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Geotechnical Investigation

Proposed Residential Development
1830 Trim Road
Ottawa, Ontario

Prepared For

Mattamy Homes

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Report: PG5083-1-Revision 2

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes to conduct a geotechnical investigation for the proposed residential development located at 1830 Trim Road in the City of Ottawa (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

- ❑ Determine the subsoil and groundwater conditions at this site by means of boreholes.

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

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

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

2.0 Proposed Development

Although specific details of the proposed development have not been provided, It is understood that the proposed residential development will consists of townhouses and single family residential dwellings with paved parking areas, access lanes and local roadways.

It is further anticipated that the site will be serviced with future municipal services.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the geotechnical investigation was carried out on September 30, 2019. At that time, a total of three (3) boreholes were spread across the subject site to provide general coverage of the proposed development taking into account of site features and underground utilities. The relevant test holes completed by others as part of the previous subsoil investigations have been provided in the current geotechnical report. The approximate locations of the test holes are shown in Drawing PG5083-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were put down using a truck-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The test hole procedures consisted of augering to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples were recovered from the boreholes using a 50 mm diameter split-spoon sampler or 73 mm diameter thin walled Shelby tubes. The split spoon soil samples were classified on site and placed in sealed plastic bags. The Shelby tubes were recovered from the borehole using a piston sampler, were sealed with caps at both ends and protected from disturbance during the entire process. The recovered auger samples were recovered from the upper part of the boreholes. All samples were transported to our laboratory. The depths at which the auger, split spoon and Shelby tube samples were recovered from the boreholes are shown as AU, SS and TW samples, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

A 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 testing, using field shear vane apparatus in boreholes was carried out in the cohesive soils encountered.

The depth to inferred bedrock was evaluated during the course of the investigation by conducting dynamic cone penetration testing (DCPT) to practical refusal at BH2-19.

The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. In general, the cone was pushed without driving through part of the clay prior to starting the DCPT. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment of penetration.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles from the applicable current boreholes, plus relevant test holes from the previous investigations are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible standpipes were installed in each of the boreholes to permit monitoring of the groundwater levels within the silty clay subsequent to the completion of the sampling program for each stage of investigation.

3.2 Field Survey

The location of the test holes and ground surface elevation at each test hole location was surveyed by Paterson personnel during the field investigation. The ground surface elevation at each test hole location were referenced to a temporary benchmark (TBM) consisting of the finished concrete floor slab of the existing commercial building. An arbitrary elevation of 100.00 m was assigned to the TBM.

The locations and ground surface elevation at each test hole location completed during the current geotechnical investigation are presented on Drawing PG5083-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

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

A total of six (6) undisturbed Shelby tube samples were recovered during the field investigation and three (3) representative samples were submitted for unidimensional consolidation as part of the current geotechnical investigation. The results of the consolidation are presented on the Consolidation Test sheets presented in Appendix 1 and are further discussed in Subsection 4.2 and 5.3.

A total of three (3) Atterberg limit tests were completed on selected soil samples. The results are presented under Subsection 4.2 and further presented in Atterberg Limit Test Result sheet in Appendix 1.

In addition, one (1) representative soil samples was submitted for grain size distribution analysis (hydrometer testing). The results of our testing are presented in Subsection 4.2 and on Grain Size Distribution sheets in Appendix 1.

All soil samples recovered during the current investigation were submitted for moisture contents as part of the current investigation. The results are provided on the Soil Profile and Test Data sheets in Appendix 1.

3.4 Analytical Testing

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

Paracel Laboratories (Paracel), of Ottawa, performed the laboratory analysis of the soil sample submitted for analytical testing. Paracel is a member of the Standards Council of Canada/Canadian Association for Environmental Analytical Laboratories (SCC/CAEAL). Paracel is accredited and certified by SCC/CAEAL for specific tests registered with the association.

The following testing guidelines were utilized for the submitted soil samples. The anions were analyzed using EPA 300.1, the pH was analyzed using EPA 150.1, the resistivity was analyzed using EPA 120.1, and the percent solids was determined using gravimetrics.

