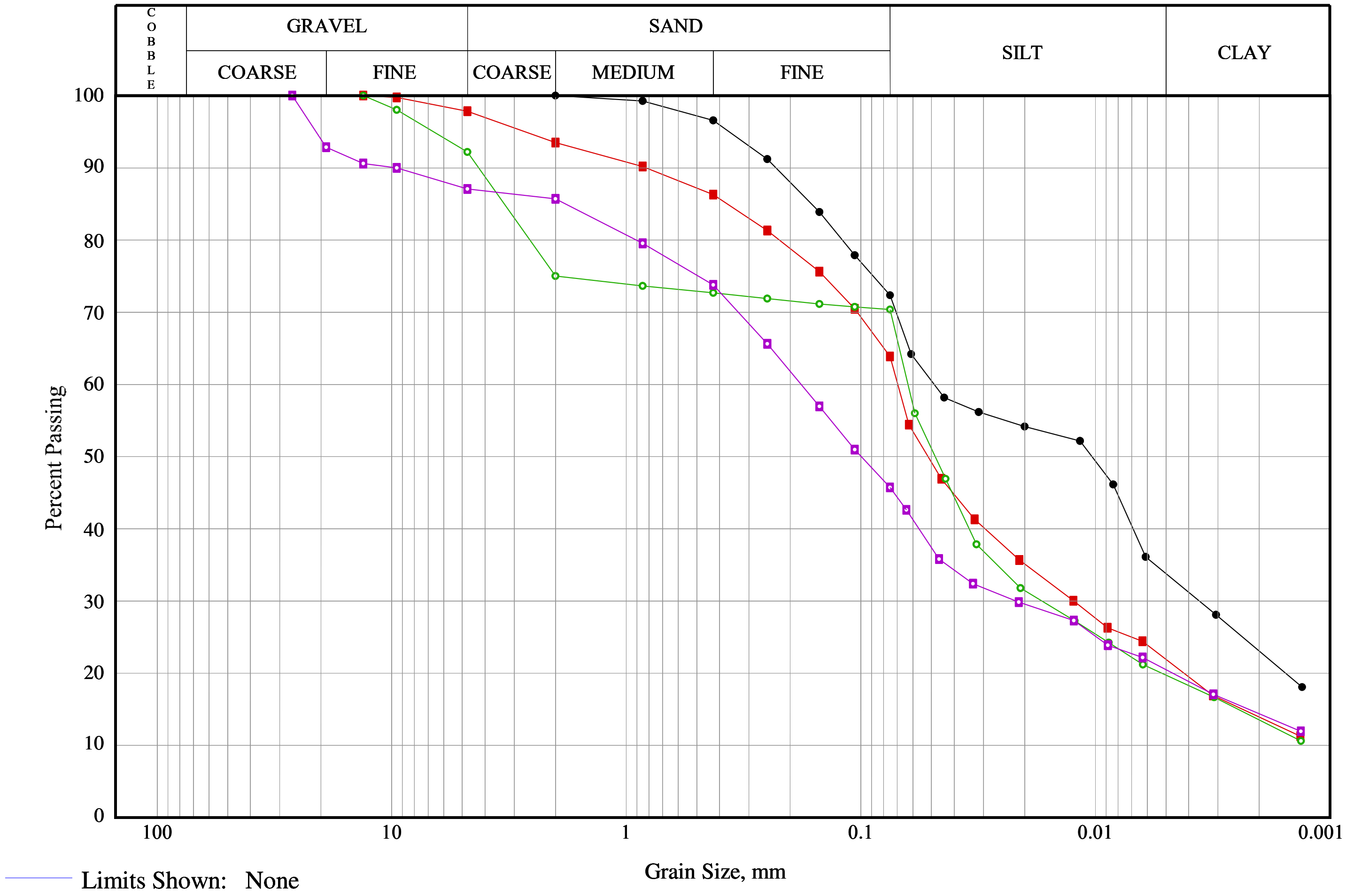
APPENDIX C

Laboratory Test Results, GEMTEC (2023)
Grain Size Distribution & Atterberg Limits Charts

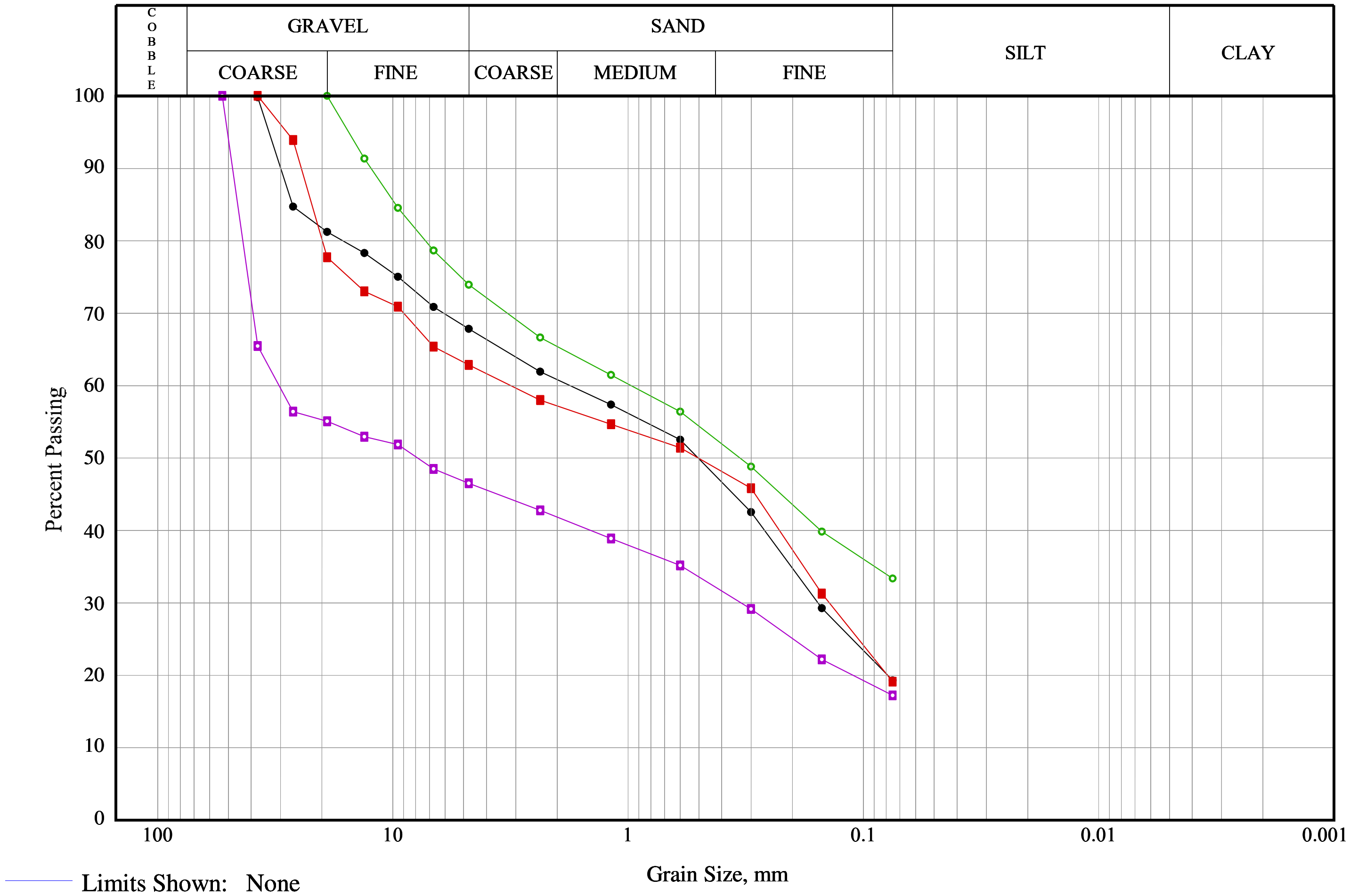
GEMTEC Consulting Engineers and Scientists	Client: The Properties Group Management Ltd Project: Geotechnical Investigation, Proposal Industrial Develop Project #: 102669001	Soils Grading Chart (LS-702/ ASTM D-422)



Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●	Fill Material	23-01	SA 3	2.2-2.8	0.0	27.6	38.6	33.8
■	Weathered Crust	23-03	SA 4	2.1-3.0	2.2	34.0	41.9	21.9
○	Fill Material	23-04	SA 3	1.1-1.4	7.8	21.8	50.6	19.7
▣	Possible Glacial Till	23-06	SA 4	2.1-2.4	12.9	41.4	25.2	20.5

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75μm
●	Sandy clayey silt	N/A	---	---	0.00	0.01	0.05	0.16	38.6
■	Sandy clayey silt , trace gravel	N/A	---	0.00	0.01	0.05	0.07	0.37	41.9
○	Sandy silt , some clay , trace gravel	N/A	---	0.00	0.02	0.05	0.06	3.31	50.6
▣	Silty clayey sand , some gravel	N/A	---	0.00	0.02	0.10	0.18	1.82	25.2

GEMTEC Consulting Engineers and Scientists		
	Client: The Properties Group Management Ltd	
	Project: Geotechnical Investigation, Proposal Industrial Develop	**Soils Grading Chart**
	Project #: 102669001	



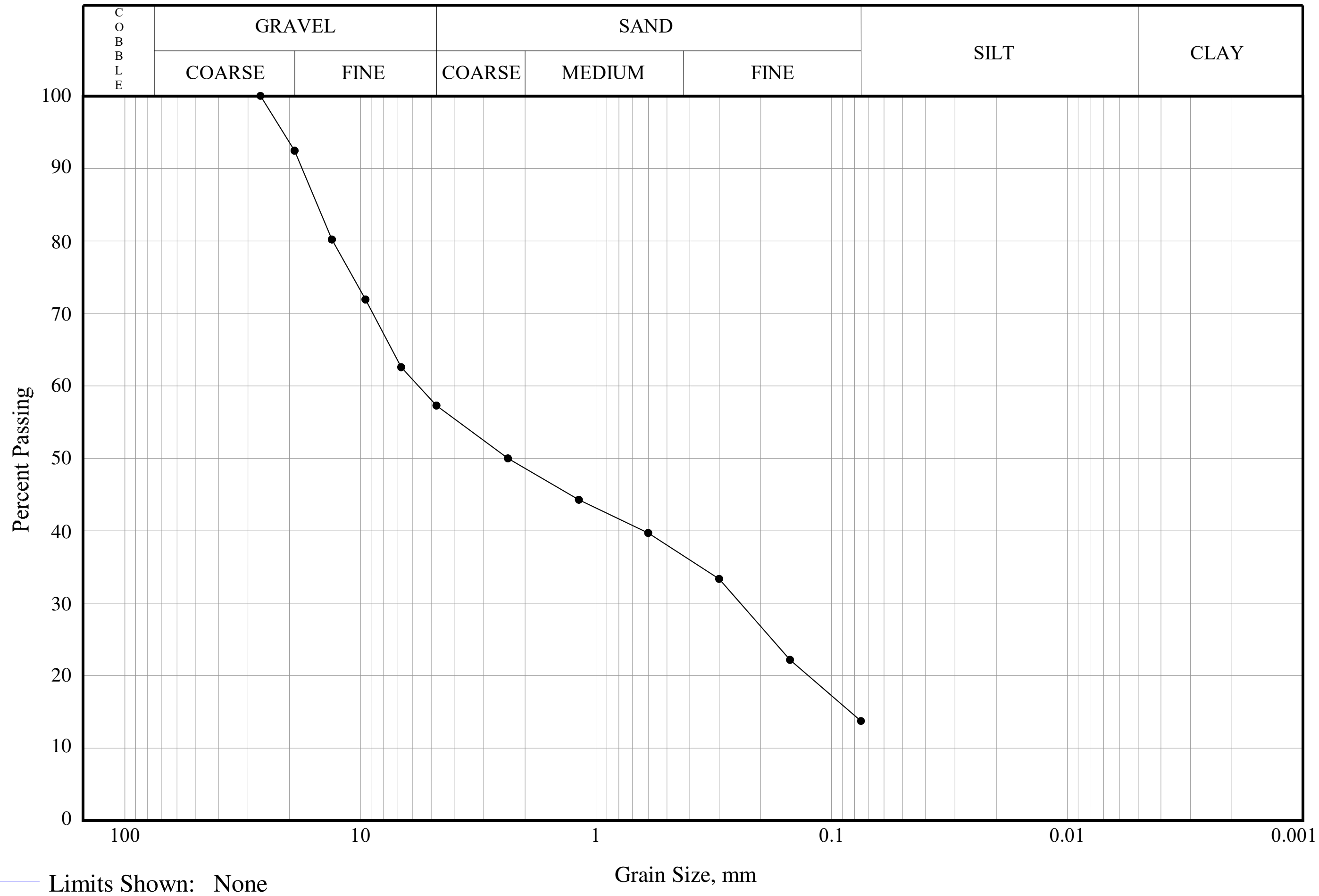
Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
●	Possible Glacial Till	23-02	SA 4	2.5-3.0	32.2	48.5	19.3	
■	Fill Material	23-09	SA 1	0.5-0.9	37.2	43.7	19.1	
○	Fill Material	23-11	SA 2	0.60-1.0	26.1	40.6	33.3	
▣	Fill Material	23-11	SA 4	2.5-3.1	53.5	29.3	17.2	

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75µm
●	Gravelly sand , some silt	N/A	---	---	0.16	0.50	1.76	26.68	---
■	Sand and gravel , some silt	N/A	---	---	0.14	0.50	3.15	22.07	---
○	Gravelly silty sand	N/A	---	---	---	0.33	0.97	9.72	---
▣	Sandy gravel , some silt	N/A	---	---	0.33	7.85	30.43	45.61	---

GEMTEC
Consulting Engineers
and Scientists

Client:	The Properties Group Management Ltd
Project:	Geotechnical Investigation, Proposal Industrial Develop
Project #:	102669001

Soils Grading Chart

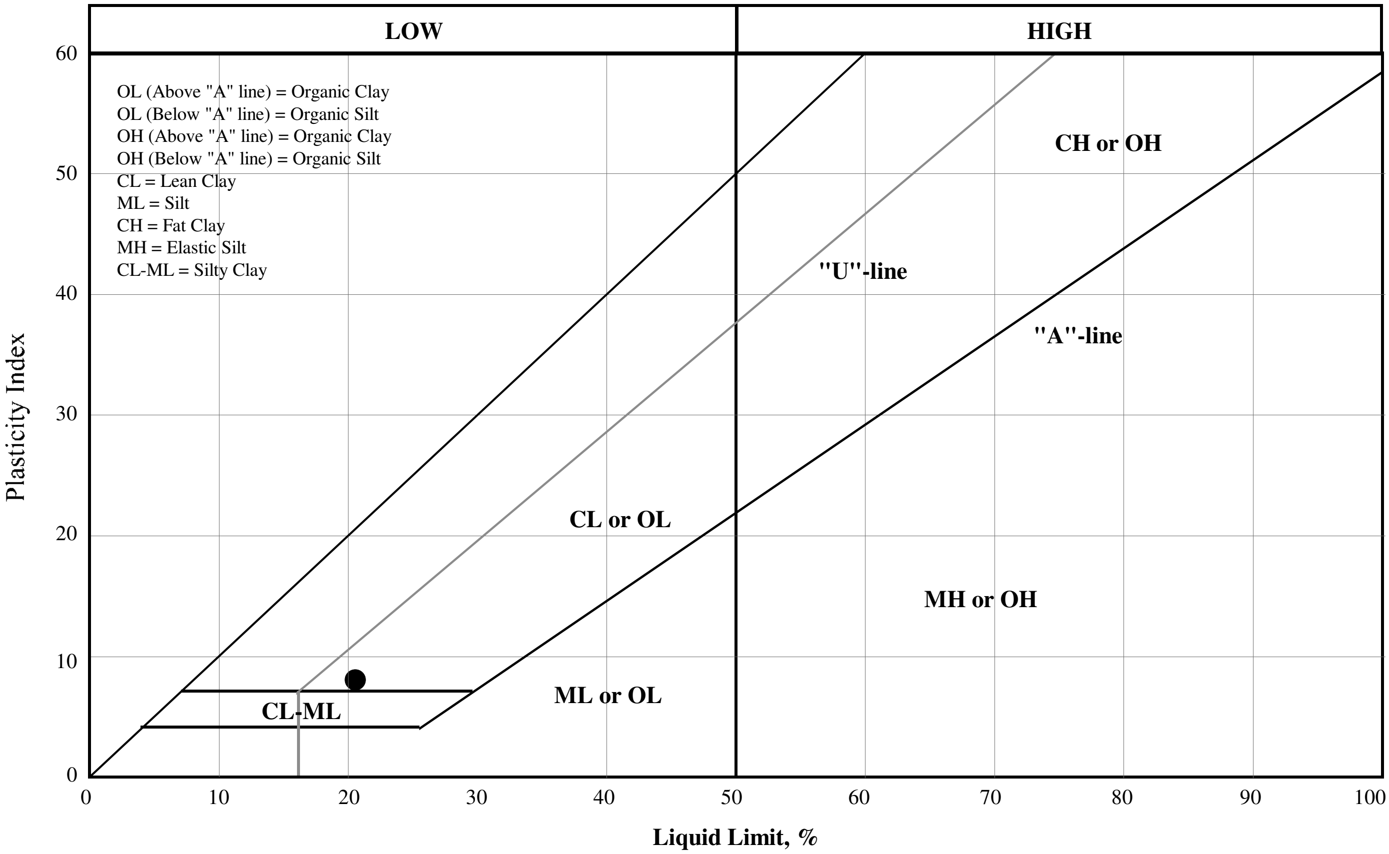


Limits Shown: None

Line Symbol	Sample	Borehole/ Test Pit	Sample Number	Depth	% Cob.+ Gravel	% Sand	% Silt	% Clay
—●—	Fill Material	23-12	SA 1	0.3-0.5	42.7	43.5	13.7	

