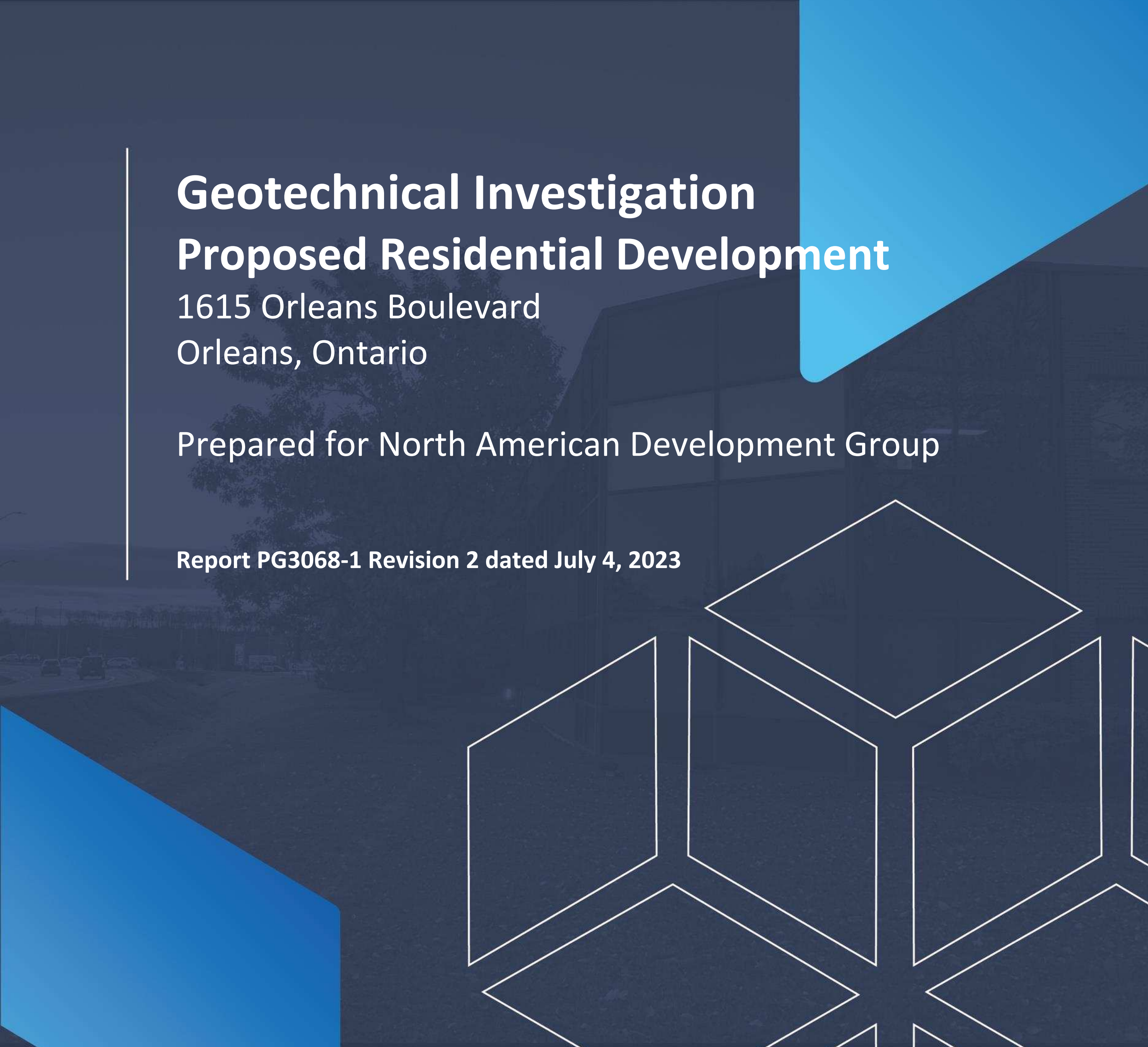

Geotechnical Investigation
Proposed Residential Development

1615 Orleans Boulevard
Orleans, Ontario

Prepared for North American Development Group

Report PG3068-1 Revision 2 dated July 4, 2023

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1.0 Introduction

Paterson Group (Paterson) was commissioned by North American Development Group to complete a geotechnical report for the proposed residential development to be located at 1615 Orleans Boulevard in the City of Ottawa, Ontario (reference should be made to Figure 1 - Key Plan in Appendix 2).

The objective of the geotechnical investigation was to:

☐ Determine the subsoil and groundwater conditions at this site by means of test holes, including test holes by others.

☐ Provide geotechnical recommendations pertaining to design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. This report contains the original findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope for this present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

It is understood that the proposed development will consist of several townhouses of slab-on-grade construction with attached garages, associated driveways, local roadways and landscaping areas. The development is anticipated to be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation was carried out on July 10 and July 11, 2019 and consisted of advancing a total of 6 boreholes to a maximum depth of 6.7 m below ground surface. The test hole locations were distributed in a manner to provide general coverage of the subject site and taking into consideration underground utilities and site features. The borehole locations are shown on Drawing PG3068-1 - Test Hole Location Plan included in Appendix 2.

A previous investigation was undertaken by others between May 31 and June 1, 2006. At that time, eight boreholes were advanced to a maximum depth of 9.1 m below ground surface throughout the subject site. The test hole locations from the previous study are also shown on Drawing PG3068-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a rubber-track mounted low-clearance power auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The testing procedure consisted of augering to the required depth at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples were recovered from the auger flights or using a 50 mm diameter split-spoon sampler. The split-spoon and auger, samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory for further examination. The depths at which the split-spoon and auger flights, samples were recovered from the boreholes are shown as SS and AU, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength tests, with a vane apparatus, were completed by others on cohesive soils at depth.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data Sheets in Appendix 1 of this report.

Groundwater

Boreholes BH 1, BH 2 and BH 3 were fitted with a 51 mm diameter PVC groundwater monitoring well. Standpipes were installed in BH 06-1, BH 06-3, BH 06-4 and BH 06-5 after the completion of drilling. The groundwater observations are discussed in Subsection 4.3 and are presented on the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The test hole locations were selected in the field by Paterson and others to provide general coverage of the proposed development with consideration to site features. The ground surface elevations at the test hole locations were referenced to an assumed benchmark (TBM), consisting of a the top spindle of a fire hydrant located on the south side of Jeanne d’Arc Boulevard.

An assumed elevation of 100.00 m was provided to the TBM. The locations and ground surface elevations of the test holes, and the location of the TBM, are presented on Drawing PG3068-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Selected samples were tested for moisture content, grain size distribution and Atterberg limits by others. The grain size analysis and Atterberg test results are presented in Section 4.2.

3.4 Analytical Testing

One soil sample from the subject site was submitted for analytical testing by others to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The analytical test results are discussed in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site consists of a paved and grass covered area within an existing commercial development. The subject site is located near the northern boundary of the Orleans Garden mall property. The ground surface throughout the subject site is relatively flat and approximately at grade with the surrounding roadways.

The subject site is bordered to the north by Jeanne d’Arc Boulevard, to the west by Orleans Boulevard, to the south by the existing mall and to the east by an existing residential subdivision.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test hole locations consisted of either a pavement structure or topsoil layer (within the grass covered portion) underlain by fill material over a stiff silty clay crust followed by a deep sensitive silty clay deposit.

The pavement structure consisted of approximately 80 mm of asphaltic concrete over 300 mm of granular material. The topsoil layer was approximately 100 mm thick in the grass covered areas. The fill layer was approximately 0.5 to 2.7 m thick and generally consisted of silty sand and/or silty clay containing variable amounts of gravel.

A weathered, brown stiff silty clay was encountered below the overlying fill layer up to depths between approximately 1.8 and 3 m below ground surface at all borehole locations. The brown clay layer was further underlain by a firm grey silty clay extending to the depth of the test hole locations.

Laboratory Testing

One sieve analysis was completed on the subbase fill material to classify according to the Unified Soil Classification System (USCS). The result is presented in Table 1.

Table 1 - Grain Size Distribution

Sample	Gravel (%)	Sand (%)	Fines (%)	Classification (USCS)
General Fill Material (Select Samples by Others)	4	48	48	SM - Silty Sand with trace gravel

Atterberg Limits results conducted on the silty clay samples obtained from BH 06-1 and BH 06-5 by others are presented in Table 2 and on the Soil Profile and Test Data sheets.

Table 2 - Atterberg Limits Results

Sample	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)	Symbol
BH 06-1 SS3	2.0	70	21	49	47	CH
BH 06-5 SS5	5.0	58	21	37	65	CH

LL: Liquid Limit PL: Plastic Limit PI: Plasticity Index w: water content
CH: Inorganic Clay of High Plasticity

Bedrock

Based on available geological mapping, the bedrock at the subject site should consist of shale from the Rockcliffe Formation. The overburden drift thickness is expected to be encountered at depths ranging from 25 to 100 m.

4.3 Groundwater

Groundwater levels were recorded at each borehole location instrumented with a monitoring device. The groundwater level readings are presented in the Soil Profile and Test Data sheets in Appendix 1. The measured groundwater levels by Paterson are presented in Table 3 below.

It should be noted that surface water can become trapped within a backfilled borehole that can lead to higher than typical groundwater level observations. Long-term groundwater levels can also be estimated based on the observed color and consistency of the recovered soil samples.