4.0 Observations

4.1 Surface Conditions

The subject site is currently occupied by a commercial slab-on-grade commercial building located within the southwest portion of the site. The remaining portion of the site was generally observed to be covered with gravel covered parking areas within the exception of the grass covered area within the east portion of the site. At the time of our field investigation, an approximately 2 to 2.4 m high stockpiled fill pile currently occupies the northeast portion of the site.

The site is generally bordered to the south and west by residential development and to the north by the existing Hydro Corridor following residential. The site is bordered to the east by the newly realigned Trim Road.

The site is relatively flat and generally observed to be approximately at grade with neighboring properties and adjacent roadways.

4.2 Subsurface Profile

Based on the subsoil profile encountered at the test hole locations, the site is generally covered with a thin layer of granular crushed stone or topsoil which in turn is overlying a relatively thick layer of inorganic native silty clay. The thickness of the silty clay deposit is estimated to extend to a depth of 30 m overlying inferred bedrock.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Silty Clay

Silty clay was encountered immediately beneath the granular fill material at all test holes completed during the current investigation. The upper portion of the silty clay layer has been weathered to a very stiff to stiff brown crust extending to depths varying between 3.6 and 3.8 m below existing ground surface at the borehole locations.

Grey silty clay was encountered below the weathered crust at all test hole locations. In situ shear vane field testing carried out within the sampled depths of this layer yielded undrained shear strength values generally ranging from 50 kPa to 30 kPa. These values are indicative of a stiff to firm consistency.

The results of the Atterberg Limit tests conducted within the silty clay layer are presented below in Table 1 - Summary of Atterberg Limits Results and are presented in Appendix 1. The tested material was classified as Inorganic Clays of High Plasticity (CH).

Table 1 - Summary of Atterberg Limits Results

Sample	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH1-19 - SS 3	31	68	26	42	CH
BH2-19 - SS 4	30	68	26	42	CH
BH3-19 - SS 3	29	77	27	50	CH

One (1) representative soil sample was submitted for grain size distribution analysis (hydrometer testing). The results are summarized in Table 2 and presented on the Grain Size Distribution sheets in Appendix 1.

Table 2 - Summary of Hydrometer Tests

Sample	Gravel %	Sand %	Fines Content	
			Silt %	Clay %
BH2-19 - SS 3	0.0	0.3	28.7	71.0

Three (3) undisturbed Shelby tube samples of the silty clay were subjected to unidimensional consolidation testing. The plotted results of the test samples are presented in Appendix 1 and are discussed and interpreted under Subsections 4.2 and 5.3.

The consolidation test results indicate that the silty clay is overconsolidated with overconsolidation ratios for the tested samples (with acceptable disturbance ratios) varying between 1.2 and 1.7. For purposes of comparison and analyses, it is assumed that the clay crust thickness is 3.5 m and the low pre-development groundwater level is 3 m.

Practical Refusal to DCPT/Inferred Bedrock

Practical refusal to DCPT testing was observed at a depth of 34 m below the ground surface at BH2-19.

Based on available geological mapping, the bedrock in this area is expected to range from 25 to 50 m. The bedrock is shown to be part of the Lindsay formation, which consists of interbedded limestone and shale of the Lindsay formation.

4.3 Groundwater

The historical groundwater levels recorded in the monitoring wells previously installed by others were measured at depths varying between 1.0 and 2.2 m below existing ground surface. It should be noted that groundwater level readings within silty clay deposits are prone to being influenced by water perched within the upper portion of the silty clay crust and/or within the borehole backfill material.

The long-term groundwater levels can also be estimated based on the observed colour, moisture level and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at an approximate depth of **2.5** to **3 m** below existing ground surface. The recorded groundwater levels based on the field observations and recovered soil samples are noted on the applicable Soil Profile and Test Data sheet presented in Appendix 1.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed residential development. However, due to the presence of the sensitive silty clay layer, the proposed development will be subjected to grade raise restrictions. Our permissible grade raise recommendations are discussed in Subsection 5.3. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures could reduce the risks of unacceptable long-term post construction total 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 any deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures to expose inorganic subgrade media.