Line Symbol	CanFEM Classification	USCS Symbol	D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	% 5-75μm
—●—	Sand and gravel , some silt	N/A	---	0.08	0.24	2.37	5.68	15.23	---

GEMTEC Consulting Engineers and Scientists		
	Client: The Properties Group Management Ltd	Plasticity Chart (D4318)
	Project: Geotechnical Investigation, Proposal Industrial Develop	
	Project #: 102669001	



Symbol	Borehole /Test Pit	Sample Number	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Non-Plastic	Moisture Content, %
●	23-07A	SA 4	3.1-3.3	20.6	12.5	8.0	☐	11.69

Note: More information available upon request

APPENDIX D

Record of Previous Investigations, Paterson (2015)
List of Abbreviations and Symbols

LEGEND:

⊕	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PG0783-2, APRIL 2008)
▚	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PH0521-LET.02, DEC. 2007
▞	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PG0783-1, APRIL 2006
◕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PG0783-1, APRIL 2006
■	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PH0521-REP.01, OCT. 2006
⊙	TEST WELL LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PH0521-REP.01, OCT. 2006
MW 1	SHALLOW MONITORING WELL INSTALLED IN TEST PIT
105.67	GROUND SURFACE ELEVATION (m)
[99.35]	PRACTICAL REFUSAL TO AUGERING/DCPT ELEVATION (m)
(103.17)	PRACTICAL REFUSAL TO EXCAVATION ELEVATION (m)
{107.9}	UNDERSIDE OF FILL &/OR TOPSOIL LAYER ELEVATION (m)
TOC	TOP OF CASING ELEVATION (m)
SWL	STATIC WATER LEVEL (m)

paterson group
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
2	BASE PLAN UPDATED	30/10/2015	DJG
1	BASE PLAN UPDATED	23/09/2015	DJG

O'KEEFE COURT PROPERTIES LIMITED

GEOTECHNICAL INVESTIGATION
PROP. OFFICE / WAREHOUSE DEVELOPMENT - 449 O'KEEFE COURT
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Stamp:

Scale: 1:500
Drawn by: MPG
Checked by: DJG
Approved by: DJG
Date: 09/2015

Report No.: PG0783
Drawing No.: PG0783-2
Revision No.: 2

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

GRAIN SIZE DISTRIBUTION SHEETS

ANALYTICAL TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

FILE NO. PG0783

REMARKS

HOLE NO. TP 1-08

BORINGS BY Hydraulic Shovel

DATE April 11, 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	106.56		
FILL: Brown silty sand, some crushed stone, trace asphalt		G	1			1	105.56		
1.90									
FILL: Crushed stone, some clay		G	2			2	104.56		
2.90									
TOPSOIL									
3.20						3	103.56		
Grey-brown **SILTY CLAY**		G	3						
4.00						4	102.56		▽
GLACIAL TILL: Brown silty sand, some clay, gravel, cobbles and boulders		G	4						
4.90									

End of Test Pit

TP terminated on bedrock surface at 4.90m depth

(GWL @ 4.0m depth based on field observations)

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

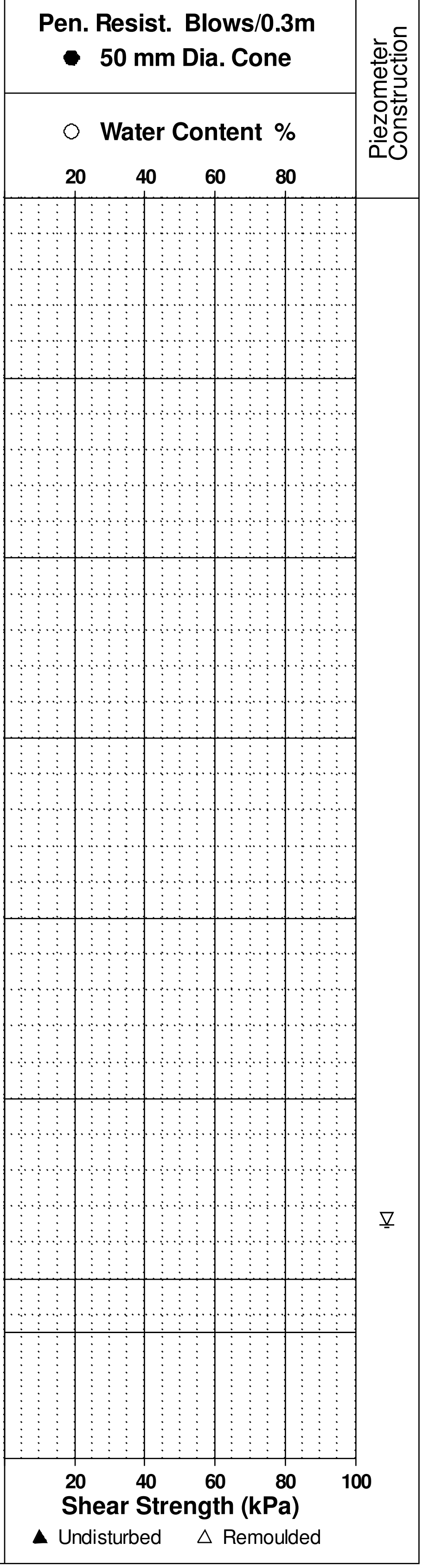
DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 2-08

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand, some crushed stone, trace asphalt	1.70	G	1		
FILL: Grey crushed stone, some clay, sand, trace asphalt	2.30	G	2		
FILL: Grey crushed stone	4.10				
TOPSOIL	4.40				
Grey-brown **SILTY CLAY,** some sand	5.20	G	3		
GLACIAL TILL: Brown silty sand, some gravel, cobbles, boulders, trace clay - grey by 5.7m depth	6.30	G G	4 5		
End of Test Pit TP terminated on bedrock surface at 6.30m depth					

DEPTH (m)	ELEV. (m)
0	107.29
1	106.29
2	105.29
3	104.29
4	103.29
5	102.29
6	101.29



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 2-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
(GWL @ 5.7m depth based on field observations)									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 3-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.95		
FILL: Brown silty sand with gravel, cobbles and boulders	▨					1	108.95		
1.50									
End of Test Pit TP terminated on bedrock surface at 1.50m depth									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 4-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	110.01		
FILL: Brown silty sand	▨					1	109.01		
1.90									
End of Test Pit TP terminated on bedrock surface at 1.90m depth									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
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DATUM Approximate geodetic

REMARKS

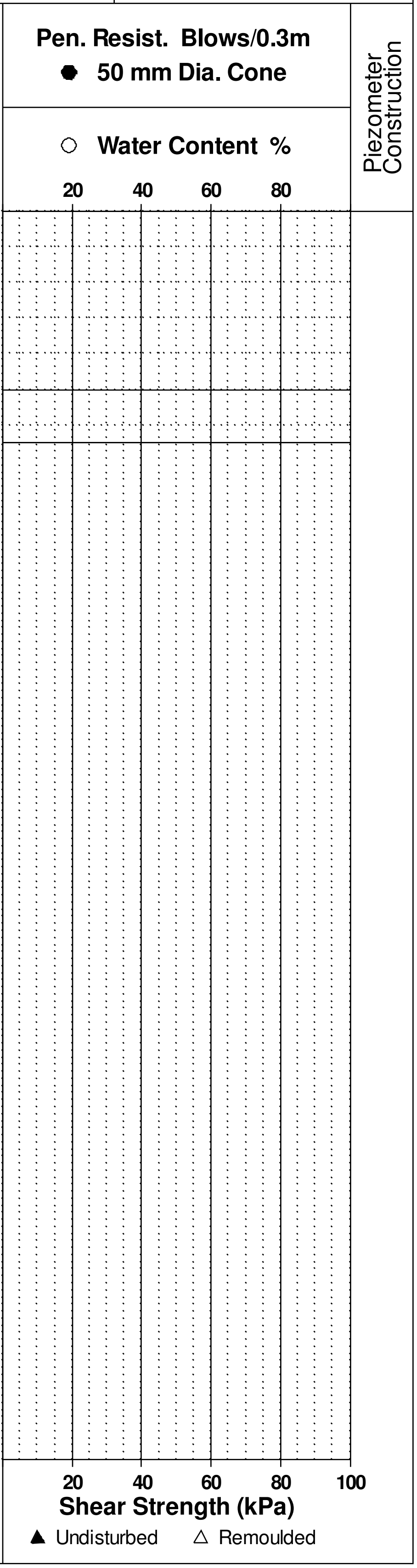
BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 5-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	109.89
FILL: Brown silty sand with gravel, some asphalt 0.40	▨						
FILL: Brown silty sand, some crushed stone 1.30	▨					1	108.89
End of Test Pit TP terminated on bedrock surface at 1.30m depth							



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REMARKS

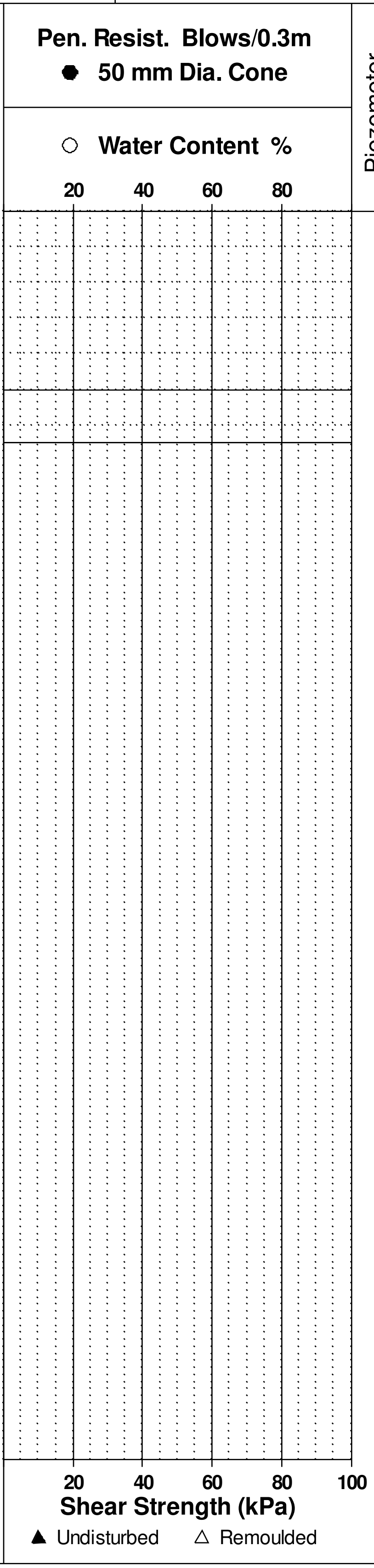
BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 6-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	109.75	
FILL: Crushed stone with asphalt 0.70	▨							
End of Test Pit TP terminated on bedrock surface at 0.70m depth						1	108.75	



SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 7-08

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	109.63		
FILL: Brown silty sand with crushed stone, blast rock and boulders	▨					1	108.63		
						2	107.63		
2.15									
End of Test Pit TP terminated on bedrock surface at 2.15m depth									

Chart scale: 20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 8-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.67		
	▨								∇
	▨					1	108.67		
FILL: Blast rock, some sand and gravel	▨								
	▨					2	107.67		
	▨					3	106.67		
3.40									
End of Test Pit TP terminated on bedrock surface at 3.40m depth (GWL @ 0.3m depth based on field observations)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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REMARKS

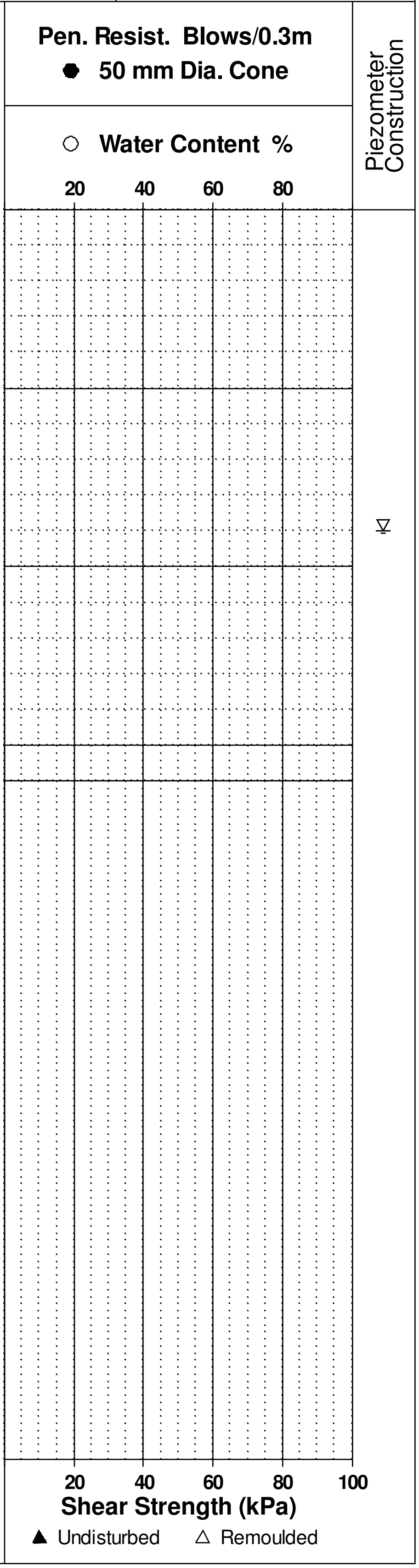
BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP 9-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.85
FILL: Brown silty sand with crushed stone	▨						
1.10						1	107.85
TOPSOIL	■						
1.40							
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders	^ ^ ^					2	106.85
3.20						3	105.85
End of Test Pit TP terminated on bedrock surface at 3.20m depth (GWL @ 1.8m depth based on field observations)							



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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP10-08

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	109.31		
FILL: Crushed stone with silty sand 0.80	▨								
TOPSOIL 1.00	■					1	108.31		
GLACIAL TILL: Brown silty sand with gravel and cobbles 2.50						2	107.31		▽
End of Test Pit TP terminated on bedrock surface at 2.50m depth (GWL @ 1.5m depth based on field observations)									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP11-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	109.68		
FILL: Crushed stone 0.10									
FILL: Brown silty sand with gravel, cobbles, boulders and blast rock 1.20						1	108.68		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 1.90									▽
End of Test Pit TP terminated on bedrock surface at 1.90m depth (GWL @ 1.7m depth based on field observations)									

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

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP12-08

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	109.69		
FILL: Crushed stone — 0.15	▨								
FILL: Brown silty sand with crushed stone — 1.00	▨					1	108.69		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders — 2.00	^^^								▽
End of Test Pit						2	107.69		

TP terminated on bedrock surface at 2.00m depth

(GWL @ 1.6m depth based on field observations)

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP13-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.68		
FILL: Crushed stone 0.30									
FILL: Brown silty sand with crushed stone 1.10						1	108.68		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 1.95									
End of Test Pit TP terminated on bedrock surface at 1.95m depth									

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

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FILE NO. PG0783

REMARKS

HOLE NO. TP14-08

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	109.71		
	▨					1	108.71		
FILL: Blast rock with sand	▨					2	107.71		
	▨					3	106.71		
3.30									
End of Test Pit TP terminated on bedrock surface at 3.30m depth									

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

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP15-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.04		
FILL: Crushed stone 0.10									
FILL: Brown silty sand with crushed stone 1.20	▨					1	108.04		
End of Test Pit TP terminated on bedrock surface at 1.20m depth									

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

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP16-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.00		
FILL: Blast rock with sand and gravel	▨					1	108.00		
1.50									
End of Test Pit TP terminated on bedrock surface at 1.50m depth									

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

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP17-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	108.84		
FILL: Blast rock	▨					1	107.84		
	▨					2	106.84		
2.90									
End of Test Pit TP terminated on bedrock surface at 2.90m depth									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 11, 2008