Based on these observations, the long-term groundwater table can be expected to be at a depth of approximately **2 to 3 m** throughout the subject site. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

The recorded groundwater levels are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

Table 3 – Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Measured Groundwater Level		Dated Recorded
		Depth (m)	Elevation (m)	
BH 1	99.62	3.65	95.97	July 17, 2019
BH 2	99.50	3.37	96.13	
BH 3	99.36	1.81	97.55	
BH 06-1	99.68	1.85	97.83	June 12, 2006
BH 06-3	99.60	2.70	96.90	
BH 06-4	99.51	5.50	94.01	
BH 06-5	99.57	2.30	97.27	

Note: The ground surface elevation at each borehole location is referenced to an arbitrary datum of 100.00 considered as the top spindle of a fire hydrant located at the boundary of the subject site and along Jeanne d'Arc Boulevard.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is expected that the proposed buildings will be founded over conventional shallow footings placed over an undisturbed stiff brown silty clay and/or compact sand bearing surface or engineered fill placed over an undisturbed, brown silty clay bearing surface.

Due to the presence of the underlying silty clay deposit, the proposed development will be subjected to grade raise restrictions. If a higher permissible grade raise is required, preloading with or without surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction and differential settlements.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, or construction debris/remnants should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures. Under paved areas, existing construction remnants, such as foundation walls, pipe ducts, etc., should be excavated to a minimum depth of 1 m below final grade.

It is important to note that due to the presence of a 0.5 to 2.7 m thick layer of fill overlying the native soils, it is expected that sub-excavation of the existing fill will be required within the footprint of the proposed residential dwellings. Where the fill is free of organic matter, the fill may be left in place provided the fill is reviewed and approved by Paterson at the time of construction.

Where the fill is deemed acceptable, sub-excavation of the existing fill down to the native subgrade will only be required to be completed below the proposed footings, including the lateral support zone of each footing. Any fill left in place will be required to be proof-rolled using suitable compaction equipment in dry conditions and above freezing temperatures. The compaction efforts should also be reviewed and approved by Paterson personnel at the time of construction.

Fill Placement

Fill placed for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The imported fill material should be tested and approved prior to delivery. The fill should be placed in maximum 300 mm thick loose lifts and compacted by suitable compaction equipment. Fill placed beneath the building should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite drainage membrane, such as Miradrain G100N or Delta Drain 6000.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff brown silty clay bearing surface can be designed with a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**. A geotechnical resistance factor of 0.5 was applied to the above-noted bearing resistance value at ULS.

Conventional spread footings placed over an undisturbed, compact brown sand bearing surface can be designed using bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **150 kPa**.

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

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

Proof Rolling and Subgrade Improvement for Loose Sand Below Footings

Where the sand bearing surface for footings is considered loose by Paterson at the time of construction, it may be recommended to proof roll (i.e., recompact) the bearing surface prior to forming for footings. Improving the bearing surface compaction will provide a suitable sand bearing medium.

Depending on the looseness and degree of saturation at the time of construction, other measures (additional compaction, dewatering, mud-slab, sub-excavation and reinstatement of crushed stone fill) may be recommended to accommodate site conditions at the time of construction. However, these considerations would be evaluated at the time of construction by Paterson on a footing-specific basis.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff to firm silty clay above the groundwater table when a plane extending horizontally and vertically from the perimeter of the footing at a minimum of 1.5H:1V passes through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Restrictions

Based on the undrained shear strength testing results, a permissible grade raise of **1.0 m** is recommended for the subject site. A long-term groundwater table of 0.5 m was assumed as part of our assessment. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post-construction total and differential settlements.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Site Class E** for the foundations considered. The soils underlying the proposed shallow foundations are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of the topsoil layer and fill, containing deleterious or organic materials, the native soil will be considered to be an acceptable subgrade surface on which to commence backfilling for slab-on-grade construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

It is recommended that the upper 200 mm sub-floor fill consists of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

5.6 Pavement Structure

For design purposes, the pavement structures presented in the following tables could be constructed for the design of car only parking areas, heavy truck parking areas and access lanes.

Table 4 - Recommended Pavement Structure - Driveways

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil.	

Table 5 - Recommended Pavement Structure - Local Residential Roadways and Fire Truck Routes

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

Table 6 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil.	

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

Weak subgrade conditions may be experienced over service trench fill materials, which will require the use of a woven geotextile liner, such as Terrafix 200W or equivalent, as well as an additional 300 to 600 mm thick granular layer, consisting of a 150 mm minus, well graded granular fill or crushed concrete, to provide adequate construction access.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

Pavement Structure Drainage

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

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

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer or sump pit.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless placed in conjunction with a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard. A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should be either excavated at acceptable slopes or retained by shoring systems from commencement of the excavation until the structure is backfilled. It is assumed that sufficient room should be available for the greater part of the excavation to be completed by open-cut methods (i.e., unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. A shallower slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain a safe working distance from the excavation sides. Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD. The bedding material should extend at a minimum to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to a minimum of 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD.

The brown silty clay above the cover material could be placed if the excavation and backfilling operations are conducted in dry and above-freezing weather conditions. Wet silty clay materials will be difficult to place and compact, as compaction is impractical without an extensive drying period with the high moisture content of the grey silty clay.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should consist of the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

To reduce long-term lowering of the groundwater level, clay seals should be provided in the service trenches. The seals should be a minimum of 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material.

The clay seals should consist of a workable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries and at strategic locations, at a maximum of 60 m intervals, in the service trenches.

6.5 Groundwater Control

Based on our observations, it is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps The contractor should be prepared to direct water away from all subgrades, regardless of the source, to prevent disturbance to the founding medium.

Permit to Take Water

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR).

A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Persons as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based on anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project.

Where excavations are completed in proximity to existing structures which may be adversely affected due to the freezing conditions. The subsurface conditions mostly consist of frost susceptible materials. In the presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In particular, where a shoring system is constructed, the soil behind the shoring system will be subjected to freezing conditions and could result in the heaving of the structure(s) placed within or above frozen soil. Provisions should be made in the contract documents to protect the walls of the excavations from freezing, if and where applicable.

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

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

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

6.8 Landscaping Considerations

Tree Planting Considerations

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), a soil review of the site was completed to determine applicable tree planting setbacks. Atterberg limits testing was completed by others for the recovered silty clay samples at selected locations throughout the subject site. The results of that testing are presented in Table 2 in Subsection 4.2 and in Appendix 1.

Based on the results of the Atterberg limit testing mentioned above, the plasticity index was found to be greater than 40% in all the tested clay samples. Based on this, the clay is considered to be a clay of high potential for soil volume change.

Paterson reviewed the following landscape plan prepared by Levstek Consultants Inc. for the proposed buildings:

❐ Landscape Plan – Orleans Gardens, 1615 Orleans Boulevard, Orleans, Ontario – Project No. 1216, Drawing No. L1.01 Revision 2, dated February 10, 2023.

Based on the plan provided, the proposed landscape plan meets our requirements and is therefore considered acceptable from a geotechnical perspective.

It is expected the proposed shrubs and small trees that will be located in proximity to the proposed buildings will have low water demand and reduced mature height than for typical City street trees. It is not expected that these shrubs or small trees would contribute to moisture depletion of the clay deposit due to their root systems significantly reduced water demand.

Based on this, the setbacks would consist of 4.5 m for small trees (mature height up to 7.5 m) and 7.5 m for medium size trees (mature tree height 7.5 to 14 m), provided the conditions noted below are met at the time of landscape design:

❑ A small tree must be provided with a minimum of 25 m^3 of available soils volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ☐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ☐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

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

7.0 Recommendations

It is recommended that the following be carried out by Paterson once preliminary and future details of the proposed development have been prepared:

- Review preliminary and detailed grading, servicing and structural plan(s) from a geotechnical perspective.
- Review of the geotechnical aspects of the excavation contractor's shoring design, prior to construction, if applicable.
- Review of architectural plans pertaining to foundation and underfloor drainage systems and waterproofing details for elevator shafts.

It is a requirement for the foundation design data provided herein to be applicable that a material testing and observation program be performed by the geotechnical consultant. The following aspects of the program should be performed by Paterson:

- Review and inspection of the installation of the foundation drainage systems.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling and follow-up field density tests to determine the level of compaction achieved.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

All excess soil must be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management*.

8.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other North American Development Group, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Drew Petahtegoose, B.Eng.