Existing granular fill, free of deleterious materials, should be reviewed by the geotechnical consultant at the time of construction to confirm if the existing granular material can be reused to reinforce the pavement structure utilized as pipe bedding and back material.

Fill Placement

Fill used 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 material. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD) under dry and above freezing temperatures.

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If site excavated material, free of organics and deleterious materials, is to be used to build up the subgrade level for areas to be paved, the site excavated material, under dry conditions, should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Shallow Foundation

Strip footings, up to 3 m wide and pad footings, up to 5 m wide, placed on undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **250 kPa**. A geotechnical resistance factor of 0.5 has been applied to the above noted bearing resistance at ULS value.

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.

Settlement

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

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 bearing surfaceabove the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

During the course of the current investigation, a total of three (3) consolidation tests were completed on three (3) of the undisturbed Shelby tubes samples recovered from the site. The results of the consolidation tests are presented in Table 3 and in Appendix 1.

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test sample. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 3 - Summary of Consolidation Test Results

Borehole	Sample	Depth	p'_c	p'_o	C_{cr}	C_c	Q
BH 1-19	TW 7	5.0	114	67	0.025	3.832	G
BH 2-19	TW 8	6.2	102	75	0.035	2.737	A
BH 3-19	TW 7	5.7	110	71	0.026	3.804	G

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests during the investigation are based on the long term groundwater level being at 0.5 m below the existing groundwater table. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the

proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

Based on the undrained shear strengths and testing results, a permissible grade raise restriction of **2.0 m** above the undisturbed silty clay at building (ignoring existing fill) and **2.5 m** within the roadway (ignoring existing fill) is recommended for this site.

5.4 Seismic Design

The site class for seismic site response can be taken as **Class D** for shallow foundation considered at the subject site according to the OBC 2012. The soils underlying the subject site are not susceptible to liquefaction.

5.5 Basement Slab/Slab-on-Grade Construction

With the removal of all organic soils, unspecified fill and deleterious materials, within the footprints of the proposed structures, the native inorganic soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The upper 150 mm of sub-slab fill should consist of 19 mm clear stone under basement slabs. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of the SPMDD.

Where slab-on-grade floors are to be constructed for the proposed structures, the use of OPSS Granular B Type I, or Type II, with a maximum particle size of 50 mm, is recommended. The upper 200 mm of sub-slab fill should consist of OPSS Granular A crushed stone for slab-on-grade floors.

5.6 Pavement Design

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and local roadways.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas/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 in situ soils or OPSS Granular B Type I or II material placed over in situ soil	

Table 5 - Recommended Pavement Structure - Local Roadways

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

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

It is recommended that the road structure granular layers be protected from surface water. Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

The pavement structure should maintain a suitable crown to shed water towards the available storm sewer catch basins. Consideration should be given to the placement of subdrains along the pavement edge for major roads, or “stubby” drains, leading into the catch basins at the subgrade level.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 100 to 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials, such as clean sand or OPSS Granular B Type I material. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain 6000 or G100N), connected to a drainage system is provided.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures, including attached garages, are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers and wing walls may require more soil cover or a combination of soil cover and insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the building excavations to be undertaken by open-cut methods (i.e. unsupported excavations). Where space restrictions exist, or to minimize the trench width for municipal services, the excavation can be carried out within the confines of a fully braced steel trench box or other acceptable shoring systems.

Unsupported excavation side slopes, extending to a maximum depth of 3 m, should be cut back at 1H:1V, or shallower.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Unsupported slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by "cut and cover" methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A should be used for bedding for sewer and water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

Generally, it should be possible to re-use the moist, not wet, silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. The wet silty clay should be given a sufficient drying period to decrease its moisture content to an acceptable level to make compaction possible prior to being re-used.

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

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

The rate of flow of groundwater into the excavation through the silty clay should be low due to the relatively impervious nature of this material. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations (with flatter excavation slopes being used below groundwater level), although surface water influx sources should also be considered.

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

For typical ground or surface water volumes, being pumped during the construction phase, 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 Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon 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. The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur.