FILE NO. PG0783

HOLE NO. TP18-08

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	108.72		
FILL: Brown silty sand with blast rock 1.00	▨					1	107.72		
FILL: Blast rock 1.80	▨								
End of Test Pit TP terminated on bedrock surface at 1.80m depth									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP21-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.44
		G	1			1	107.44
FILL: Grey-brown silty sand with crushed stone, trace asphalt						2	106.44
						3	105.44
3.50		G	2				
TOPSOIL 3.80							
Brown **SILTY CLAY** 3.95							
						4	104.44
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders		G	3				
4.70							
End of Test Pit TP terminated on bedrock surface at 4.70m depth							

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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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP22-08

SOIL DESCRIPTION	Bottom depth (m)
GROUND SURFACE	
FILL: Brown silty sand with crushed stone, gravel, cobbles, trace asphalt	2.90
FILL: Crushed stone, trace asphalt	3.80
TOPSOIL	3.90
Brown **SILTY CLAY** with sand, trace gravel	4.25
GLACIAL TILL: Brown silty sand, some clay, gravel, cobbles and bouldes	5.40
End of Test Pit TP terminated on bedrock surface at 5.40m depth	

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

DEPTH (m)	ELEV. (m)
0	109.31
1	108.31
2	107.31
3	106.31
4	105.31
5	104.31

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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REMARKS

BORINGS BY Hydraulic Shovel

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FILE NO. PG0783

HOLE NO. TP23-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	106.49	
FILL: Brown silty sand, some crushed stone 0.45	▨	G	1					
TOPSOIL 0.75	■							
GLACIAL TILL: Brown silty sand, some clay, gravel, cobbles and bouldes 2.30	^	G	2			1	105.49	
						2	104.49	▽
End of Test Pit TP terminated on bedrock surface at 2.30m depth (GWL @ 2.1m depth based on field observations)								

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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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP24-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	105.69		
FILL: Brown silty sand with crushed stone 0.40	▨	G	1						
FILL: Crushed stone 1.10	▨	G	2			1	104.69		
TOPSOIL 1.15	■								
GLACIAL TILL: Brown silty sand with gravel, cobbles, boulders, trace clay	^	G	3			2	103.69		
						3	102.69		
- grey by 4.1m depth 4.10	^					4	101.69		
End of Test Pit TP terminated on bedrock surface at 4.10m depth									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP25-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	104.85
FILL: Crushed stone 0.40		G	1				
FILL: Blast rock 0.60							
TOPSOIL 0.75							
Brown **SILTY CLAY** 2.50		G	2			1 2	103.85 102.85
GLACIAL TILL: Brown silty sand, some clay, gravel, cobbles and boulders - grey by 3.4m depth 4.00						3	101.85
End of Test Pit TP terminated on bedrock surface at 4.00m depth (GW infiltration at 0.6m depth)							

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

SOIL PROFILE AND TEST DATA

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REMARKS

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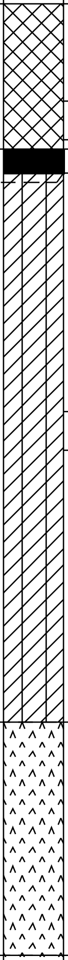
FILE NO. PG0783

HOLE NO. TP26-08

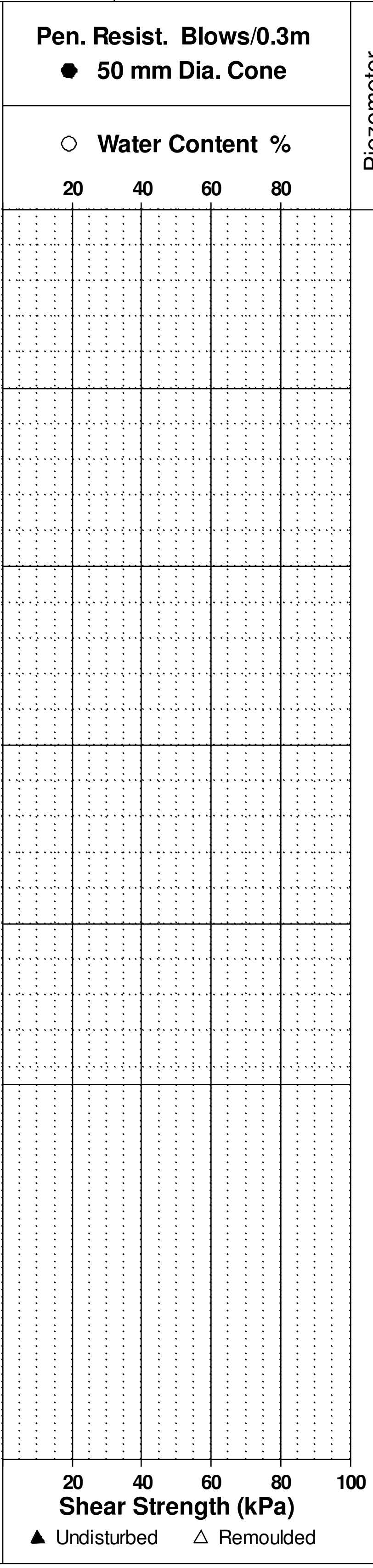


SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.64
FILL; Crushed stone and blast rock,some sand — 0.75	G	1				
TOPSOIL — 0.87						
					1	103.64
Very stiff to stiff, brown **SILTY CLAY,** some sand	G	2			2	102.64
					3	101.64
— 3.70						
GLACIAL TILL: Grey silty clay, some sand, gravel, cobbles and boulders					4	100.64
— 4.90						

End of Test Pit

TP terminated on bedrock surface at 4.90m depth

(GWL @ 1.7m depth based on field observations)



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP27-08

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Crushed stone, some sand, trace topsoil, cobbles and boulders	G G	1 2		
3.15				
FILL: Crushed stone				
3.85				
FILL: Brown silty clay, some organics				
4.10				
FILL: Crushed stone and blast rock				
5.10				
TOPSOIL				
5.30				
Bluish brown **SILTY CLAY**				
5.90				
End of Test Pit TP terminated in silty clay at 5.90m depth				

DEPTH (m)	ELEV. (m)
0	108.55
1	107.55
2	106.55
3	105.55
4	104.55
5	103.55

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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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP28-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.67		
FILL: Brown silty sand, trace crushed stone		G	1						
1.10						1	108.67		
FILL: Blast rock, some silty sand									
2.00						2	107.67		
FILL: Brown silty sand, some clay, gravel, cobbles and bouldes		G	2						
2.90						3	106.67		
FILL: Grey silty clay, some sand, gravel, cobbles and boulders		G	3			4	105.67		
5.10						5	104.67		
FILL: Crushed stone 5.20									
End of Test Pit (GW infiltration at 5.0m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP29-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	106.50		
FILL: Brown silty sand, some gravel, cobbles, trace clay — 0.70		G	1						
TOPSOIL — 0.96						1	105.50		
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders — 2.90		G	2			2	104.50		
End of Test Pit									

TP terminated on bedrock surface at 2.90m depth

(GWL @ infiltration at bottom of test pit)

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Office/Warehouse Development - 449 O'Keefe Court
Ottawa, Ontario

DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP30-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.78
FILL: Brown silty sand, trace crushed stone and organics 0.30	▨	G	1				
TOPSOIL 0.60	■						
GLACIAL TILL: Bluish brown silty sand, some gravel, cobbles and boulders	▒					1	104.78
	▒					2	103.78
2.20	▒	G	2				
End of Test Pit TP terminated on bedrock surface at 2.20m depth (GWL infiltration at bottom of test pit)							

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
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Ottawa, Ontario

DATUM Approximate geodetic	**FILE NO.** PG0783
REMARKS	**HOLE NO.** TP31-08
BORINGS BY Hydraulic Shovel **DATE** April 14, 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	106.60		
FILL: Brown silty clay, trace crushed stone 0.50	▩	G	1						
TOPSOIL 0.65	■								
Bluish brown **SILTY CLAY,** trace sand 1.60	▨	G	2			1	105.60		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 1.97	⁂								
End of Test Pit TP terminated on bedrock surface at 1.97m depth									

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
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REMARKS

BORINGS BY Hydraulic Shovel

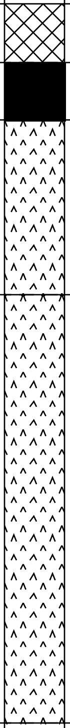
DATE April 14, 2008

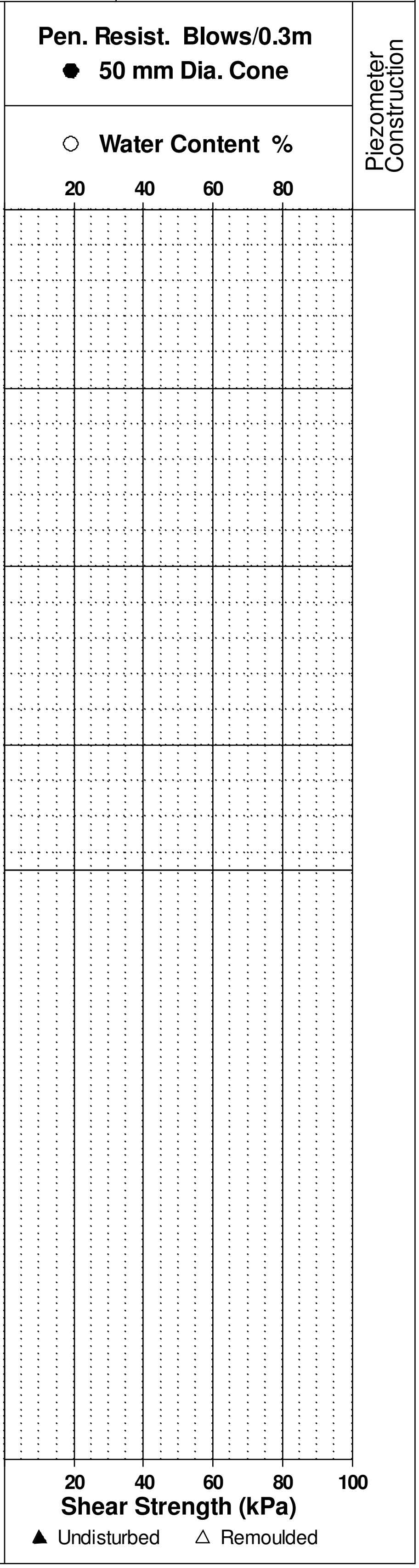
FILE NO. PG0783

HOLE NO. TP32-08

SOIL DESCRIPTION	DEPTH (m)	ELEV. (m)
GROUND SURFACE	0	107.70
FILL: Organics, some crushed stone	0.30	
TOPSOIL	0.60	
GLACIAL TILL: Brown silty clay, some sand, gravel and cobbles	1.50	
	1	106.70
	2	105.70
GLACIAL TILL: Grey-brown silty sand, some gravel, cobbles and boulders, trace clay	3.70	
	3	104.70
End of Test Pit TP terminated on bedrock surface at 3.70m depth (GW infiltration at 1.4m depth)		

STRATA PLOT	SAMPLE			
	TYPE	NUMBER	% RECOVERY	N VALUE or RQD





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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP33-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	108.10		
FILL: Organics, trace blast rock 0.30									
TOPSOIL 0.62									
GLACIAL TILL: Brown sand with gravel and cobbles 2.20						1	107.10		
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders 3.10						2	106.10		
End of Test Pit TP terminated on bedrock surface at 3.10m depth						3	105.10		

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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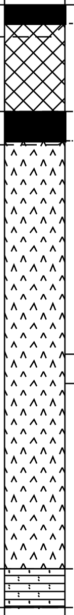
REMARKS

BORINGS BY Hydraulic Shovel

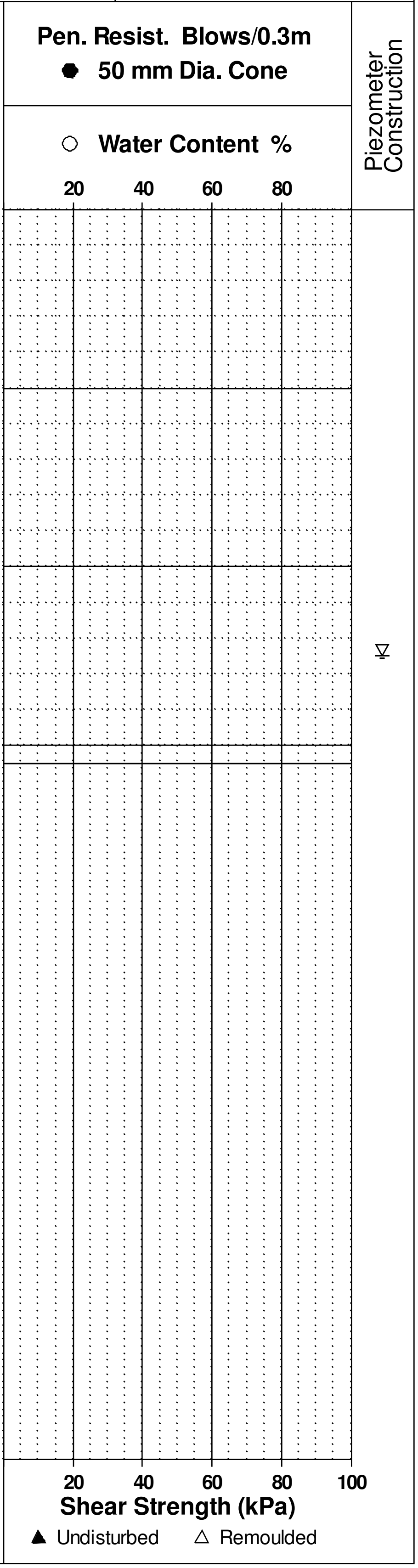
DATE April 14, 2008

FILE NO. **PG0783**

HOLE NO. **TP34-08**



SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.46
Topsoil — 0.10							
FILL: Organics with crushed stone — 0.55							
TOPSOIL — 0.70						1	107.46
GLACIAL TILL: Dense, brown silty sand, some gravel, cobbles, trace boulders — 2.90		G	1			2	106.46
Inferred **BEDROCK** — 3.10						3	105.46
End of Test Pit (GWL @ 2.5m depth based on field observations)							



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP35-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	108.50		
FILL: Crushed stone 0.15									
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders						1	107.50		
						2	106.50		
2.50									
Inferred **BEDROCK** 2.60									
End of Test Pit									
(GW infiltration at bedrock surface)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP36-08

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand, trace gravel, cobbles and clay 0.60	☒				
TOPSOIL 0.80	■				
Brown **SILTY CLAY** 1.20	▨				
GLACIAL TILL: Dense, brown silty sand, some gravel, cobbles and boulders - grey by 3.3m depth 4.40	^				
End of Test Pit TP terminated on bedrock surface at 4.40m depth					

DEPTH (m)	ELEV. (m)
0	107.44
1	106.44
2	105.44
3	104.44
4	103.44

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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REMARKS

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DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP37-08

SOIL DESCRIPTION	STRATA PLOT	DEPTH OF BASE (m)
GROUND SURFACE		
FILL: Brown silty clay, some sand, gravel, cobbles	▨	0.75
TOPSOIL	■	1.00
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders	^^^	3.50
End of Test Pit TP terminated in glacial till at 3.50m depth		

DEPTH (m)	ELEV. (m)
0	107.23
1	106.23
2	105.23
3	104.23

SAMPLE: TYPE | NUMBER | % RECOVERY | N VALUE or RQD

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

SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP38-08

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	108.36		
FILL: Brown silty sand, some gravel, cobbles and boulders, trace clay									
0.90						1	107.36		
GLACIAL TILL: Dense, brown silty sand, some gravel, cobbles and boulders									
2.10						2	106.36		
End of Test Pit TP terminated in glacial till at 2.10m depth									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP39-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.10		
FILL: Brown silty sand with gravel, cobbles, some crushed stone 0.30									
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders 1.50						1	108.10		
End of Test Pit TP terminated on bedrock surface at 1.50m depth									

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

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SOIL PROFILE AND TEST DATA

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REMARKS
BORINGS BY Hydraulic Shovel
DATE April 14, 2008
FILE NO. PG0783
HOLE NO. TP40-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.34		
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders 0.90	^^^								
End of Test Pit TP terminated on bedrock surface at 0.90m depth									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