LICENSED PROFESSIONAL ENGINEER
July 4, 2023
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

Report Distribution:

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- ☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

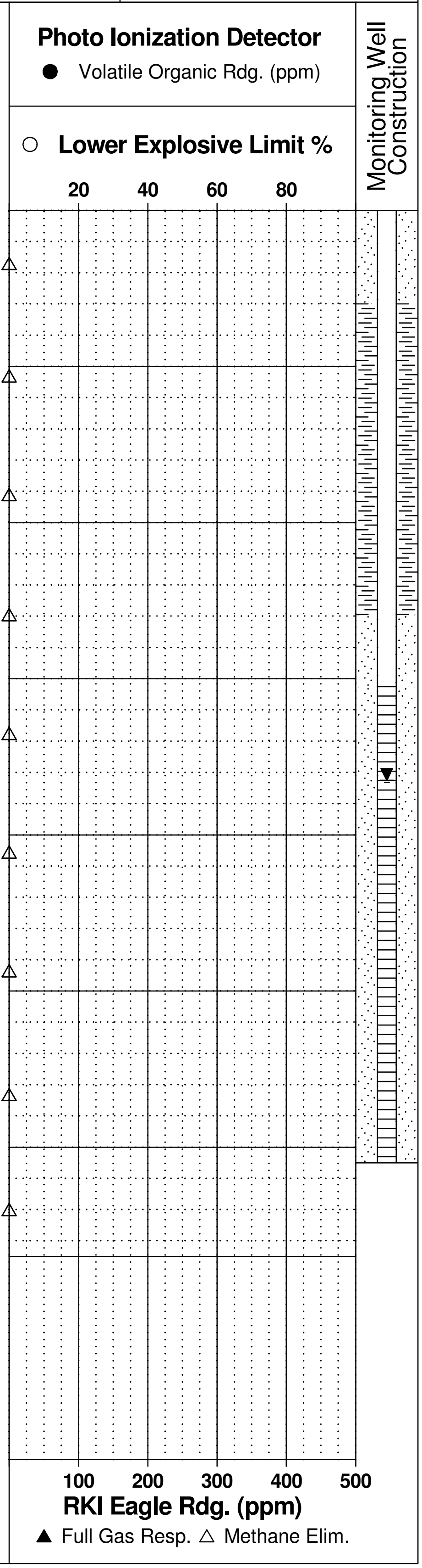
BORINGS BY CME 55 Power Auger

DATE 2019 July 10

FILE NO. PE1962

HOLE NO. BH 1

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	99.62
Asphaltic concrete 0.08						
FILL: Brown silty sand with gravel, crushed stone 0.60	AU	1				
Compact, brown **SAND** 1.52	SS	2	58	15	1	98.62
Very stiff, brown **CLAYEY SILT / SILTY CLAY** - silt content decreasing with depth 2.29	SS	3	92	7	2	97.62
Stiff, brown **SILTY CLAY** - firm and grey by 3.8m depth	SS	4	96	4		
	SS	5	0	3	3	96.62
	SS	6	88	W	4	95.62
	SS	7	100	W	5	94.62
	SS	8	100	W	6	93.62
6.70	SS	9	100	W		
End of Borehole (GWL @ 3.65m - July 17, 2019)						



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 July 10

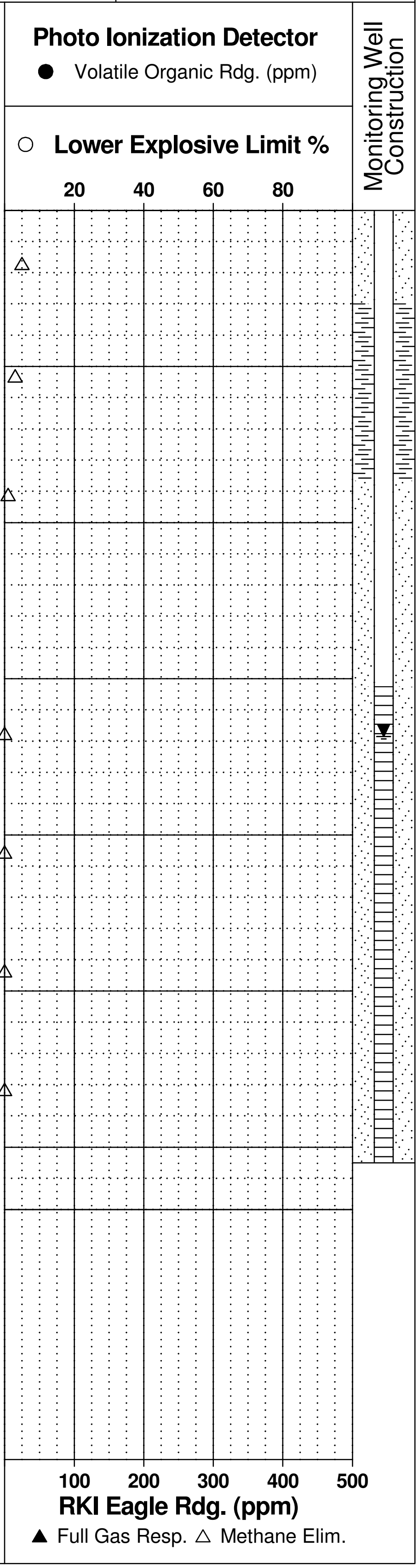
FILE NO. PE1962

HOLE NO. BH 2

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
Asphaltic concrete	0.08
FILL: Brown silty sand with gravel, crushed stone	0.60
Comapct to loose, brown **SILTY SAND** with clay	1.27
Very stiff to firm, brown **SILTY CLAY** - firm and grey by 3.5m depth	6.40
End of Borehole (GWL @ 3.37m - July 17, 2019)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	67	8
SS	3	100	6
SS	4	0	2
SS	5	100	W
SS	6	100	W
SS	7	100	W
SS	8	100	W

DEPTH (m)	ELEV. (m)
0	99.50
1	98.50
2	97.50
3	96.50
4	95.50
5	94.50
6	93.50



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

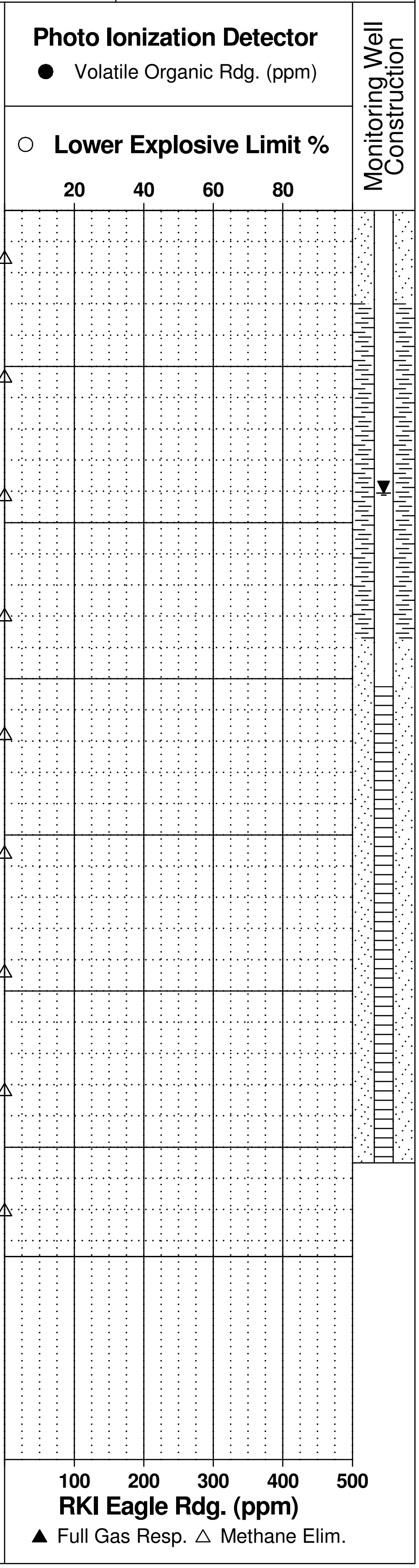
DATE 2019 July 10

FILE NO. PE1962

HOLE NO. BH 3

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty sand with gravel and organics 0.60	AU	1		
Very stiff to stiff, brown **SILTY CLAY**	SS	2	88	9
	SS	3	100	6
	SS	4	100	W
- firm and grey by 3.0m depth	SS	5	100	W
	SS	6	100	W
	SS	7	100	W
	SS	8	100	W
6.70	SS	9	100	W
End of Borehole (GWL @ 1.81m - July 17, 2019)				

DEPTH (m)	ELEV. (m)
0	99.36
1	98.36
2	97.36
3	96.36
4	95.36
5	94.36
6	93.36



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

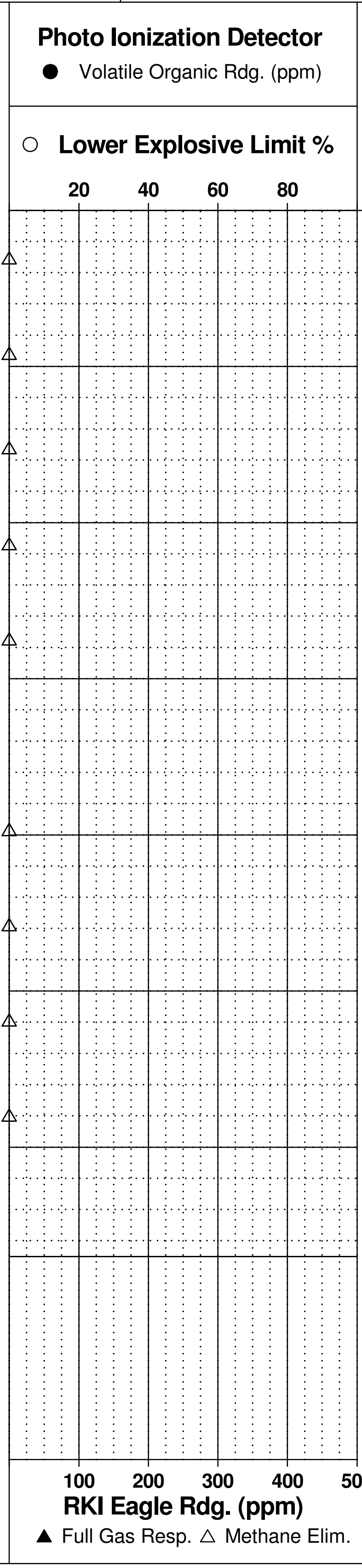
BORINGS BY Geoprobe

DATE 2019 July 11

FILE NO. PE1962

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Monitoring Well Construction
GROUND SURFACE						0	99.66	
FILL: Brown silty sand, some gravel		S	1	25	26			
0.91		SS	2	100	9	1	98.66	
Very stiff to stiff, brown **SILTY CLAY**		SS	3	100	2			
		SS	4	100	W	2	97.66	
		SS	5	100	W	3	96.66	
- firm and grey by 3.2m depth								
		SS	7	100	W	4	95.66	
		SS	8	100	W			
		SS	9	100	W	5	94.66	
		SS	10	100	W	6	93.66	
		SS	11	100	W			
6.70								
End of Borehole								