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

Trench excavation and backfilling and pavement construction are also difficult to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. 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 an aggressive to very aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Restrictions

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

The results of the shrinkage testing of BH1-19 - SS 4 resulted in a shrinkage limit of **21%** with a shrinkage ratio of **1.74**.

Based on the results of our review, a high sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below anticipated finished grade as per City Guidelines. Based on our Atterberg Limits test results, the modified plasticity limit generally exceeds 40%. The following tree planting setbacks are recommended for these high sensitivity areas.

High Sensitivity Clay Soils

Large trees (mature height over 14 m) can be planted within this area provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits is 7.5 m for small (mature tree height up to 7.5 m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the following conditions are met:

- ❏ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.
- ❏ A small tree must be provided with a minimum of 25 m^3 of available soil 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 surround 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.

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed at least 5 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer's specifications.

Installation of Decks or Additions

Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

7.0 Recommendations

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

- ❑ Grading plan review from a geotechnical perspective, once the final grading plan is available.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

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

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be retained to review the grading plans, once prepared, for conformance to our recommendations.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mattamy Homes or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Richard Groniger, C. Tech.

David J. Gilbert, P.Eng.

Report Distribution

- ❑ Mattamy Homes (4 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

SOIL PROFILE AND TEST DATA SHEETS (by others)

CONSOLIDATION TEST RESULTS

ATTERBERG LIMITS TESTING RESULTS

GRAIN SIZE DISTRIBUTION ANALYSIS RESULTS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1830 Trim Road
Ottawa, Ontario

DATUM TBM - Finished floor level at the main door located on the east side of existing building. An arbitrary elevation of 100.00m was assigned to the TBM.

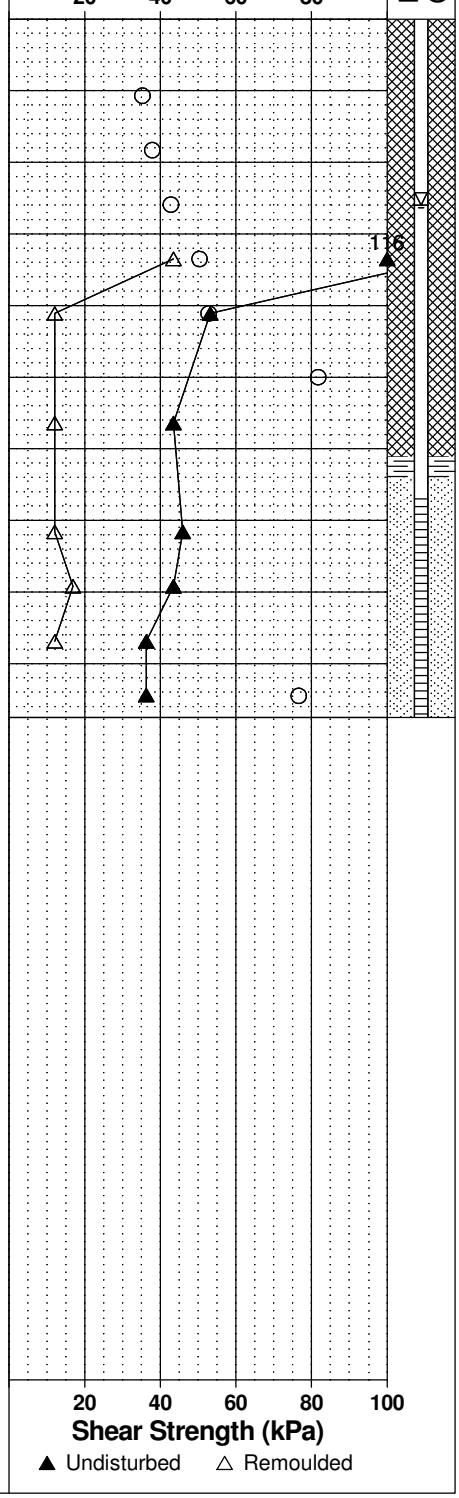
FILE NO. PG5083

REMARKS

HOLE NO. BH 1-19

BORINGS BY CME 55 Power Auger **DATE** 2019 September 30

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	99.27		
FILL: Crushed stone, some sand 0.60		AU	1						
		SS	2	100	10	1	98.27		
		SS	3	100	13	2	97.27		
Very stiff to stiff, brown **SILTY CLAY**		SS	4	100	6	3	96.27		
		SS	5	100	1				
- firm and grey by 3.6m depth		SS	6	100	W	4	95.27		
		TW	7			5	94.27		
		TW	8			6	93.27		
						7	92.27		
						8	91.27		
						9	90.27		
		SS	9	100					
9.75 End of Borehole									
(GWL @ 2.6m depth based on field observations)									