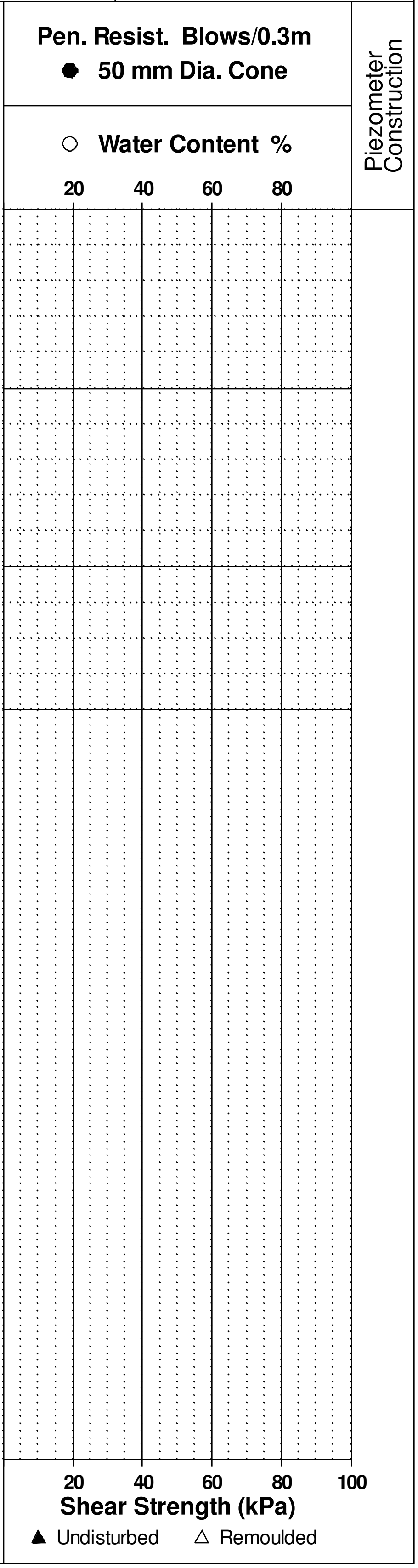
BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP41-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.94
FILL: Blast rock with crushed stone	▨					1	107.94
						2	106.94
2.80							
End of Test Pit TP terminated on bedrock surface at 2.80m depth							



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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

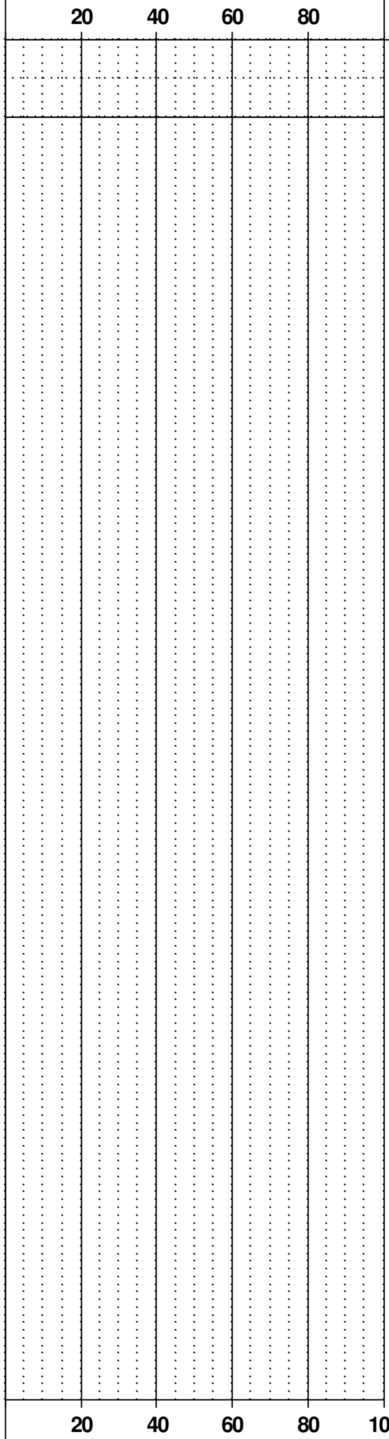
BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP42-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
						0	108.99		
FILL: Crushed stone 0.40	▨								
End of Test Pit TP terminated on bedrock surface at 0.40m depth									



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP43-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE									
FILL: Blast rock, some asphalt 0.60	▨					0	109.06		
End of Test Pit TP terminated on bedrock surface at 0.60m depth									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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DATUM Approximate geodetic

REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP44-08

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	109.35		
FILL: Blast rock, some asphalt	▨								
1.10						1	108.35		
FILL: Blast rock with crushed stone	▨					2	107.35		
						3	106.35		
3.50									
End of Test Pit TP terminated in blast rock fill at 3.50m depth									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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DATUM Approximate geodetic

FILE NO. PG0783

REMARKS

HOLE NO. TP45-08

BORINGS BY Hydraulic Shovel

DATE April 14, 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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.48		
FILL: Crushed stone 0.40	▨								
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders 0.90	^^^								
End of Test Pit TP terminated on bedrock surface at 0.90m depth									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP46-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.84		
FILL: Blast rock with asphalt	▨					1	108.84		
1.50									
End of Test Pit TP terminated on bedrock surface at 1.50m depth									

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

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SOIL PROFILE AND TEST DATA

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FILE NO. PG0783

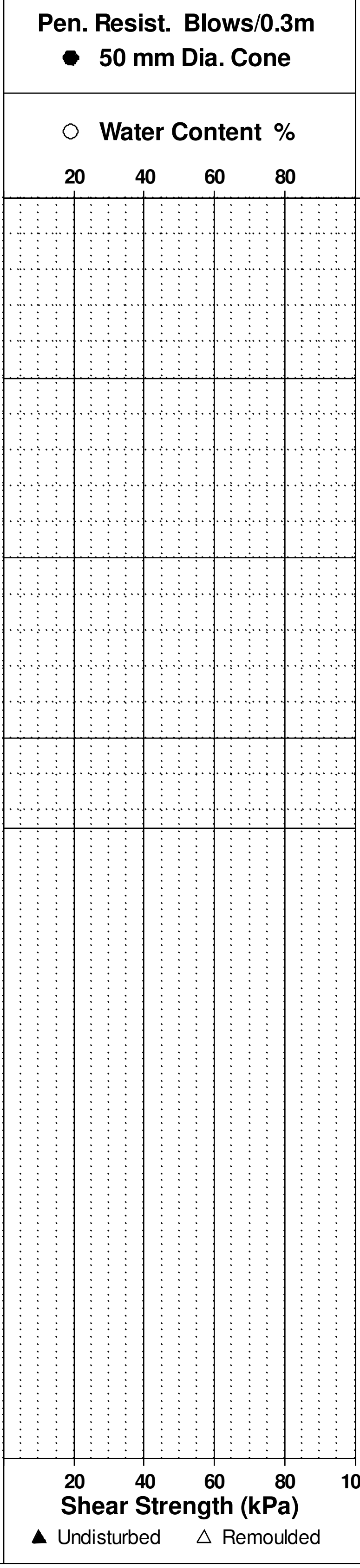
REMARKS

HOLE NO. TP47-08

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	109.94	
FILL: Blast rock	▨					1	108.94	
	▨					2	107.94	
	▨					3	106.94	
3.50								
End of Test Pit TP terminated in blast rock fill at 3.50m depth								



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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP48-08

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	110.01		
FILL: Blast rock, some crushed stone, sand, trace asphalt	▨					1	109.01		
1.70									
End of Test Pit TP terminated on bedrock surface at 1.70m depth									

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

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP49-08

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	108.91		
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders	^^^					1	107.91		
						2	106.91		
2.30									
End of Test Pit TP terminated on bedrock surface at 2.30m depth (GW infiltration at 2.1m depth)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP50-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	108.85		
FILL: Crushed stone and blast rock	▨					1	107.85		
	▨					2	106.85		
3.20	▨					3	105.85		
End of Test Pit TP terminated on bedrock surface at 3.20m depth									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

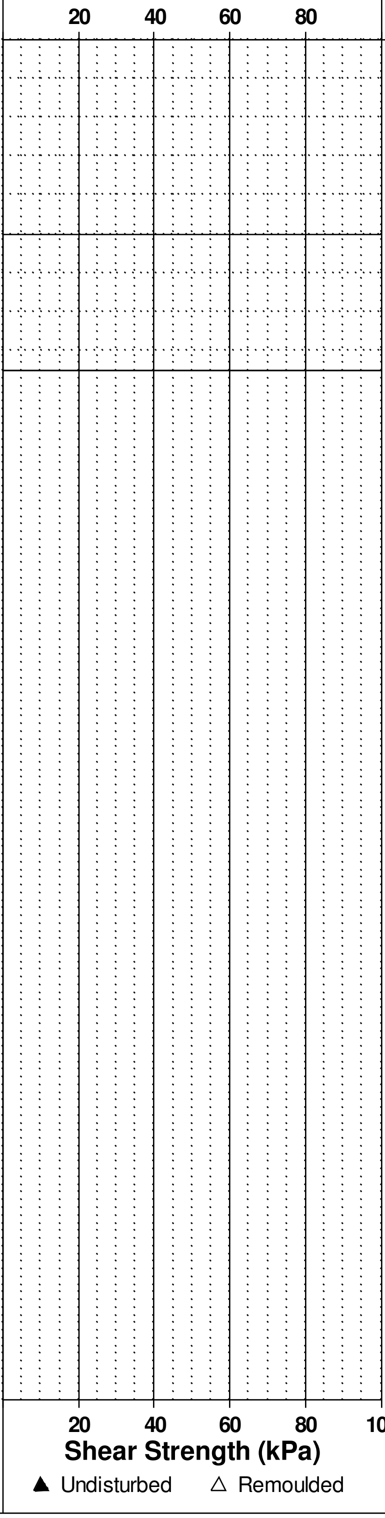
BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP51-08

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	108.90		
GLACIAL TILL: Brown silty sand, some gravel, cobbles and boulders	^^^					1	107.90		
1.70									
End of Test Pit									



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REMARKS

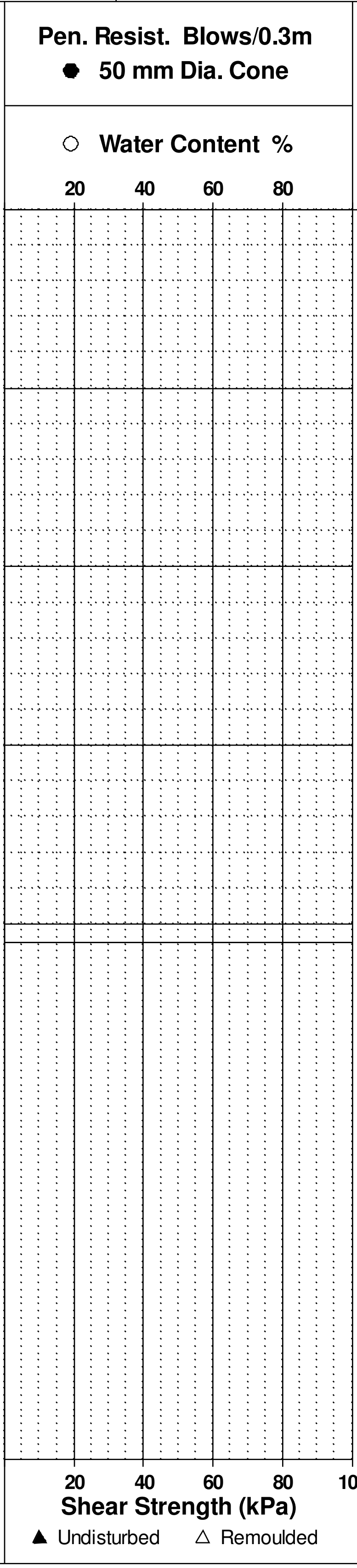
BORINGS BY Hydraulic Shovel

DATE April 14, 2008

FILE NO. PG0783

HOLE NO. TP52-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	107.18
						1	106.18
FILL: Grey-brown silty clay, some sand, gravel, cobbles, boulders, trace asphalt						2	105.18
						3	104.18
3.30							
TOPSOIL 3.40							
GLACIAL TILL: Grey silty sand, some gravel, cobbles and boulders						4	103.18
4.10							
End of Test Pit TP terminated on bedrock surface at 4.10m depth							



Piezometer Construction

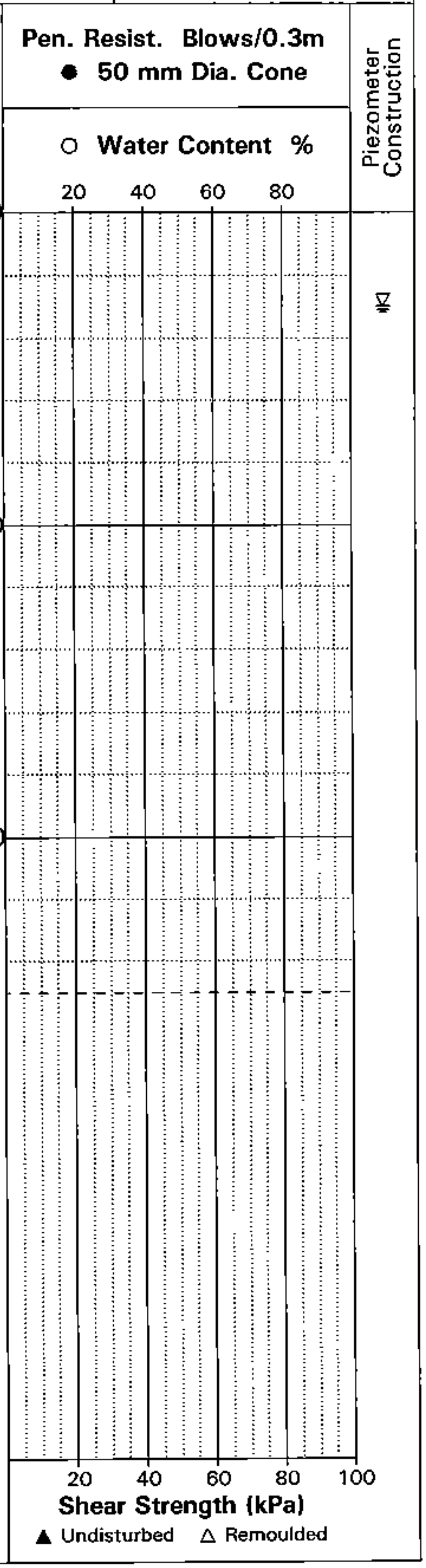
patersongroup Consulting Engineers
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.
REMARKS
BORINGS BY Backhoe
DATE 16 NOV 07
FILE NO. PH0521
HOLE NO. TP1-07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
FILL: Sand, silt, gravel 0.34						0	105.30
FILL: Blast rock 0.80							
Stiff to very stiff SANDY SILTY CLAY 2.50						1 2	104.30 103.30
End of Test Pit (Open hole GWL @ 0.3m depth)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

REMARKS

BORINGS BY Backhoe

DATE 16 NOV 07

FILE NO. PH0521

HOLE NO. TP2-07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	105.30		
FILL: Boulders	▨								∇
0.80									
						1	104.30		
Stiff to very stiff SANDY SILTY CLAY	▨								
						2	103.30		
2.50									
End of Test Pit (Open hole GWL @ 0.6m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

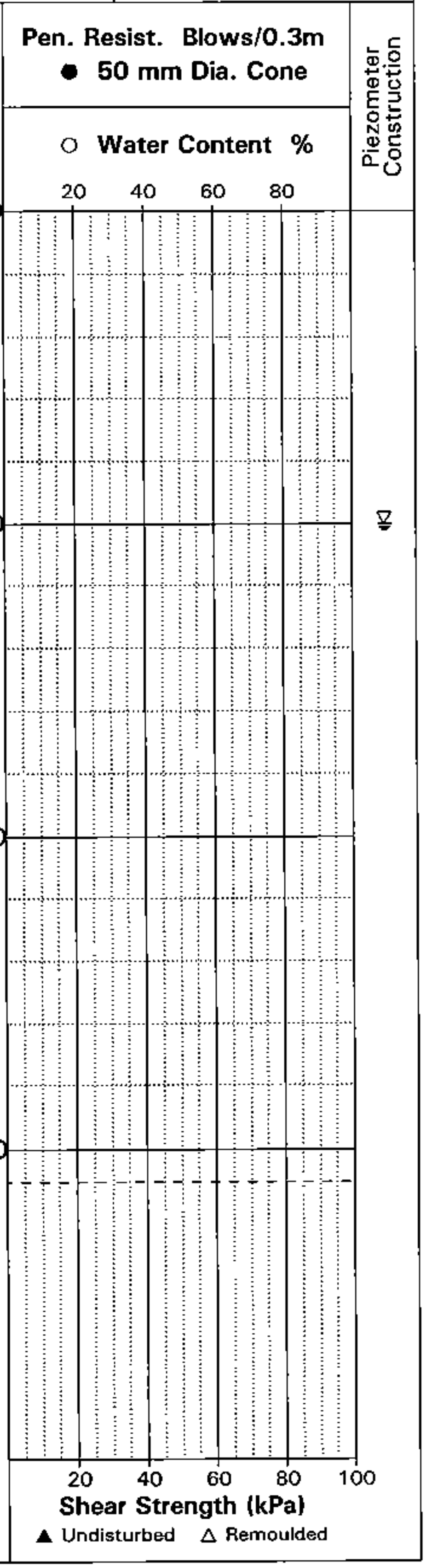
DATUM Ground surface elevation interpolated from topographic plan.
REMARKS
BORINGS BY Backhoe
DATE 16 NOV 07
FILE NO. **PH0521**
HOLE NO. **TP3-07**