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

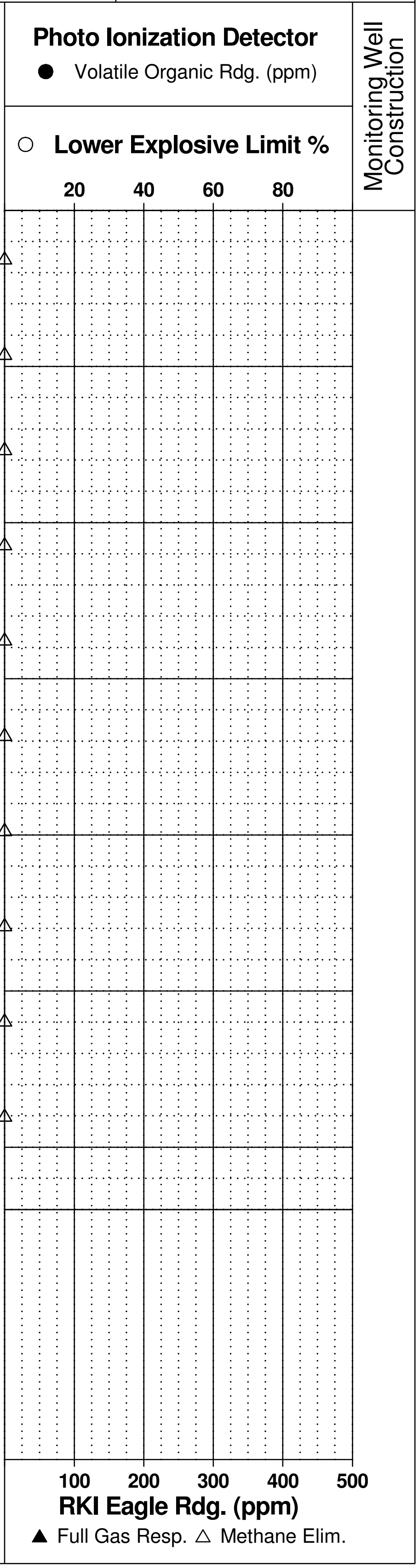
BORINGS BY Geoprobe

DATE 2019 July 11

FILE NO. PE1962

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.55
FILL: Brown silty sand with gravel 0.25							
FILL: Brown silty sand with gravel and crushed stone		SS	1	88	72		
1.22		SS	2	38	38	1	98.55
FILL: Brown silty clay with sand and gravel		SS	3	62	3		
		SS	4	83	12	2	97.55
2.70							
Stiff, brown **SILTY CLAY**		SS	5	67	3		
- firm and grey by 3.2m depth		SS	6	100	W	3	96.55
		SS	7	100	W	4	95.55
		SS	8	100	W		
		SS	9	100	W	5	94.55
		SS	10	100	W	6	93.55
6.40							
End of Borehole							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
Part of 1615 Orleans Boulevard
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the north property boundary, along Jeanne D'Arc Blvd. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

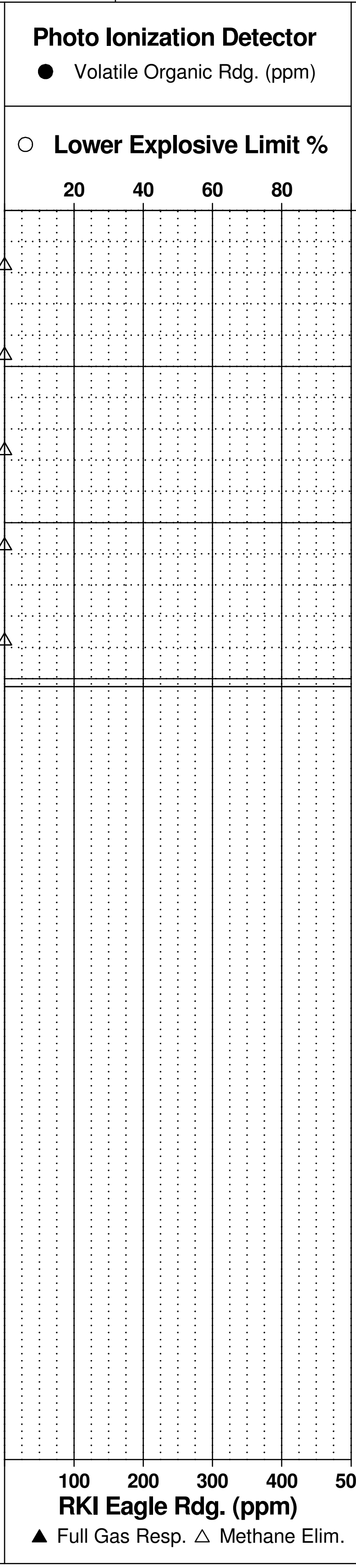
BORINGS BY Geoprobe

DATE 2019 July 11

FILE NO. PE1962

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.92
Asphaltic concrete 0.08							
FILL: Brown sand with gravel and crushed stone 0.66		SS	1	10			
		SS	2	75	5	1	97.92
Very stiff to stiff, brown **SILTY CLAY**		SS	3	100	3		
						2	96.92
		SS	4	100	W		
- firm and grey by 2.6m depth		SS	5	100	W		
3.05						3	95.92
End of Borehole							



Monitoring Well Construction

Jacques Whitford

BOREHOLE RECORD

BH 06-1

1 of 1

CLIENT Centrecorp Management Services Ltd.

LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON

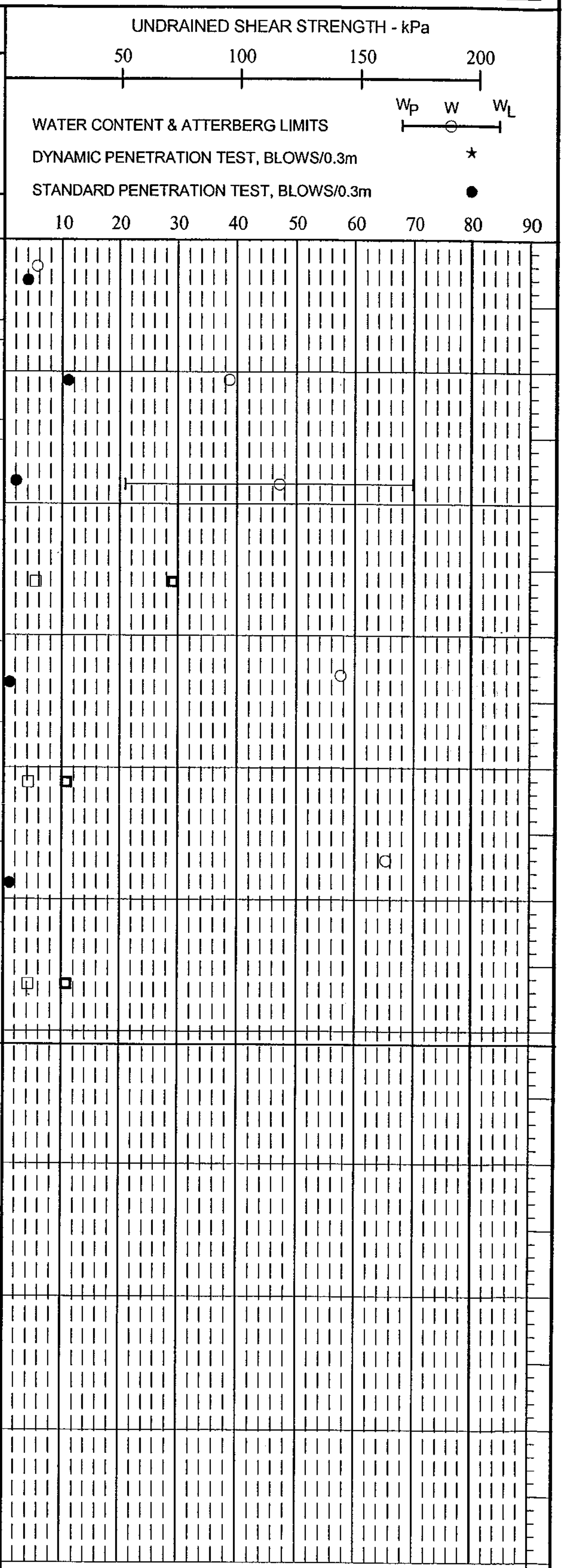
DATES: BORING June 1, 2006 WATER LEVEL June 12, 2006

BOREHOLE No. BH 06-1

PROJECT No. 1013488

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	99.68							
	99.6	80 mm Asphaltic Concrete						
	99.3	Poorly graded gravel with silt and sand (GP-GM): FILL			SS	1	100	4
1		Compact, light brown silty sand (SM): FILL						
	98.5	Stiff, brown FAT CLAY (CH)			SS	2	300	11
2				▼	SS	3	400	2
3	96.3	Firm, grey FAT CLAY (CH)			SS	4	300	1
4								
5					SS	5	610	1
6	93.6	End of Borehole Standpipe Installed						
7								
8								
9								
10								



$\underline{\nabla}$ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa

☐ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd BA

Date 06/06/19

Jacques Whitford

BOREHOLE RECORD

BH 06-2

1 of 1

CLIENT Centrecorp Management Services Ltd.

LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON

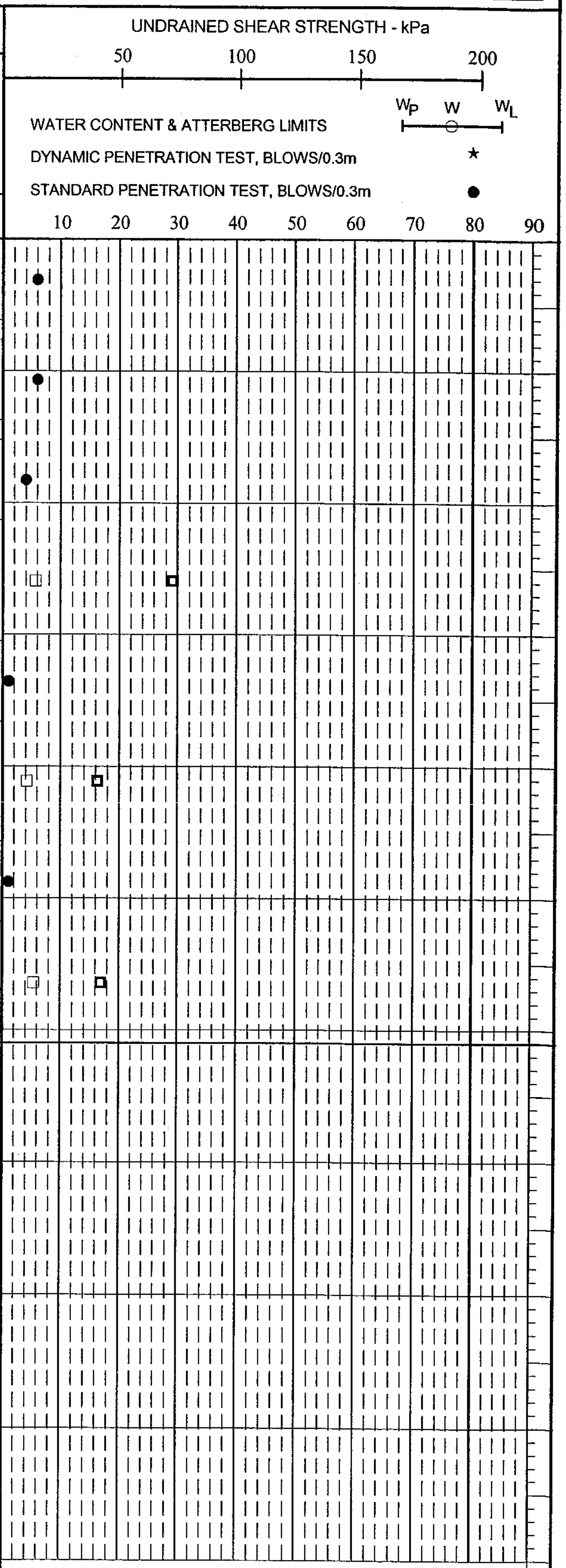
DATES: BORING May 31, 2006 WATER LEVEL

BOREHOLE No. BH 06-2

PROJECT No. 1013488

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	99.20							
	99.1	Topsoil						
		Loose, light brown silty sand (SM): FILL			SS	1	100	6
	98.6	Stiff, brown FAT CLAY (CH)						
1					SS	2	450	6
2					SS	3	10	4
3	96.2	Firm, grey FAT CLAY (CH)			SS	4	600	1
4								
5					SS	5	610	1
6	93.1	End of Borehole						
7								
8								
9								
10								



∇ Inferred Groundwater Level

$\blacktriangledown$ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

⌷ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd BJ

Date 06/06/19

Jacques Whitford

BOREHOLE RECORD

BH 06-3

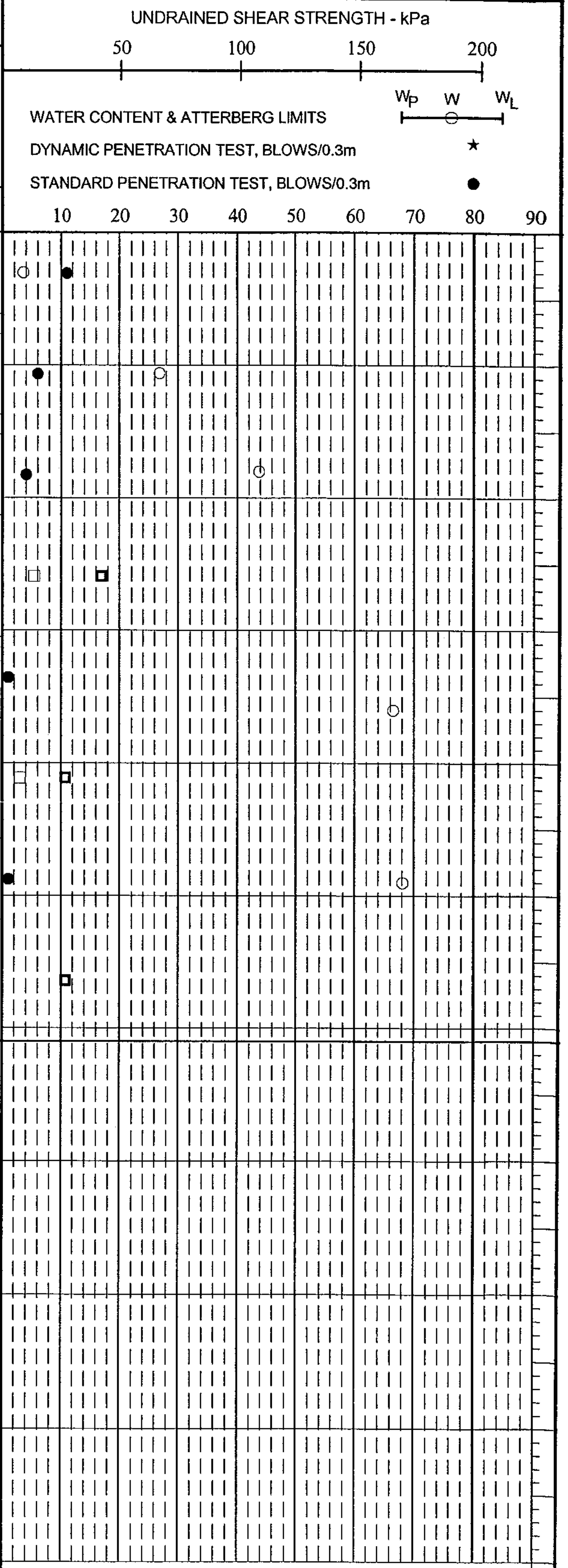
1 of 1

CLIENT Centrecorp Management Services Ltd.
LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON
DATES: BORING June 1, 2006 WATER LEVEL June 12, 2006

BOREHOLE No. BH 06-3
PROJECT No. 1013488
DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION
0	99.60	
	99.5	80 mm Asphaltic Concrete
	99.2	Poorly graded gravel with silt and sand (GP-GM): FILL
	98.7	Loose, light brown silty sand (SM): FILL
		Firm, brown FAT CLAY (CH)
3	96.6	Firm, grey FAT CLAY (CH)
6	93.5	End of Borehole Standpipe Installed

TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
SS	1	200	11
SS	2	200	6
SS	3	550	4
SS	4	600	1
SS	5	610	1



▽ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd BF
Date 06/06/19

Jacques Whitford

BOREHOLE RECORD

BH 06-4

1 of 1

CLIENT Centrecorp Management Services Ltd.

LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON

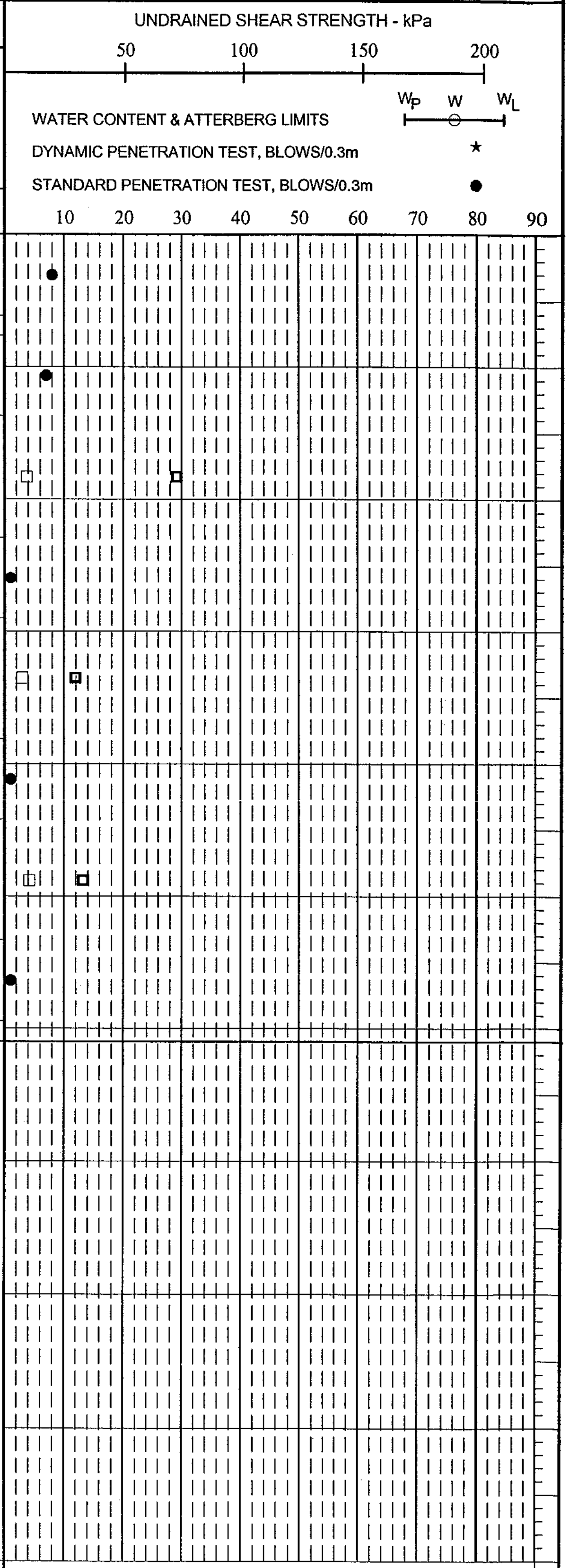
DATES: BORING June 1, 2006 WATER LEVEL June 12, 2006

BOREHOLE No. BH 06-4

PROJECT No. 1013488

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	99.51						
	99.4	Topsoil					
		Compact, light brown silty sand (SM): FILL		SS	1	200	8
1	98.6	Stiff, brown FAT CLAY (CH)		SS	2	450	7
				SS	3	600	1
3	96.8	Firm, grey FAT CLAY (CH)					
4				SS	4	600	1
			▼	SS	5	600	1
6	93.4	End of Borehole Standpipe Installed					



▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

⊓ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd BF

Date 06/06/19

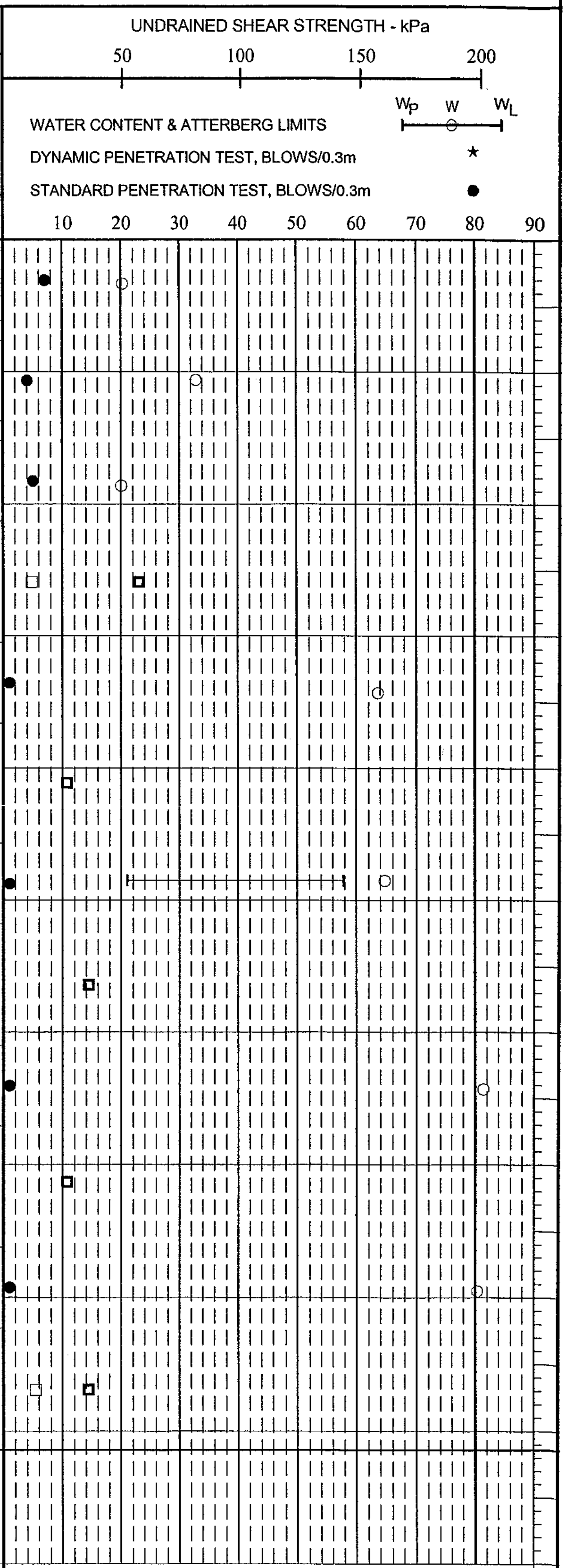
Jacques Whitford

BOREHOLE RECORD

BH 06-5

CLIENT Centrecorp Management Services Ltd.
LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON
DATES: BORING June 1, 2006 WATER LEVEL June 12, 2006
BOREHOLE No. BH 06-5
PROJECT No. 1013488
DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	99.57							
	99.5	Topsoil						
	99.0	Compact, light brown silty sand (SM): FILL	▨		SS	1	150	7
1		Stiff, brown FAT CLAY (CH)	▨		SS	2	500	4
2			▨		SS	3	50	5
	97.1		▨	▼				
3		Firm, grey FAT CLAY (CH)	▨		SS	4	600	1
5			▨		SS	5	600	1
6			▨		SS	6	600	1
8			▨		SS	7	600	1
9	90.4	End of Borehole Standpipe Installed						
10								



▽ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd BF
Date 06/06/19

Jacques Whitford

BOREHOLE RECORD

BH 06-6

1 of 1

CLIENT Centrecorp Management Services Ltd.

LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON

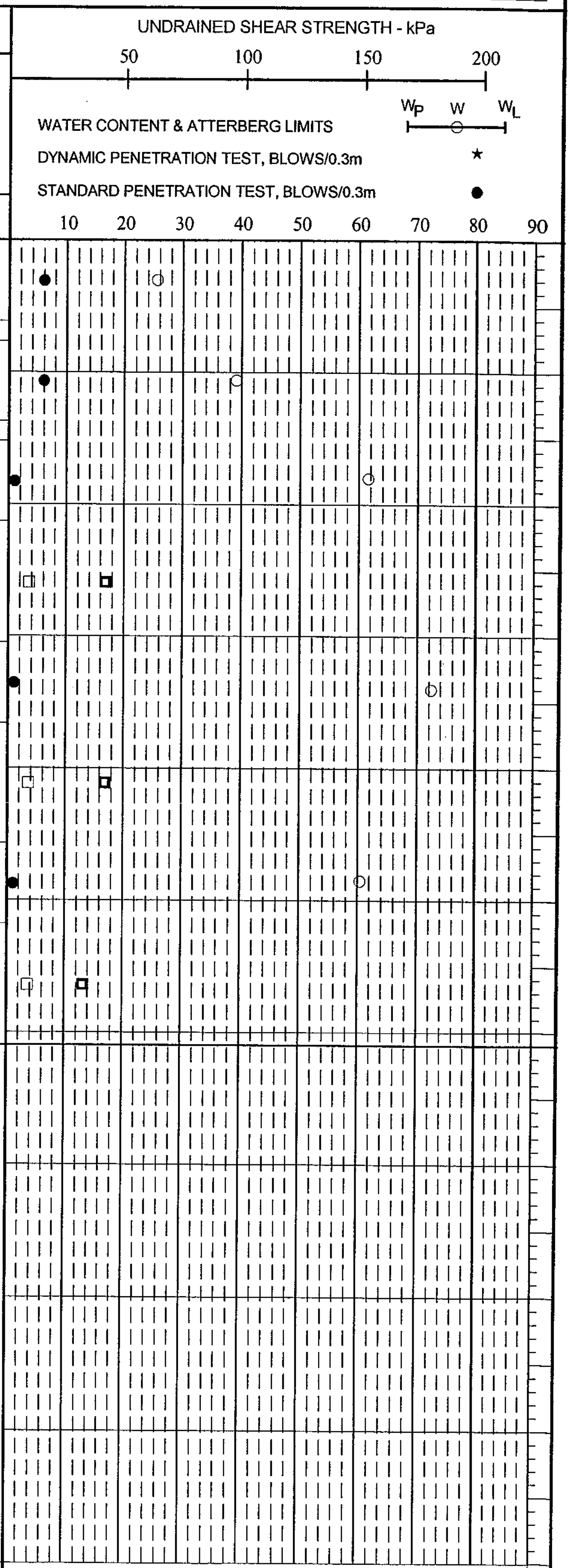
DATES: BORING May 31, 2006 WATER LEVEL

BOREHOLE No. BH 06-6

PROJECT No. 1013488

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	**99.10**					
	99.0	Topsoil				
	98.6	Compact, light brown silty sand (SM): FILL	SS	1	200	6
		Stiff, brown FAT CLAY (CH)				
1			SS	2	200	6
2			SS	3	600	1
	96.7	Firm, grey FAT CLAY (CH)				
3			SS	4	600	1
4						
5			SS	5	600	1
6	93.0	End of Borehole				
7						
8						
9						
10						



▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

◘ Field Vane Test, kPa

☐ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd BF

Date 06/06/19

Jacques Whitford

BOREHOLE RECORD

BH 06-8

1 of 1

CLIENT Centrecorp Management Services Ltd.

LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON

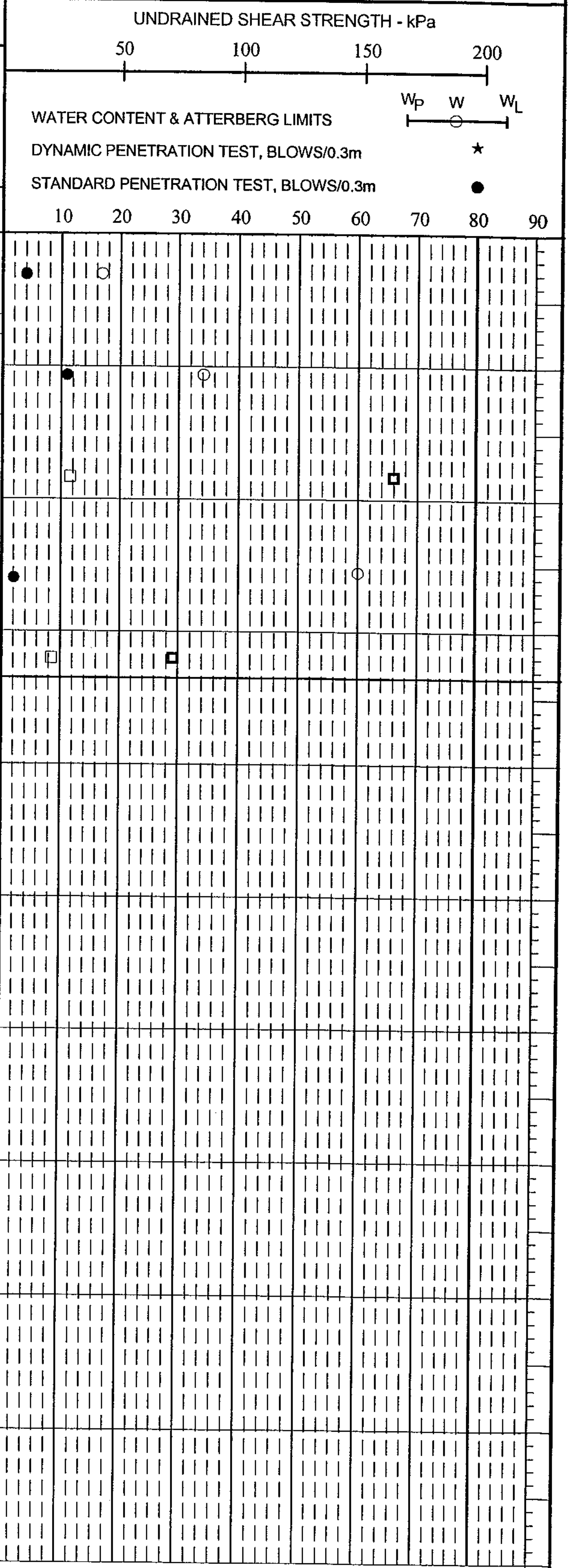
DATES: BORING May 31, 2006 WATER LEVEL

BOREHOLE No. BH 06-8

PROJECT No. 1013488

DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm)	SAMPLES N-VALUE OR RQD
0	99.34							
	99.1	Topsoil						
	98.7	Loose, light brown silty sand (SM): FILL			SS	1	300	4
1		Stiff to very stiff, brown FAT CLAY(CH)			SS	2	400	11
2								
		- becoming saturated			SS	3	500	2
3	96.0	End of Borehole						
4								
5								
6								
7								
8								
9								
10								



▽ Inferred Groundwater Level

▼ Groundwater Level Measured in Standpipe

□ Field Vane Test, kPa

□ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

App'd BF

Date 06/06/19

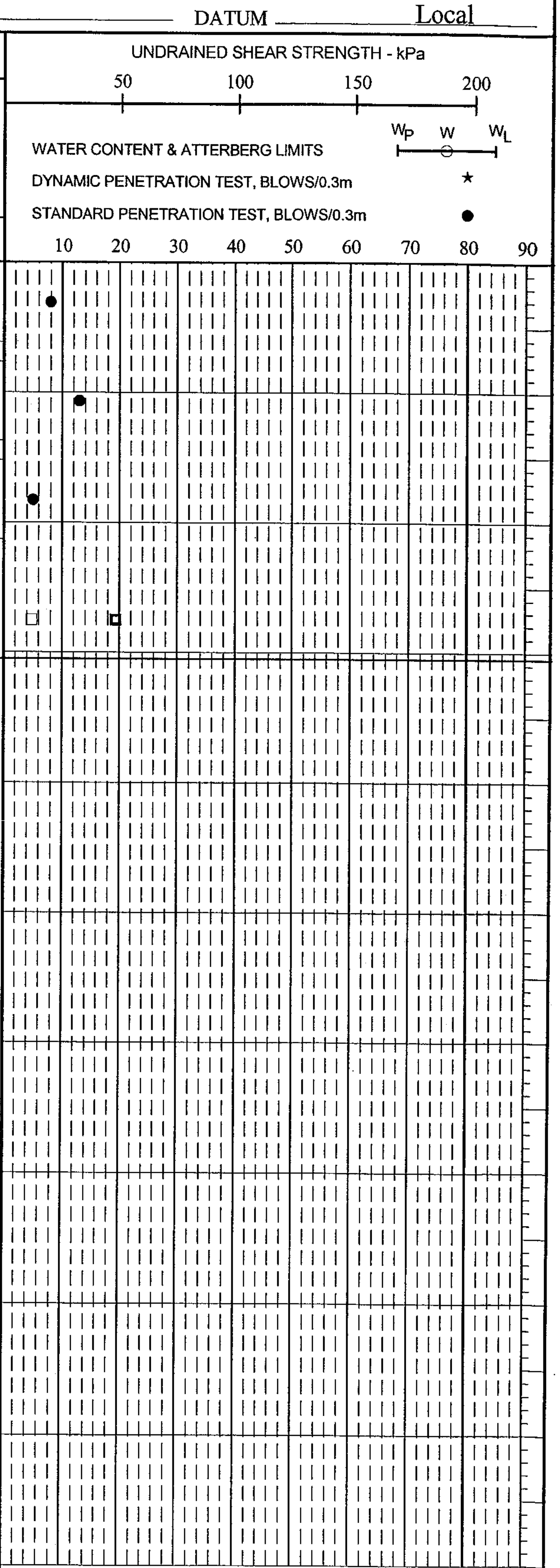
Jacques Whitford

BOREHOLE RECORD

BH 06-9

CLIENT Centrecorp Management Services Ltd.
BOREHOLE No. BH 06-9
LOCATION Orleans Gardens, Jeanne D'Arc Blvd. and Orleans Blvd., Ottawa, ON
PROJECT No. 1013488
DATES: BORING May 31, 2006 WATER LEVEL
DATUM Local

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	NUMBER	RECOVERY (mm)	N-VALUE OR RQD
0	99.38							
	99.3	Topsoil						
	98.8	Brown clay with sand (CH): FILL			SS	1	300	8
1	98.0	Compact, light brown silty sand (SM): FILL			SS	2	50	13
2		Stiff, brown FAT CLAY (CH)			SS	3	300	5
3	96.3	- becoming saturated						
		End of Borehole						
4								
5								
6								
7								
8								
9								
10								



∇ Inferred Groundwater Level
▼ Groundwater Level Measured in Standpipe

■ Field Vane Test, kPa
□ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

App'd RF
Date 06/06/11

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 = $(D30)^2 / (D10 \times D60)$
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)