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1830 Trim Road
Ottawa, Ontario

DATUM TBM - Finished floor level at the main door located on the east side of existing building. An arbitrary elevation of 100.00m was assigned to the TBM.

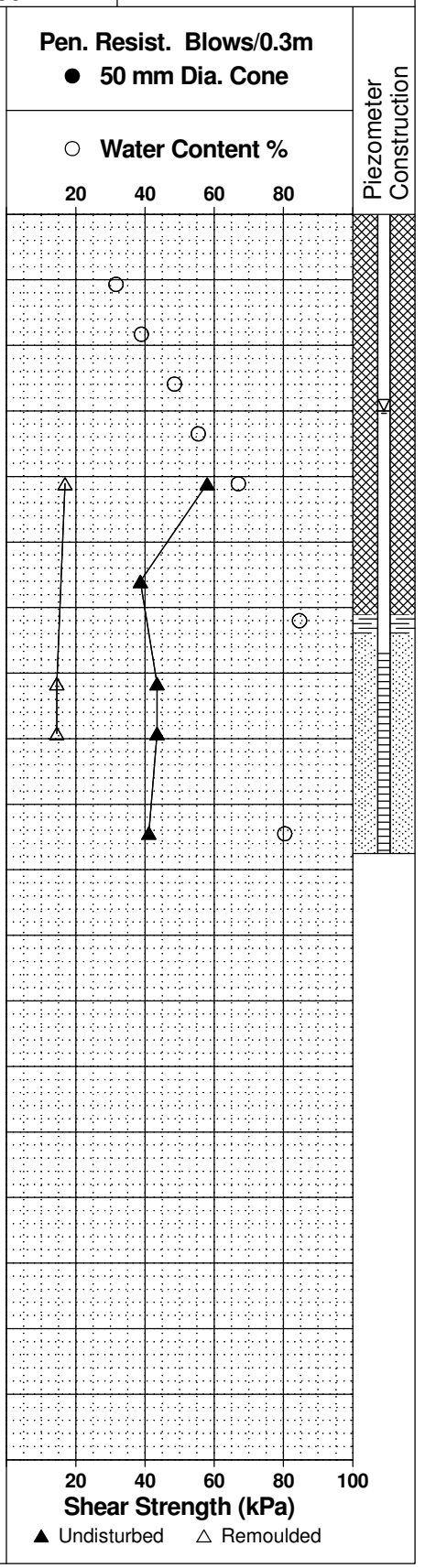
FILE NO. PG5083

REMARKS

HOLE NO. BH 2-19

BORINGS BY CME 55 Power Auger **DATE** 2019 September 30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.30
FILL: Crushed stone, some sand, trace clay 0.41		AU	1				
		SS	2	83	8	1	98.30
		SS	3	100	12	2	97.30
Very stiff to stiff, brown **SILTY CLAY**		SS	4	100	6	3	96.30
		SS	5	100	4		
- firm and grey by 3.8m depth		SS	6	100	W	4	95.30
		TW	7			5	94.30
		TW	8			6	93.30
						7	92.30
						8	91.30
						9	90.30
9.75		SS	9	100	W		
Dynamic Cone Penetration Test commenced at 9.75m depth. Cone pushed to 32.3m depth.						10	89.30
						11	88.30
						12	87.30
						13	86.30
						14	85.30
						15	84.30
						16	83.30
						17	82.30
						18	81.30
						19	80.30



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1830 Trim Road
Ottawa, Ontario

DATUM TBM - Finished floor level at the main door located on the east side of existing building. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5083