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
FILL: Boulders	1.10
TOPSOIL	1.20
Dense to very dense **SANDY SILT** to **SILTY SAND**, some clay	3.10
End of Test Pit (Open hole GWL @ 1.0m depth)	

STRATA PLOT

SAMPLE			
TYPE	NUMBER	% RECOVERY	N VALUE or RQD

DEPTH (m)	ELEV. (m)
0	105.50
1	104.50
2	103.50
3	102.50



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

FILE NO. PH0521

REMARKS

HOLE NO. TP4-07

BORINGS BY Backhoe

DATE 16 NOV 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	104.90		
FILL: Boulders 0.45									∇
FILL: Boulders with organics 0.90									
TOPSOIL 1.15						1	103.90		
Stiff, grey SANDY SILTY **CLAY**						2	102.90		
3.00						3	101.90		
End of Test Pit (Open hole GWL @ 0.4m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

FILE NO. PH0521

REMARKS

HOLE NO. TP5-07

BORINGS BY Backhoe

DATE 16 NOV 07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	104.90		
									∇
FILL: Gravel	▩								
						1	103.90		
1.40									
Light brown to grey **SANDY SILTY CLAY**	▨								
						2	102.90		
3.00						3	101.90		
End of Test Pit (Open hole GWL @ 0.3m depth)									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

FILE NO. **PH0521**

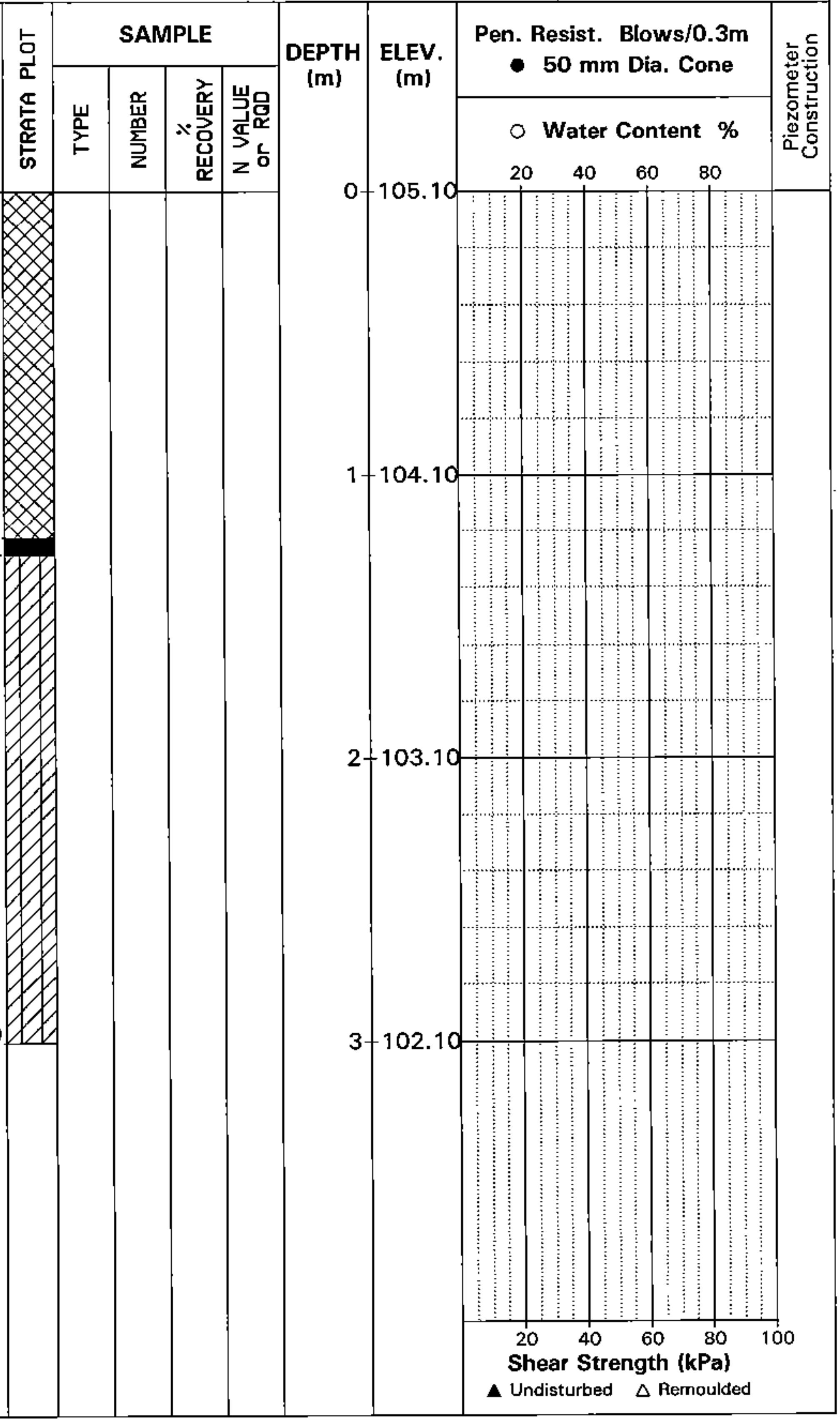
REMARKS

HOLE NO. **TP6-07**

BORINGS BY Backhoe

DATE 16 NOV 07

SOIL DESCRIPTION	Depth
GROUND SURFACE	
FILL: Gravel with silt and sand	1.22
TOPSOIL	1.28
Stiff, grey SILTY CLAY, trace sand	3.00
End of Test Pit	



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

REMARKS

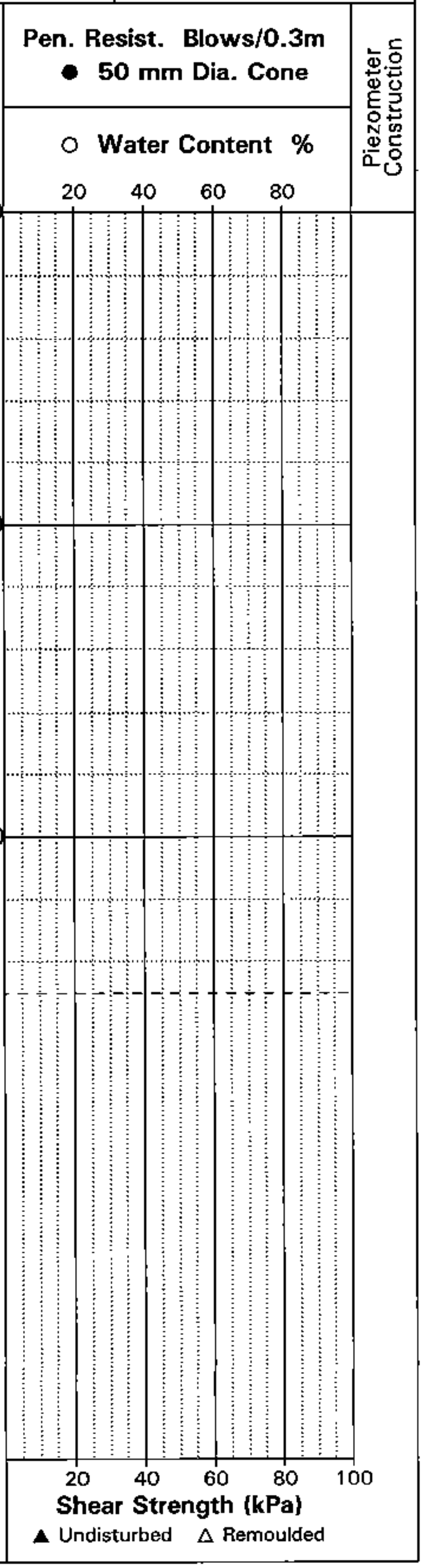
BORINGS BY Backhoe

DATE 16 NOV 07

FILE NO. **PH0521**

HOLE NO. **TP7-07**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.10
FILL: Blast rock	▨					1	107.10
	▨					2	106.10
2.50							
End of Test Pit (Heavy groundwater infiltration)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Office/Warehouse Development
4497 O'Keefe Court
Ottawa, Ontario

DATUM Ground surface elevation interpolated from topographic plan.

REMARKS

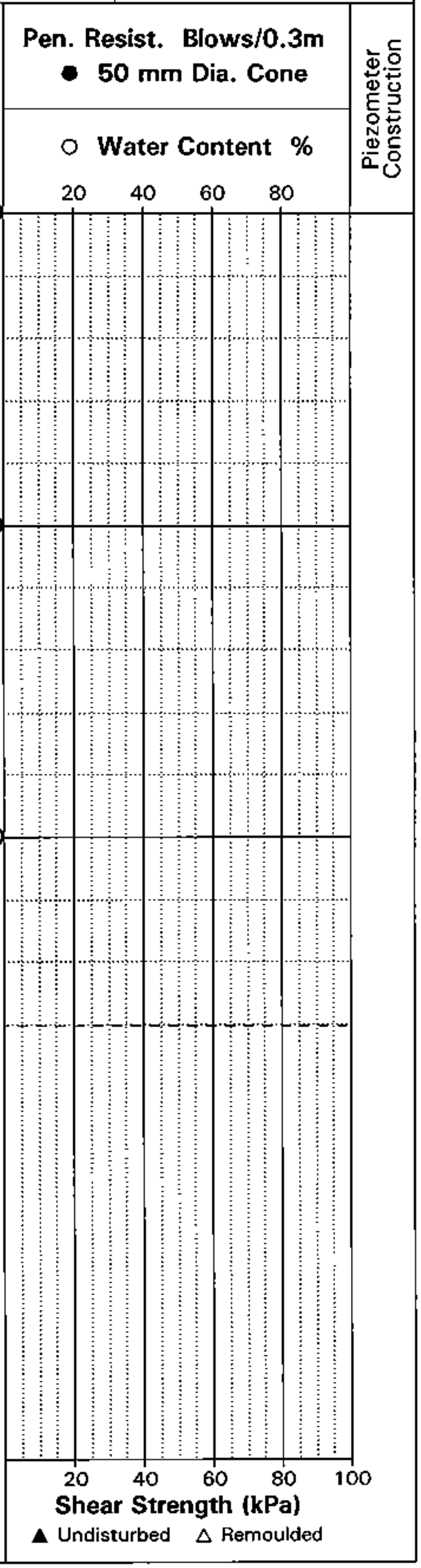
BORINGS BY Backhoe

DATE 16 NOV 07

FILE NO. PH0521

HOLE NO. TP8-07

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	109.20
FILL: Blast rock	▨					1	108.20
	▨					2	107.20
2.60							
End of Test Pit (Heavy groundwater infiltration)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

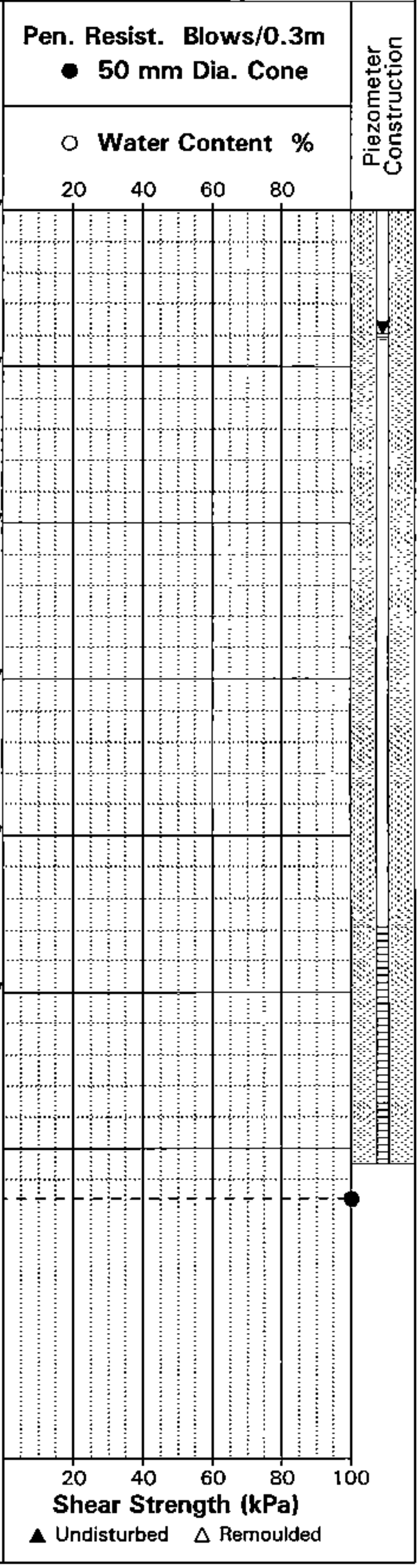
BORINGS BY CME 75 Power Auger

DATE 14 MAR 06

FILE NO. PG0783

HOLE NO. BH1-06

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	105.67
FILL: Brown silty sand with gravel 0.76						
FILL: Topsoil with sand and gravel 1.37	SS	1	17	21	1	104.67
FILL: Dark brown silty clay with sand, gravel and organic matter 2.13	SS	2	0	23	2	103.67
Dense to very dense, brown SILTY SAND with gravel, cobbles and boulders	SS	3	67	30		
	SS	4	67	77+	3	102.67
- loose by 3.8m depth	SS	5	50	7	4	101.67
- dense by 4.5m depth	SS	6	33	38	5	100.67
6.10	SS	7			6	99.67
Dynamic Cone Penetration Test commenced @ 6.10m depth Inferred SILTY SAND 6.32						
End of Borehole DCPT refusal @ 6.32m depth (GWL @ 0.79m-Mar. 24/06)						



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 14 MAR 06

FILE NO. PG0783

HOLE NO. BH2-06

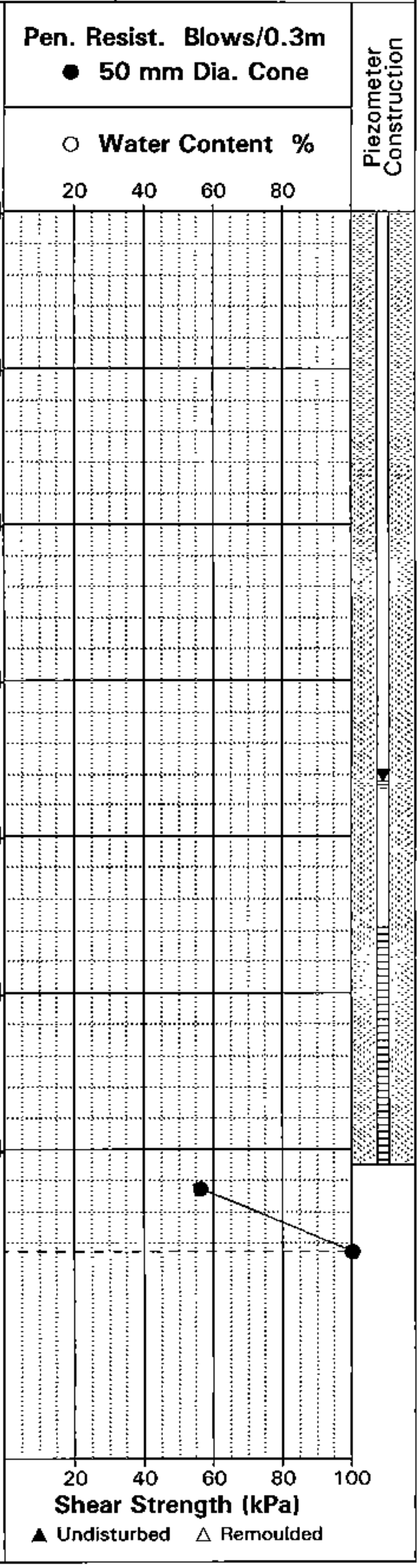
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown to dark brown silty clay with sand, gravel and cobbles	SS	1	17	30
	SS	2	42	71
2.90	SS	3	0	17
Loose, grey-brown to brown SANDY SILT with gravel - trace to some clay by 3.7m depth - dense by 4.5m depth	SS	4	50	6
	SS	5	58	9
5.18	SS	6	100	50+
Dense, brown SILTY SAND with gravel, cobbles and boulders	SS	7	50	35
6.10				
Dynamic Cone Penetration Test commenced @ 6.10m depth				
6.65				
Inferred SILTY SAND				

End of Borehole

DCPT refusal @ 6.65m depth

(GWL @ 3.65m-Mar. 24/06)