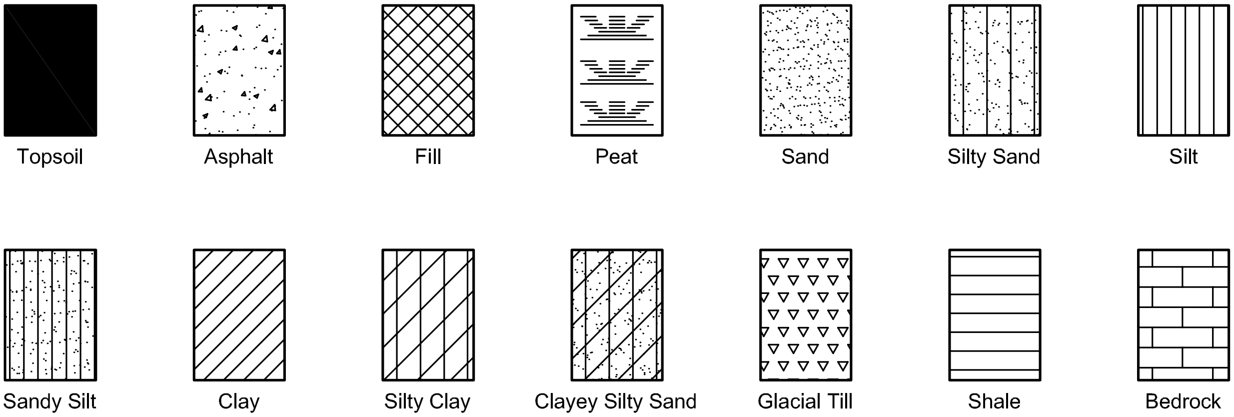
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

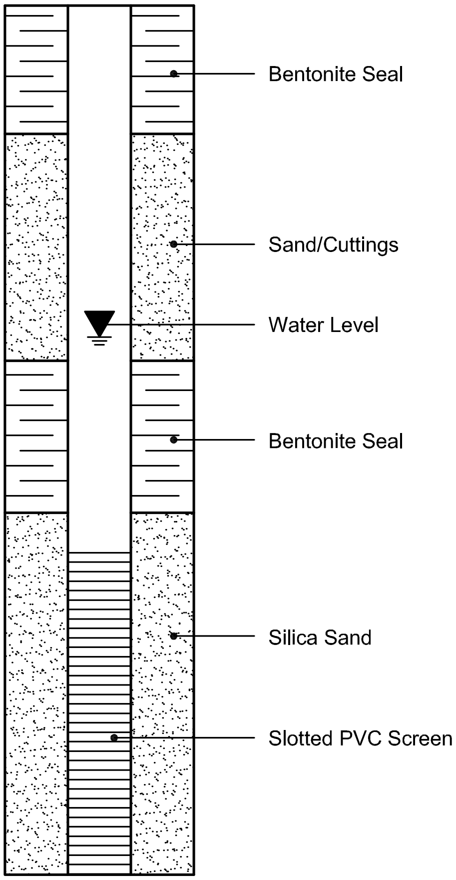
SYMBOLS AND TERMS (continued)

STRATA PLOT

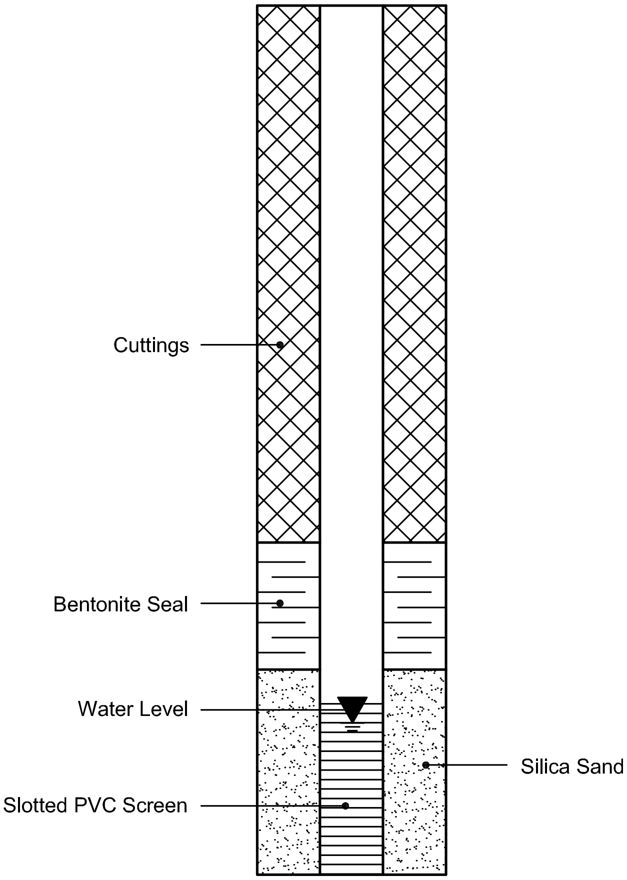


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



APPENDIX 2

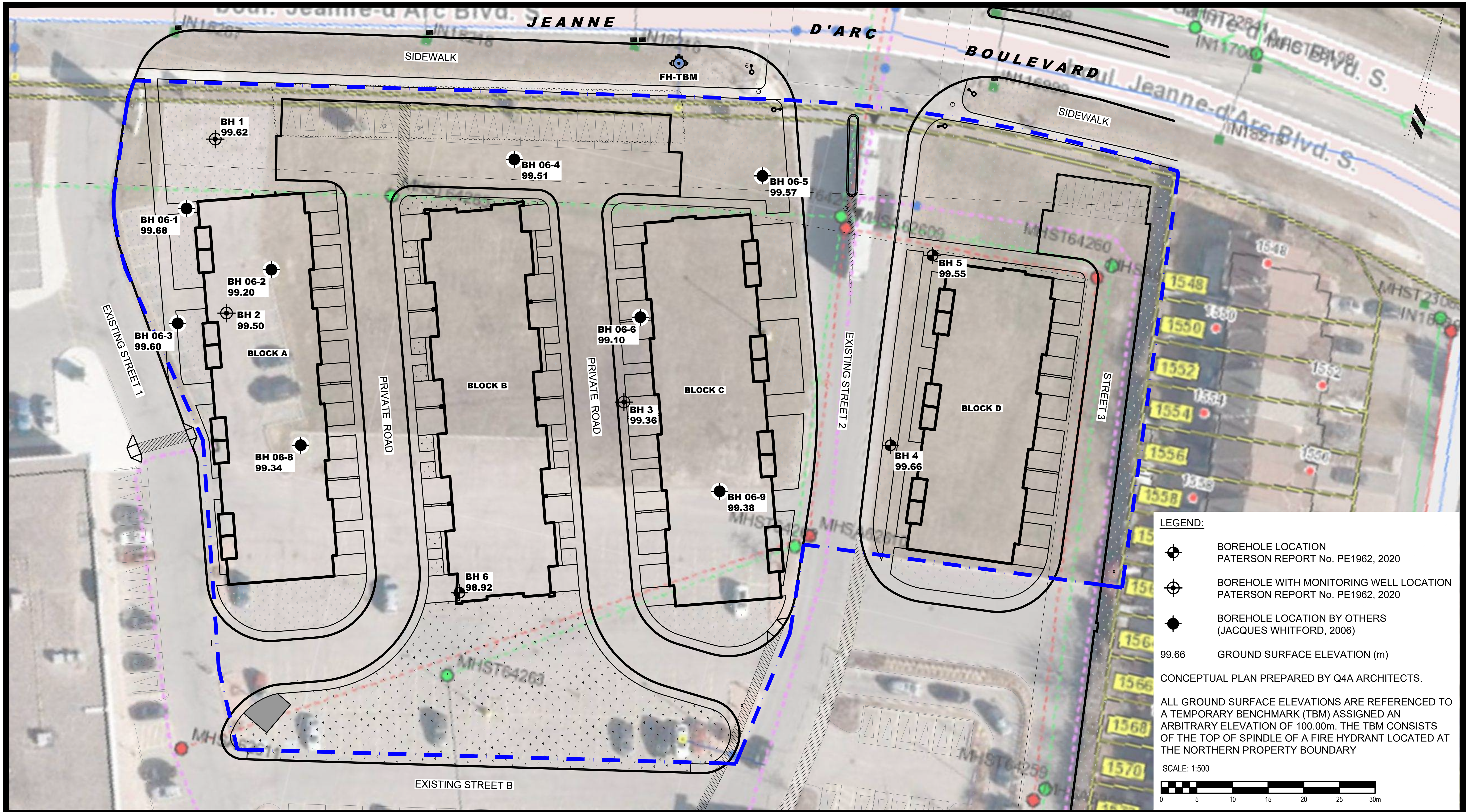
FIGURE 1 – KEY PLAN

DRAWING PG3068-1 - TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN

PATERSON
GROUP



LEGEND:

⌖	BOREHOLE LOCATION PATERSON REPORT No. PE1962, 2020
⌖	BOREHOLE WITH MONITORING WELL LOCATION PATERSON REPORT No. PE1962, 2020
●	BOREHOLE LOCATION BY OTHERS (JACQUES WHITFORD, 2006)
99.66	GROUND SURFACE ELEVATION (m)

CONCEPTUAL PLAN PREPARED BY Q4A ARCHITECTS.

ALL GROUND SURFACE ELEVATIONS ARE REFERENCED TO A TEMPORARY BENCHMARK (TBM) ASSIGNED AN ARBITRARY ELEVATION OF 100.00m. THE TBM CONSISTS OF THE TOP OF SPINDLE OF A FIRE HYDRANT LOCATED AT THE NORTHERN PROPERTY BOUNDARY

SCALE: 1:500

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	02/21/2023	DP

NORTH AMERICAN DEVELOPMENT GROUP
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
1615 ORLEANS BOULEVARD
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500
Date: 08/2013
Drawn by: YA
Report No.: PG3068-1
Checked by: EA
Dwg. No.: PG3068-1
Approved by: DJG
Revision No.: 1

11x17

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