REMARKS

HOLE NO. BH 2-19

BORINGS BY CME 55 Power Auger **DATE** 2019 September 30

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	100.00		
						19	80.30		
						20	79.30		
						21	78.30		
						22	77.30		
						23	76.30		
						24	75.30		
						25	74.30		
						26	73.30		
						27	72.30		
						28	71.30		
						29	70.30		
						30	69.30		
						31	68.30		
						32	67.30		
32.60						33	66.30		
Inferred **GLACIAL TILL** by 32.6m depth									
33.93									
End of Borehole									
Practical DCPT refusal at 33.93m depth.									
(GWL @ 3.0m depth based on field observations)									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 1830 Trim Road
Ottawa, Ontario

DATUM TBM - Finished floor level at the main door located on the east side of existing building. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5083

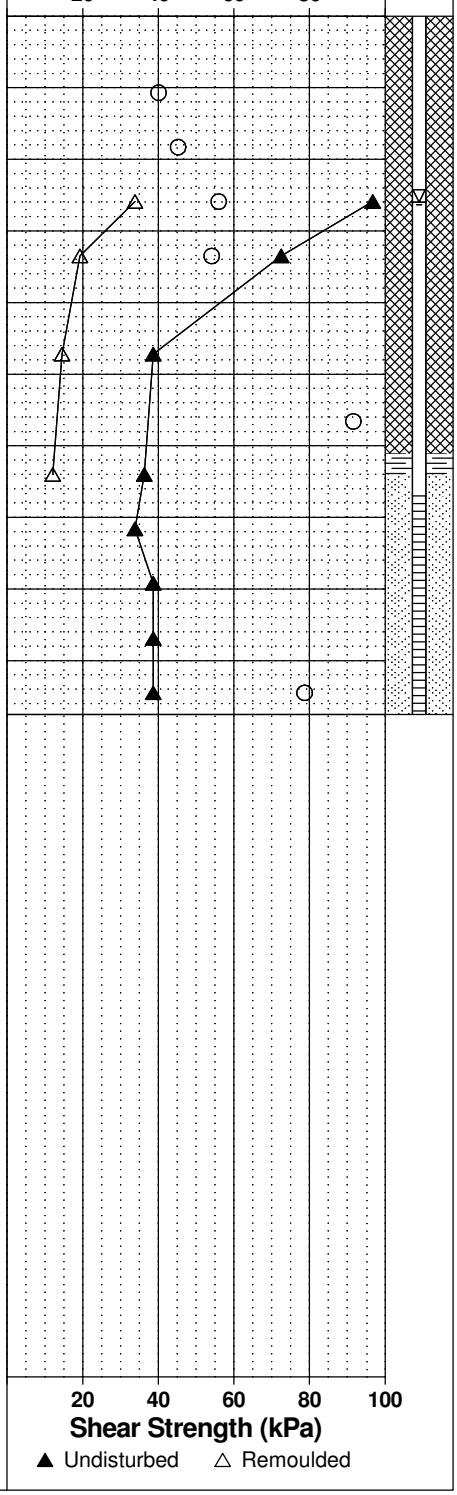
REMARKS

HOLE NO. BH 3-19

BORINGS BY CME 55 Power Auger **DATE** 2019 September 30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.33
FILL: Crushed stone, some sand 0.60		AU	1				
		SS	2	50	8	1	98.33
		SS	3	83	6	2	97.33
Very stiff to stiff, reddish brown **SILTY CLAY**		SS	4	88	W	3	96.33
		SS	5	100	W		
- firm and grey by 3.6m depth		TW	6			4	95.33
		TW	7			5	94.33
						6	93.33
						7	92.33
						8	91.33
						9	90.33
9.75 End of Borehole		SS	8	100	W		
(GWL @ 2.6m depth based on field observations)							