DEPTH (m)	ELEV. (m)
0	108.34
1	107.34
2	106.34
3	105.34
4	104.34
5	103.34
6	102.34



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

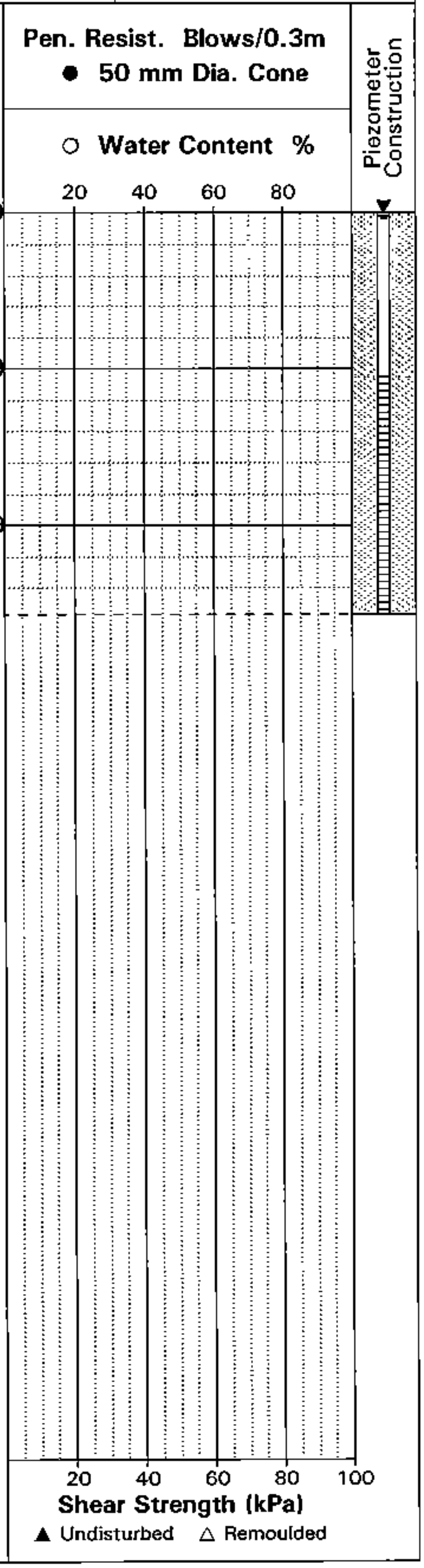
BORINGS BY CME 75 Power Auger

DATE 14 MAR 06

FILE NO. **PG0783**

HOLE NO. **BH3-06**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
						0	108.59
FILL: Topsoil with gravel 0.76							
FILL: Brown/black silty sand with gravel and organic matter 1.37		SS	1	31	90+	1	107.59
Very dense, brown SILTY SAND with gravel, cobbles and boulders 2.57		SS	2	38	50+	2	106.59
End of Borehole Practical refusal to augering @ 2.57m depth (GWL @ ground surface - Mar. 24/06)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

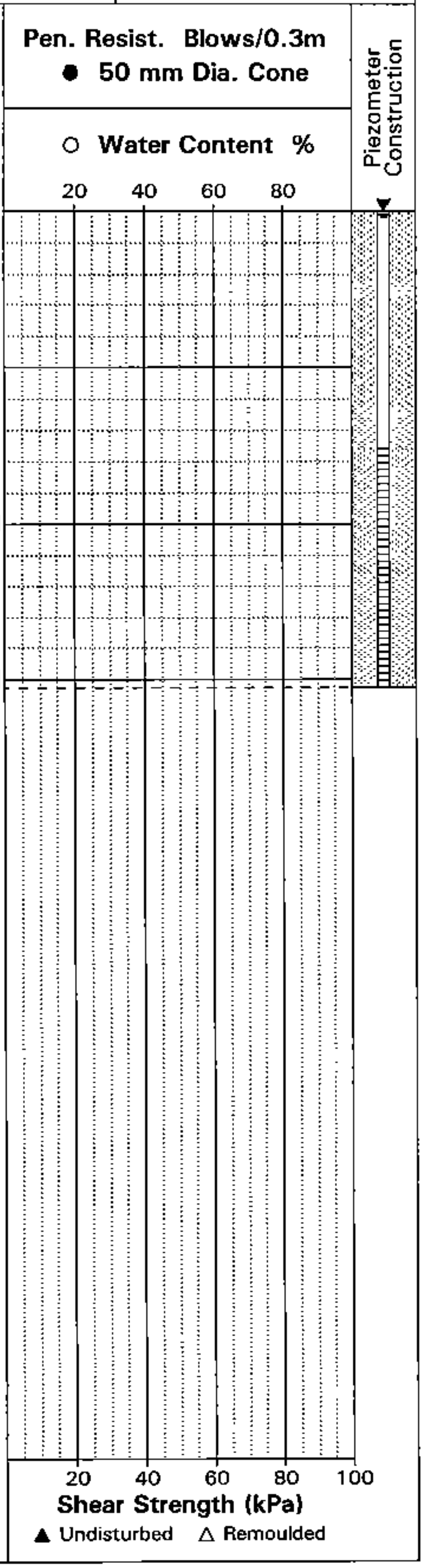
BORINGS BY CME 55 Power Auger

DATE 14 MAR 06

FILE NO. PG0783

HOLE NO. BH4-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.91
TOPSOIL							
		SS	1	12	24	1	105.91
1.37							
Very dense, brown to grey-brown SILTY SAND with gravel, cobbles and boulders		SS	2	36	50+		
						2	104.91
		SS	3	71	58+		
3.05						3	103.91
End of Borehole							
Practical refusal to augering @ 3.05m depth							
(GWL @ ground surface - Mar. 24/06)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP1-06

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	107.98		
FILL: Dark brown silty sand mixed with clay, gravel and cobbles 0.76	▨	G	1						
	▨	G	2			1	106.98		
FILL: Dark brown silty sand mixed with gravel, crushed stone, cobbles, boulders, asphaltic concrete and organic matter	▨	G	3						
	▨	G	4			2	105.98		
2.59									
End of Test Pit									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP2-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	107.45		
FILL: Dark brown silty sand mixed with gravel, crushed stone, cobbles, boulders, asphaltic concrete and organic matter	▨	G	1						
	▨	G	2			1	106.45		
	▨	G	3						
	▨					2	105.45		
	▨	G	4						
2.74									
End of Test Pit									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP3-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.92
FILL: Dark brown silty sand with topsoil	▨	G	1				
0.76							
FILL: Brown to dark brown silty sand mixed with clay, gravel, cobbles, boulders and asphaltic concrete	▨	G	2			1	107.92
	▨	G	3			2	106.92
	▨	G	4			3	105.92
	▨	G	5				
3.66							
End of Test Pit							

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP4-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	107.69		
FILL: Brown silty sand mixed with organic matter, clay, gravel, cobbles, boulders	▨	G	1						
	▨	G	2			1	106.69		
	▨	G	3						
2.00	▨					2	105.69		
FILL: Dark brown silty clay with sand, gravel and cobbles	▨	G	4						
	▨	G	5			3	104.69		
3.35									
End of Test Pit									

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

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

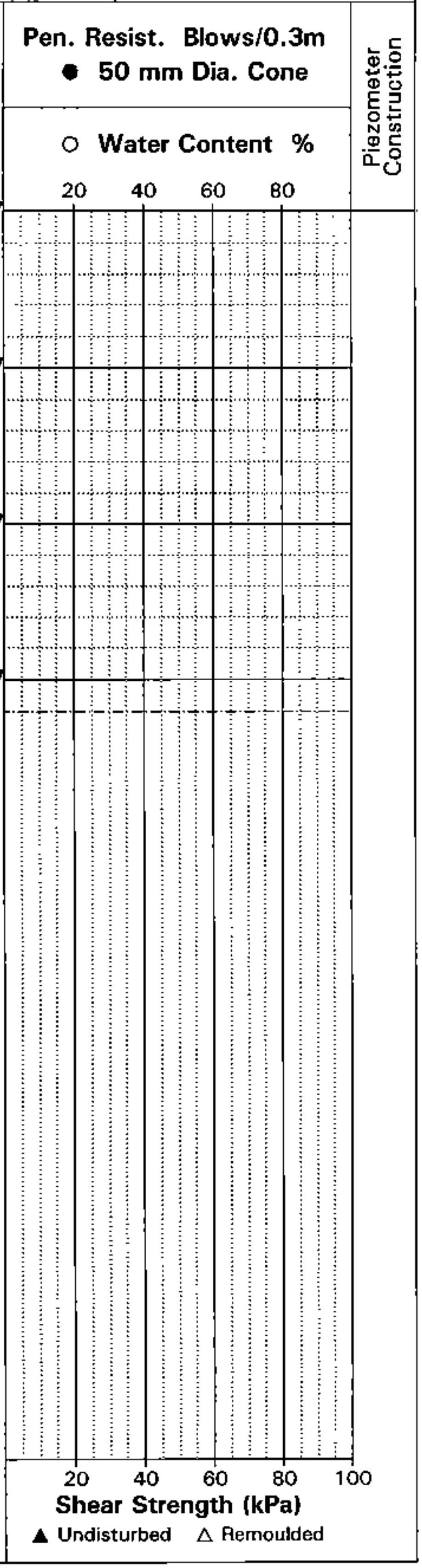
BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP5-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	111.87
FILL: Reddish brown to dark brown silty sand mixed with gravel, cobbles, boulders and asphaltic concrete	▨	G	1				
	▨	G	2			1	110.87
	▨	G	3				
	▨	G	4			2	109.87
2.60							
FILL: Dark brown silty sand with clay, gravel, cobbles, boulders and organic matter	▨	G	5			3	108.87
3.20							
End of Test Pit							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Geotechnical Investigation
O'Keefe Court and Highway 416
Ottawa, Ontario

DATUM TBM - Top of test well casing (TW 1), elevation 107.60m, as provided by Paterson Group Report No. PH0208-1.

REMARKS

BORINGS BY Backhoe

DATE 24 MAR 06

FILE NO. PG0783

HOLE NO. TP6-06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	111.64		
FILL: Dark brown silty sand mixed with gravel, cobbles, wood and asphaltic concrete	▨	G	1						
	▨	G	2			1	110.64		
	▨	G	3						
1.98									
End of Test Pit									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

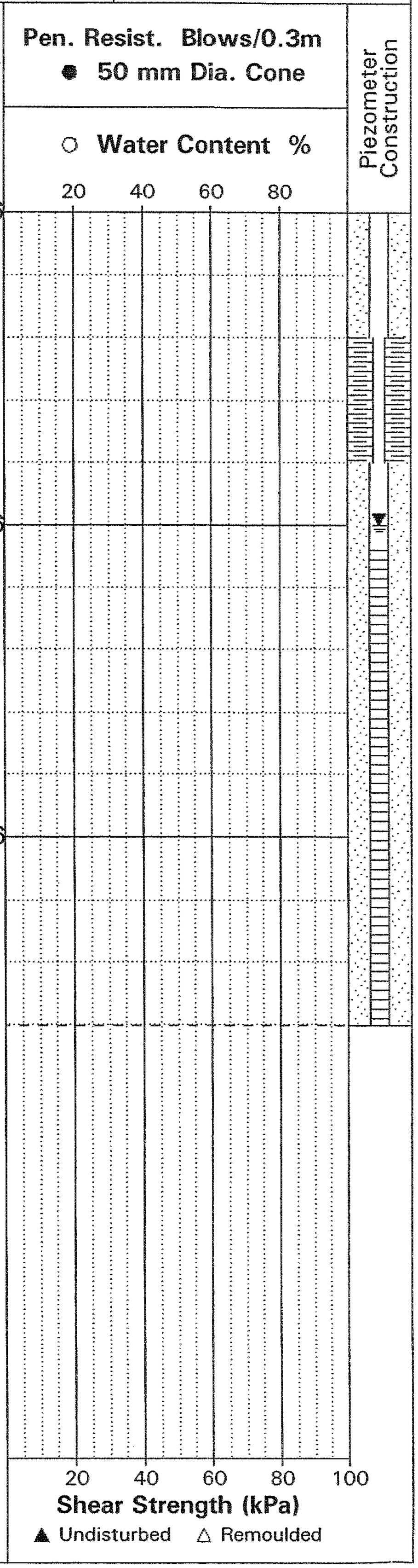
BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP1/MW1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.96
TOPSOIL 0.05							
FILL: Light brown silty sand with gravel and cobbles		G	1				
1.00						1	105.96
Grey-brown SANDY SILT to SANDY CLAY, some gravel		G	2				
						2	104.96
2.60							
End of Test Pit Refusal on inferred bedrock surface @ 2.60m depth (GWL @ 1.0m-Dec. 20/05)							



patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

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 % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	108.89		
TOPSOIL 0.20	■								
Yellow-brown SILTY SAND, some gravel and cobbles						1	107.89		▽
						2	106.89		
3.00						3	105.89		
End of Test Pit Refusal on inferred bedrock surface @ 3.00m depth (Water infiltration @ 1.3m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

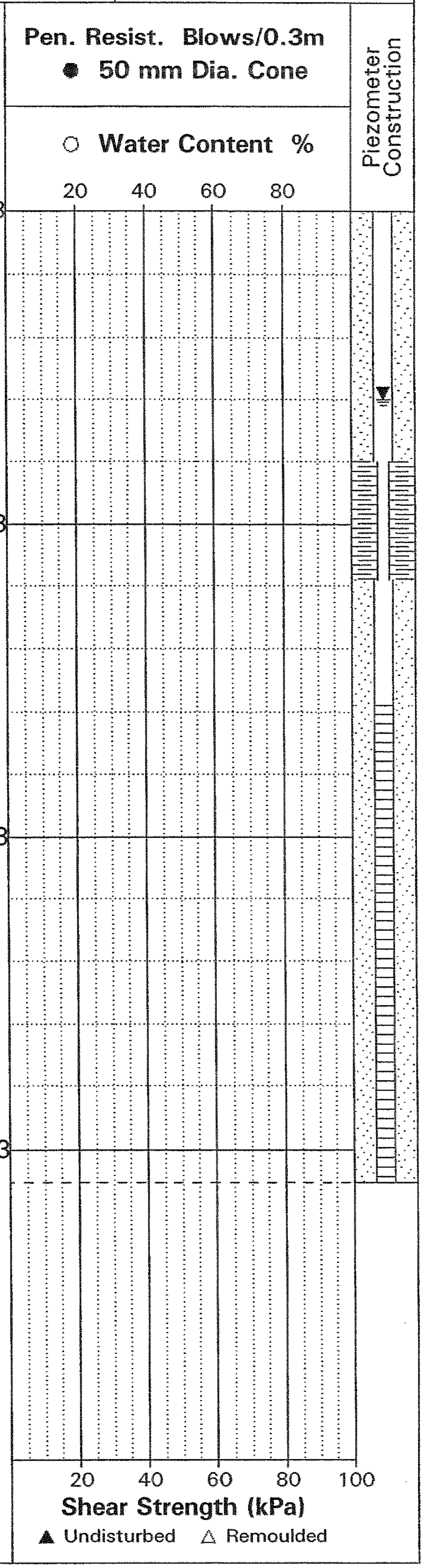
HOLE NO. TP3/MW2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	108.63
TOPSOIL 0.25							
						1	107.63
Yellow-brown SILTY **SAND**, some gravel and cobbles		G	3				
						2	106.63
						3	105.63
3.10 End of Test Pit							

End of Test Pit

Refusal on inferred bedrock surface @ 3.10m depth

(GWL @ 0.6m-Dec. 20/05)



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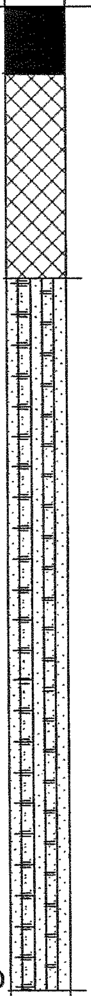
28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

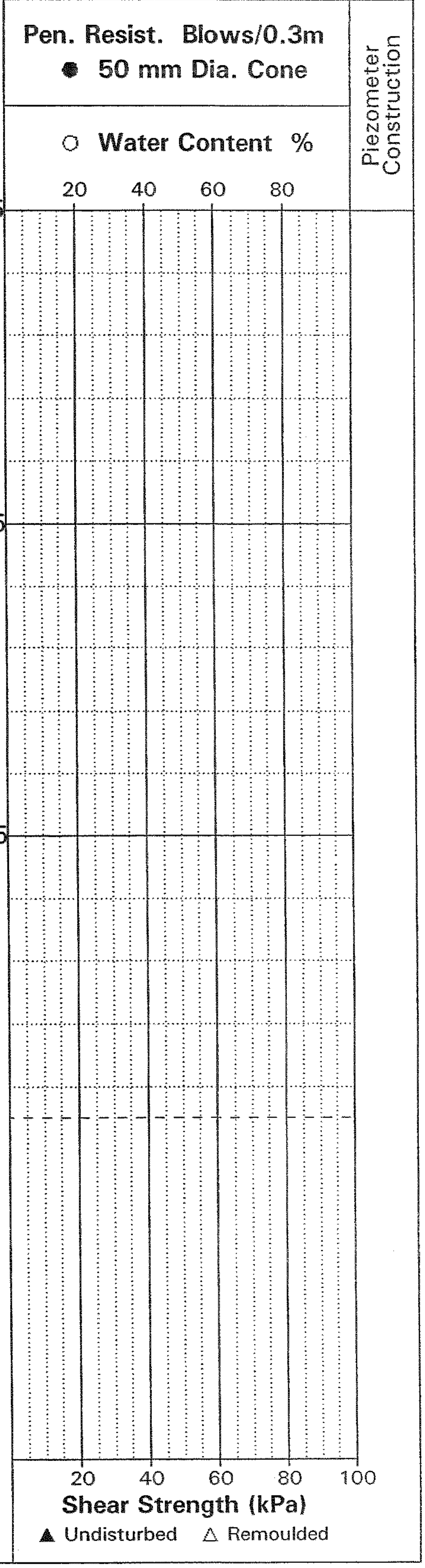
SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM	Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.
REMARKS	Ground surface elevations based on vertical elevation survey by Paterson Group.
BORINGS BY	Excavator
DATE	15 AUG 05
FILE NO.	PH0208
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	110.75
TOPSOIL 0.20							
FILL: Brown silty sand with cobbles 0.80							
						1	109.75
Dense, grey SILTY **SAND-GRAVEL** with cobbles		G	4				
						2	108.75
2.90							
End of Test Pit Refusal on inferred bedrock @ 2.90m depth (TP dry upon completion)							





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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

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REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP 5

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	109.00		
FILL: Brown silty sand with gravel and cobbles						1	108.00		
1.20									
TOPSOIL									
1.80						2	107.00		
Dense, grey-brown **SILTY SAND** with cobbles and boulders		G	5			3	106.00		
3.50									
End of Test Pit (TP dry upon completion)									

Pen. Resist. / Water Content scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

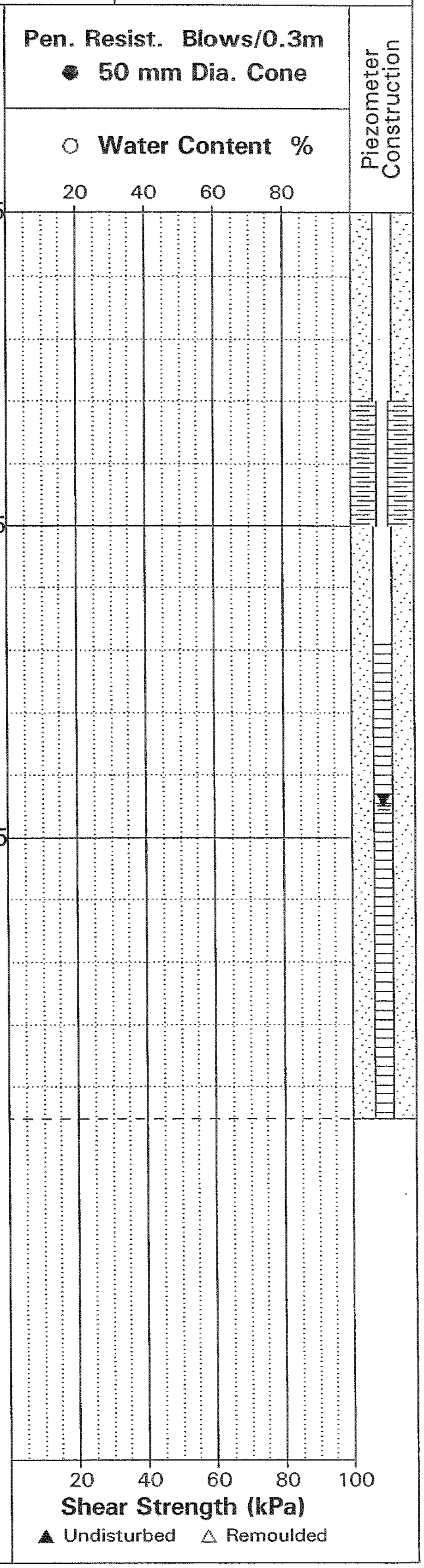
BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP6/MW3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	106.25
TOPSOIL 0.17							
FILL: Brown silty sand with cobbles 1.05						1	105.25
Dense, grey-brown **SILTY SAND-GRAVEL** with cobbles and boulders 2.90						2	104.25
End of Test Pit Refusal on inferred bedrock @ 2.90m depth (GWL @ 1.9m-Dec. 20/05)							



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SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

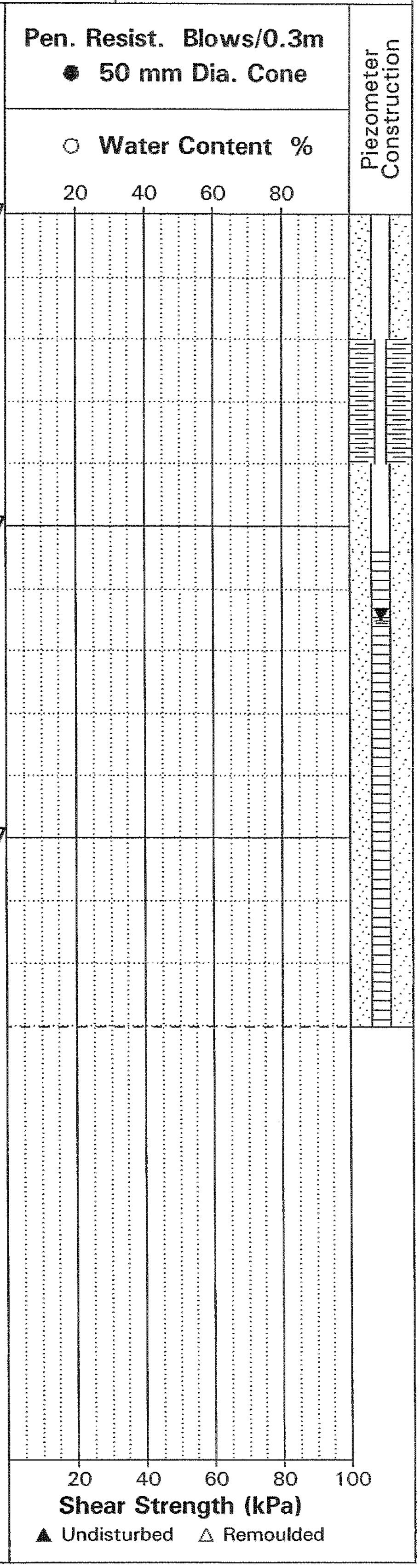
BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP7/MW4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.77
FILL: Dark brown silty sand with cobbles	▨						
0.50							
TOPSOIL	■						
0.75							
						1	104.77
Dense, yellow-brown **SILTY SAND-GRAVEL** with cobbles		G	6				
						2	103.77
2.60							
End of Test Pit Refusal on inferred bedrock @ 2.60m depth (GWL @ 1.3m-Dec. 20/05)							



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SOIL PROFILE & TEST DATA

Proposed Commercial Development
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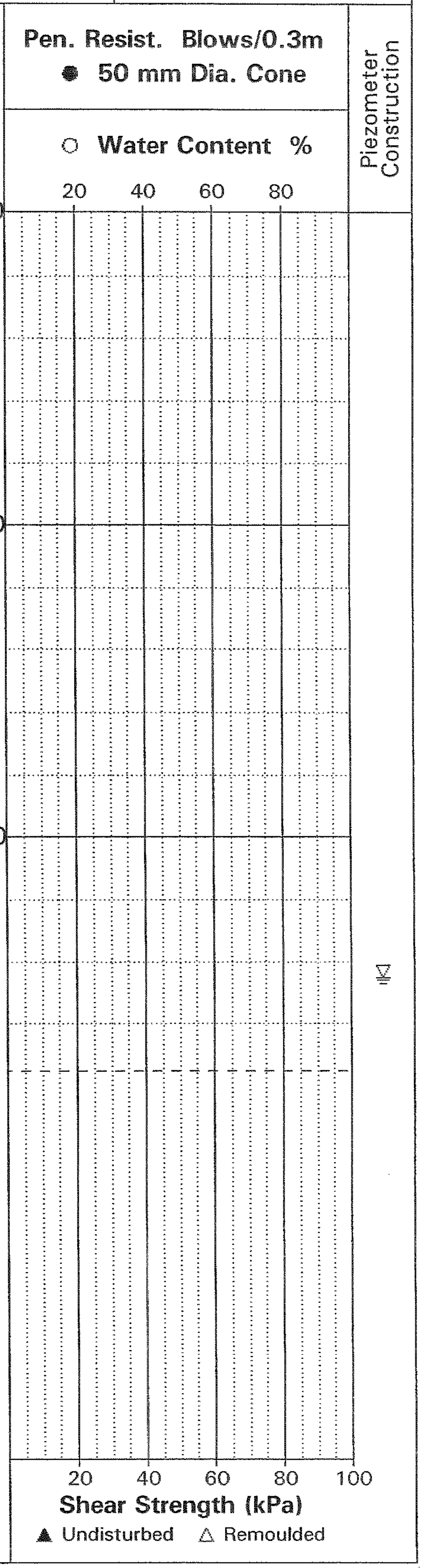
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.
REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.
BORINGS BY Excavator
DATE 15 AUG 05

FILE NO. PH0208
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	105.30
FILL: Brown silty sand with gravel and cobbles	▨						
1.00						1	104.30
TOPSOIL	■						
1.30							
Dense, yellow-brown SILTY fine SAND with cobbles	▥	G	7			2	103.30
2.75							
End of Test Pit Refusal on inferred bedrock surface @ 2.75m depth (Water infiltration @ 2.45m depth)							



SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

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BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP 9

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	105.40		
FILL: Gravel with silty sand									
0.70									
FILL: Blast rock									
1.00						1	104.40		
TOPSOIL									▽
1.10									
Dense, brown-grey **SILTY SAND-GRAVEL** with cobbles		G	9						
						2	103.40		
2.30									
Light brown **SANDY SILTY CLAY**		G	8						
						3	102.40		
3.50									
End of Test Pit (Water infiltration @ 1.1m depth)									

Water Content %: 20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

DATUM Geodetic elevation information taken from base mapping provided by Fotenn Consultants Inc.

REMARKS Ground surface elevations based on vertical elevation survey by Paterson Group.

BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP10

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	105.50		
FILL: Silty sand with cobbles and wood pieces 0.59									
TOPSOIL 0.90									
						1	104.50		
Dense, brown-grey **SILTY SAND-GRAVEL**						2	103.50		▽
2.96									
End of Test Pit Refusal on inferred bedrock surface @ 2.96m depth (Water infiltration @ 2.3m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

Proposed Commercial Development
Part 14, Lot 21, Concession 4 (R.F.)
Ottawa (Nepean), Ontario

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BORINGS BY Excavator

DATE 15 AUG 05

FILE NO. PH0208

HOLE NO. TP11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	109.25		
TOPSOIL 0.25	■								
FILL: Brown silty sand with cobbles, boulders, wood and rebar	▨					1	108.25		
	▨					2	107.25		
	▨					3	106.25		
3.60 End of Test Pit (TP dry upon completion)									

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
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)

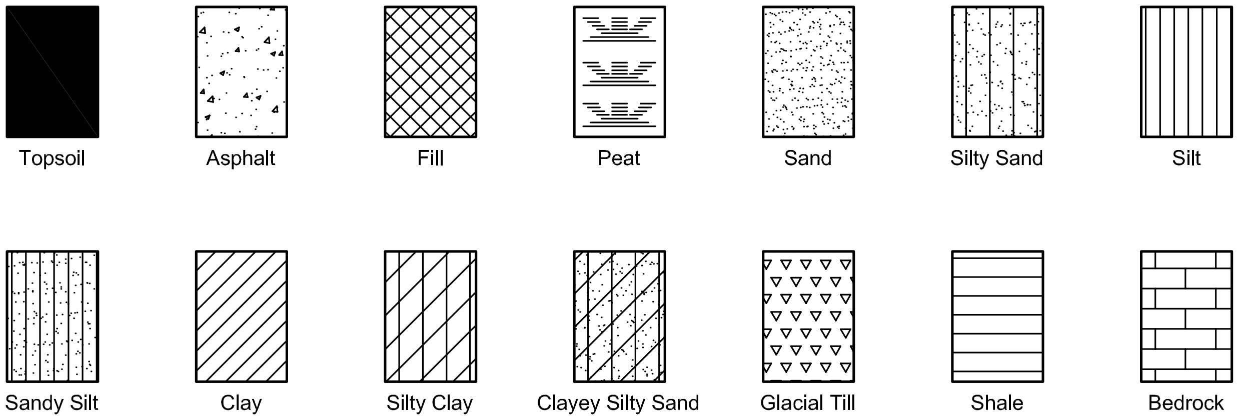
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

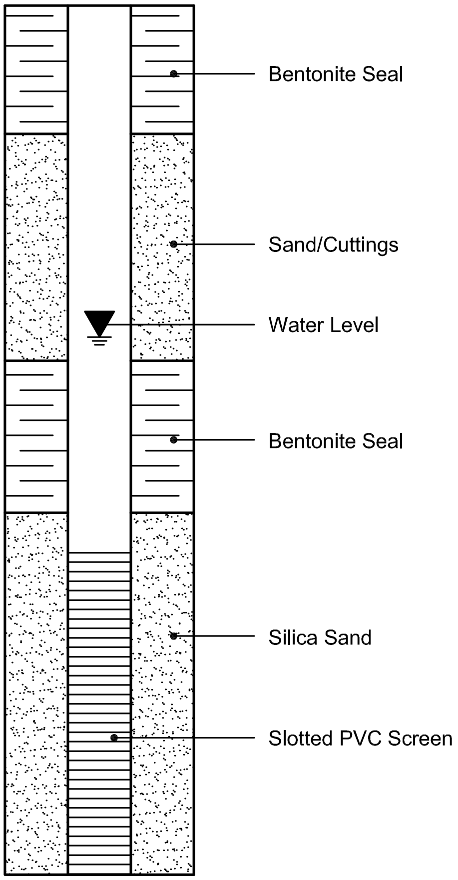
SYMBOLS AND TERMS (continued)