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



Piezometer Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

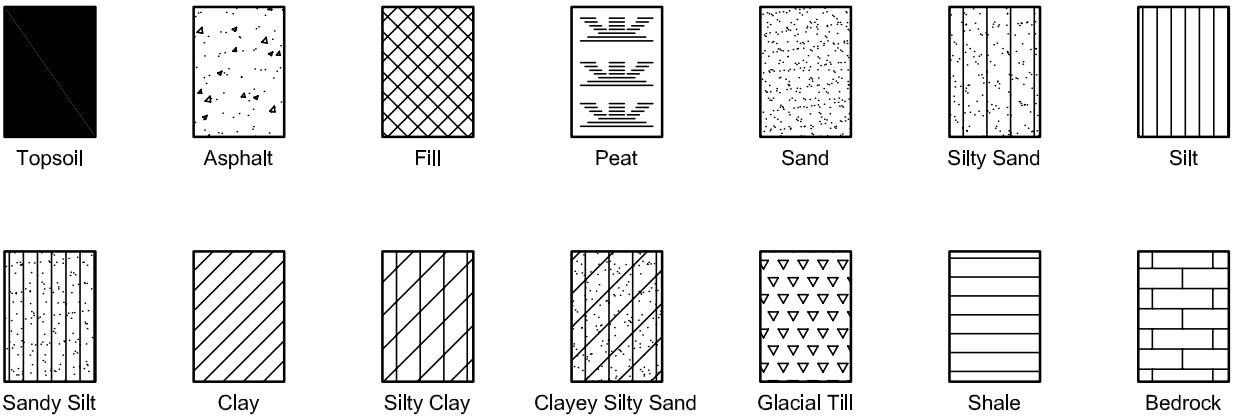
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

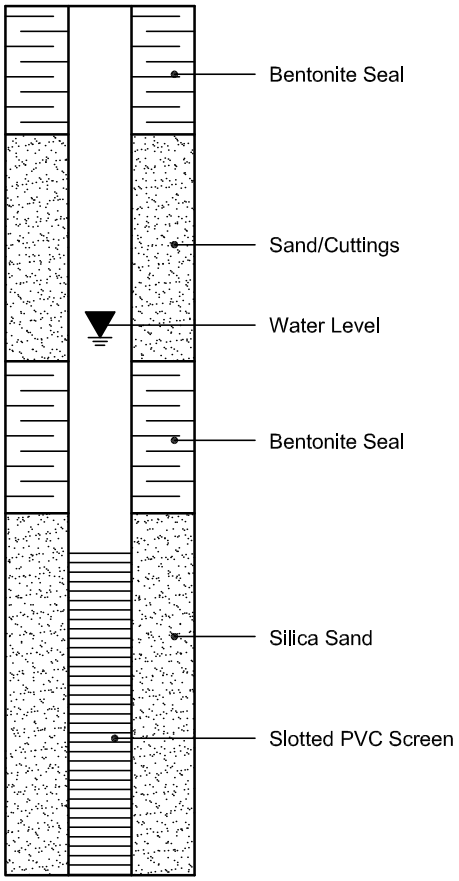
SYMBOLS AND TERMS (continued)