STRATA PLOT

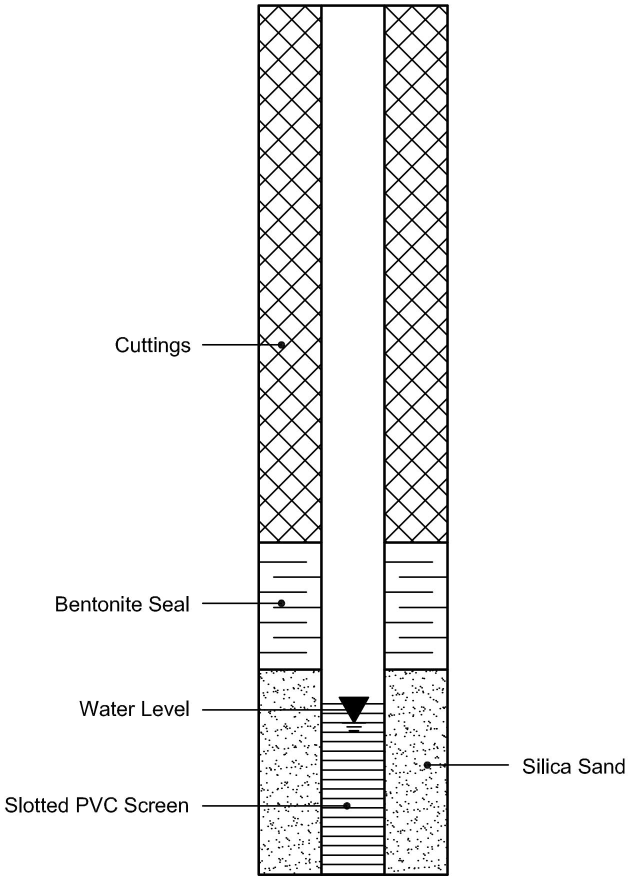


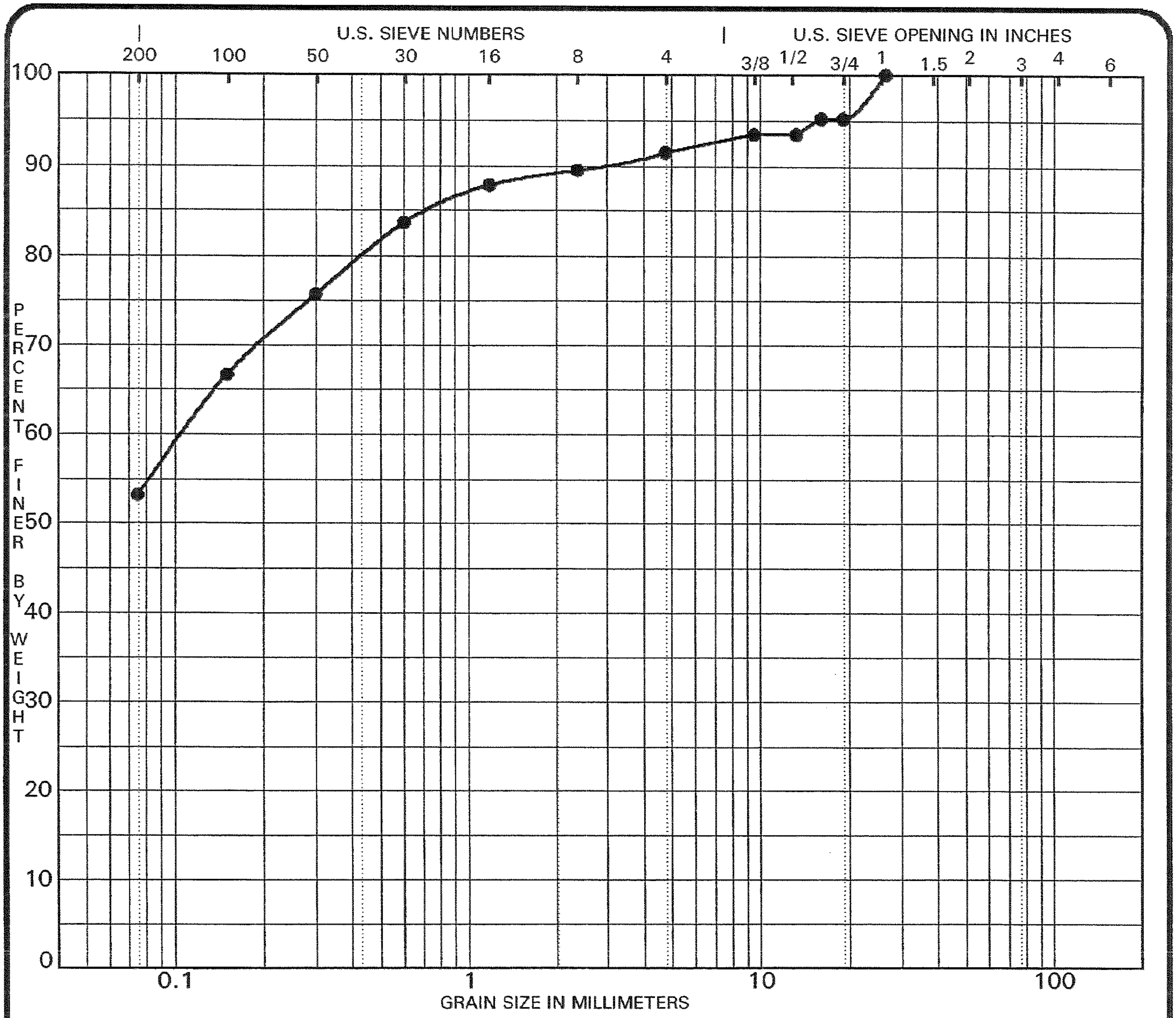
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● TP1/MW1 G2	**Sandy Silt to Sandy Clay, some gravel (SM-SC)**						
	Based on ASTM D 2487						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **TP1/MW1 G2**	**26.50**	**0.11**			**8.5**	**38.3**	**53.2**	

CLIENT **Lafarge North America**
FILE NO. **PH0208**
PROJECT **Proposed Commercial Development - Part 14, Lot 21, Concession 4 (R.F.)**
DATE **15 AUG 05**

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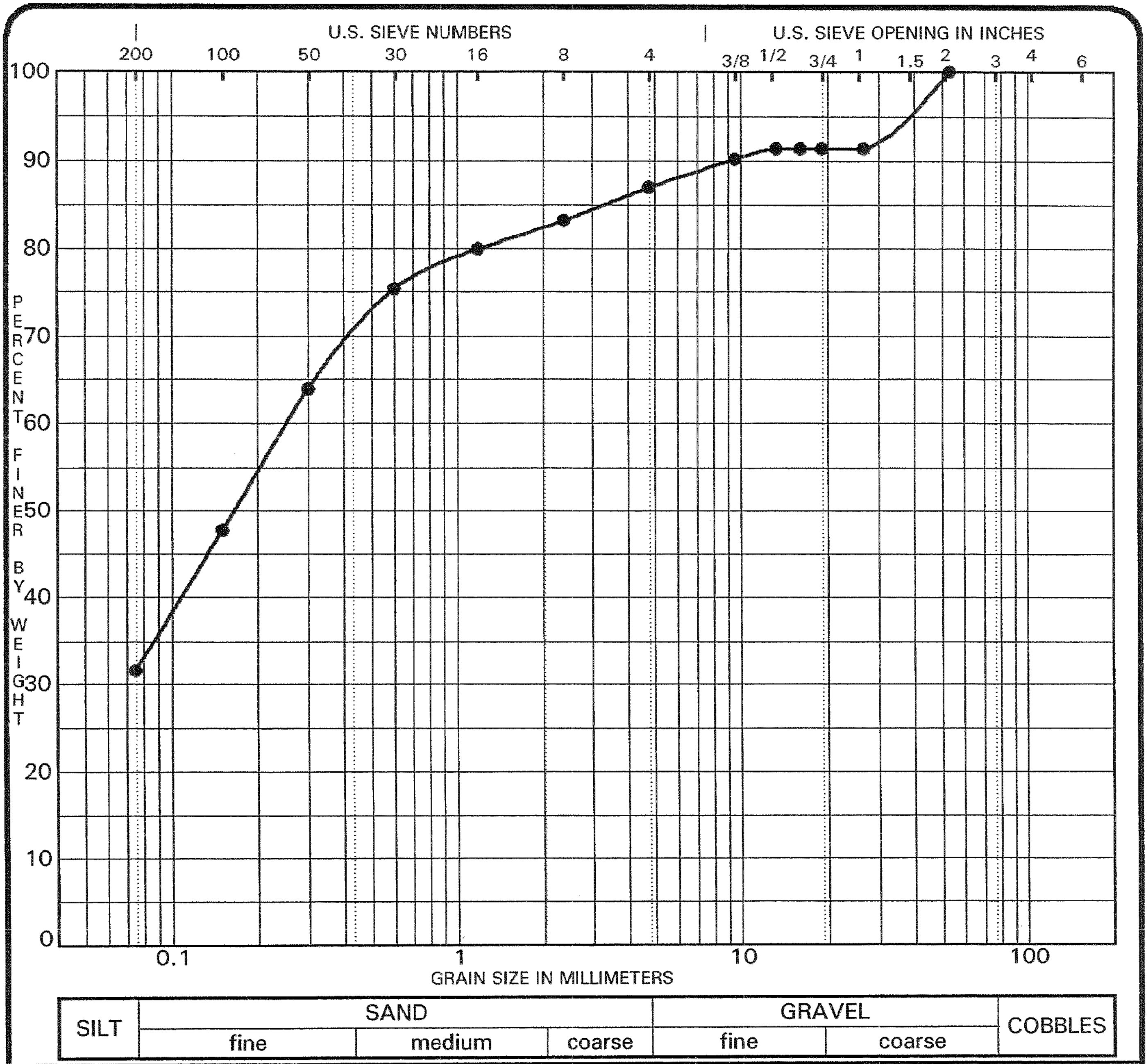
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

GRAIN SIZE DISTRIBUTION



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **TP3/MW2 G3**	**Silty Sand, some gravel (SM)**						
	Based on ASTM D 2487						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **TP3/MW2 G3**	**53.00**	**0.25**			**13.0**	**55.4**	**31.6**	

CLIENT **Lafarge North America**

PROJECT **Proposed Commercial Development - Part 14,**
Lot 21, Concession 4 (R.F.)

FILE NO. **PH0208**

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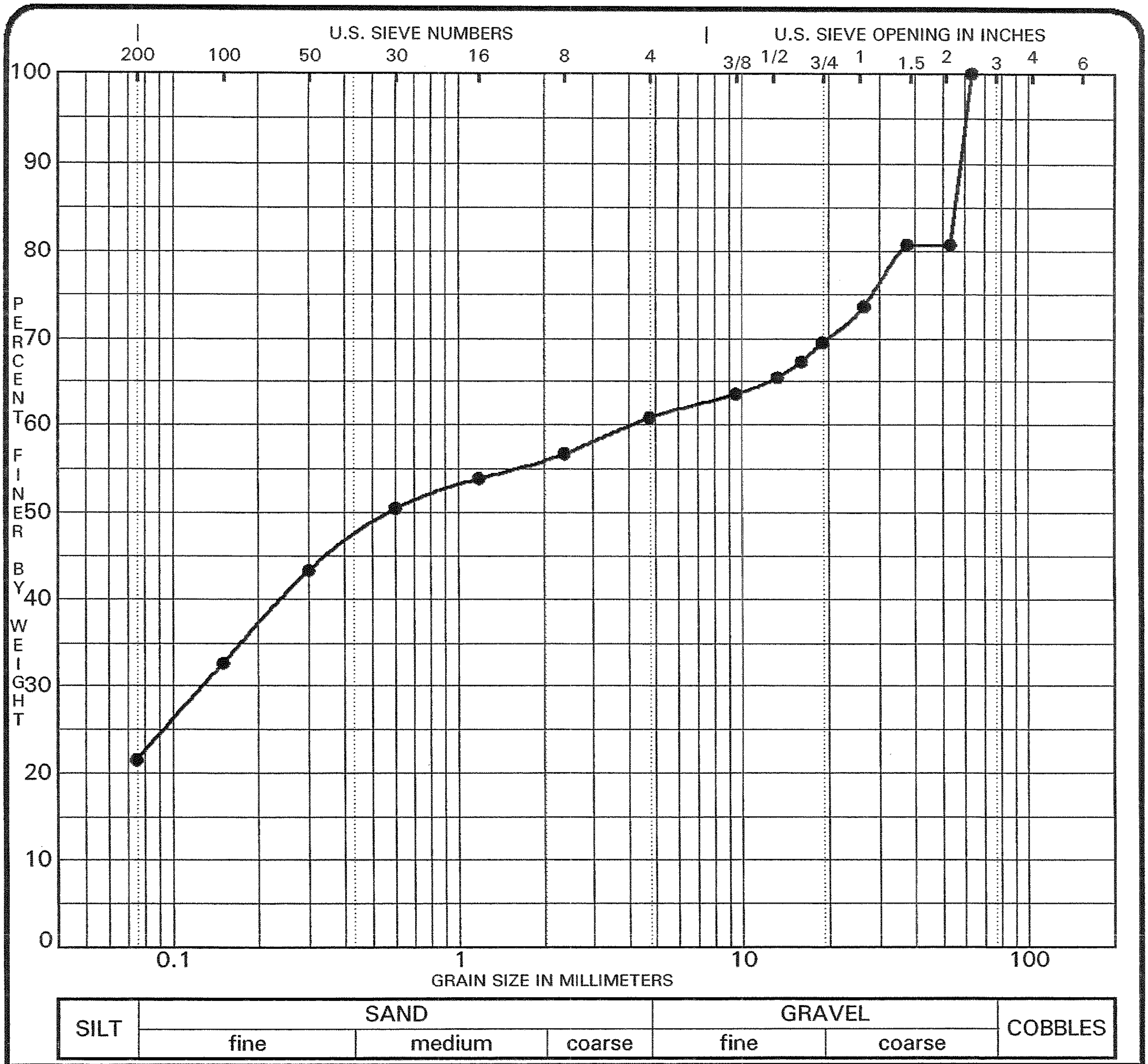
GRAIN SIZE DISTRIBUTION



Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP7/MW4 G6**	**Gravel, Sand, Clay mixture (GC)**						
		Based on ASTM D 2487						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP7/MW4 G6**	**63.00**	**4.14**	**0.127**		**39.2**	**39.3**	**21.5**	

CLIENT **Lafarge North America**
PROJECT **Proposed Commercial Development - Part 14, Lot 21, Concession 4 (R.F.)**

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patersongroup **Consulting Engineers**
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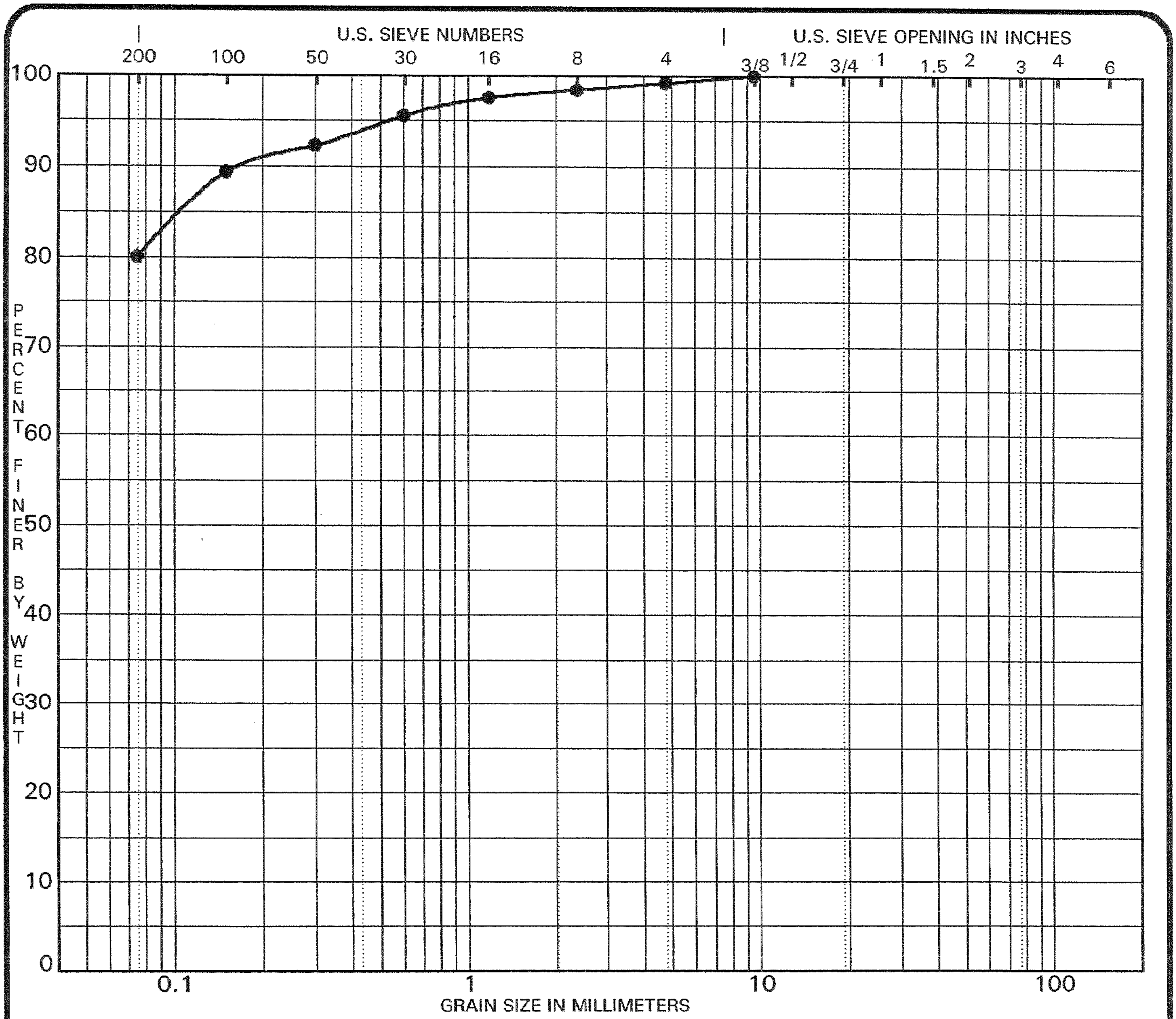
GRAIN SIZE DISTRIBUTION



<table>
<tr><td rowspan="2">SILT</td><td colspan="3">SAND</td><td colspan="2">GRAVEL</td><td rowspan="2">COBBLES</td></tr>
<tr><td>fine</td><td>medium</td><td>coarse</td><td>fine</td><td>coarse</td></tr>
</table>

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP 9**	**G8**	**Inorganic Clay - Silty Clay (CL)**						
			Based on ASTM D 2487						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP 9**	**G8**	**9.50**				**0.8**	**19.2**	**80.0**	

CLIENT **Lafarge North America**

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FILE NO. **PH0208**

DATE **15 AUG 05**

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28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

GRAIN SIZE DISTRIBUTION

Certificate of Analysis

Client: **Paterson Group Inc.**

Client PO: **2174**

Project: **PG0783**

Report Date: 10-Apr-2006
Order Date: 04-Apr-2006

Matrix: Soil

	Sample ID:	BH4 SS3	TP4 G2
	Sample Date:	04/04/2006	04/04/2006
Parameter	MDL/Units	L5343.1	L5343.2
Chloride	5 ug/g	150	5
Sulphate	5 ug/g	50	30
pH	0.05 pH units	8.49	7.90
Resistivity	0.1 ohm.m	29	68

experience • knowledge • integrity

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geotechnical	géotechnique
environmental	environnementale
field services	surveillance de chantier
materials testing	service de laboratoire des matériaux

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