STRATA PLOT

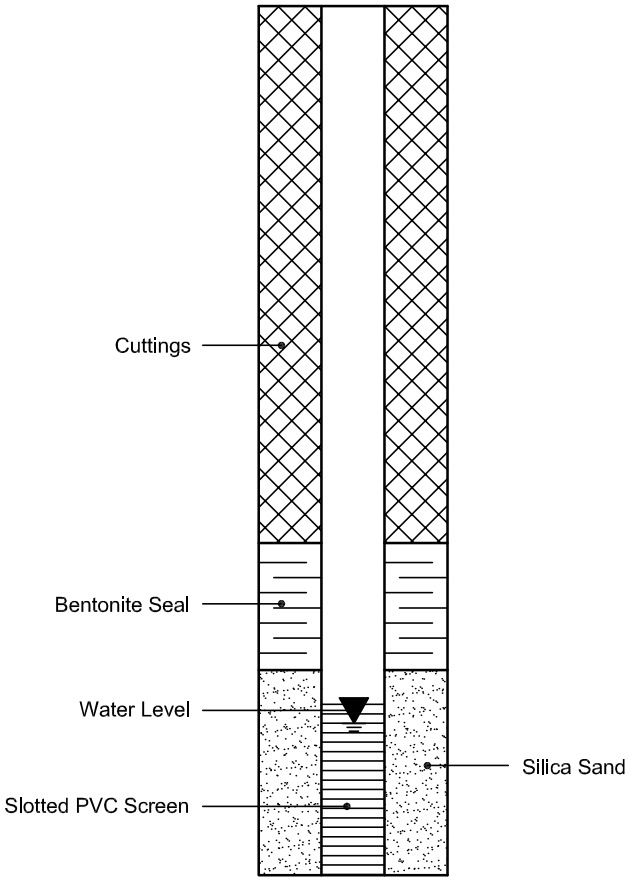


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



LOG NO: BH16-1

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

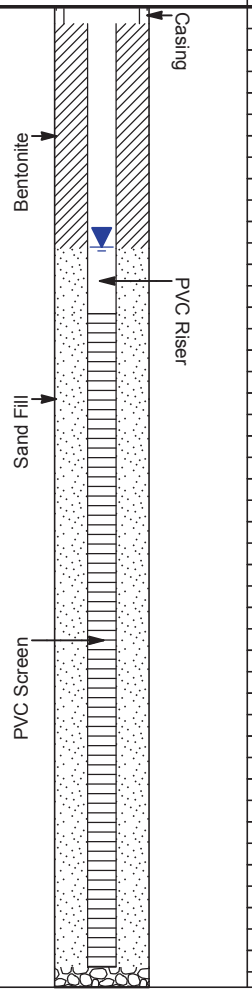
DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035764 **EASTING** 463430
DRILL DATE 2/9/16
GROUND ELEVATION 99.56 masl **TOC ELEVATION** 99.49 masl
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL 1.04 mbtoc (18/02/2016)
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION 98.45 mbgs (18/02/2016)

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS
0.2 – 1.0		**GRAVEL**, FILL, no staining, no odour		1	G	100		55 ppm	
			98.55 1.01	2		50	4-5-3-3	60 ppm	M, I, P, B, F1, F2, V
1.2 – 2.2		**CLAYEY SILT**, NATIVE, with gravel, loose, very moist by 1.2 m depth, no staining, no odour		X		0	5-5-5-7		
			97.23 2.33	3		95	2-4-3-4	0 ppm	
2.4 – 4.4		**CLAY**, light greyish blue, firm to very soft, wet, no staining, no odour		4		100	2-2-2-2	0 ppm	M, I, P, B, F1, F2, V
				5		100	1	0 ppm	
			94.99 4.57						

End of Borehole at 4.57meters

WELL DIAGRAM

Casing Type: Flush Mount
Ground Level to TOC: -0.08 (m)



NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

G Grab Sample
Split Spoon

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-2

BOREHOLE LOG

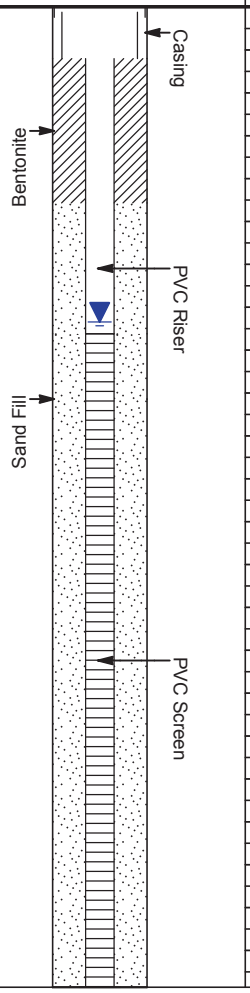
PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035748 **EASTING** 463980
DRILL DATE 2/9/16
GROUND ELEVATION 99.65 masl **TOC ELEVATION** 99.4 masl
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL 1.23 mbtoc (18/02/2016)
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION 98.17 mbgs (18/02/2016)

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS
0.0	**GRAVEL**, FILL, light to dark brown, no staining, no odour		1	G	100		0 ppm	
1.0	**CLAY**, NATIVE, light grey, firm, wet, no staining, no odour	98.63 / 1.02	X		0	3-3-5-7		M, I, P, B, F1, F2, V
2.0			2		100	1-2-5-5	0 ppm	
2.2	Becoming soft at 2.13m	2.13						
3.0			3		100	2-2-1-2	0 ppm	
3.2	Becoming very soft at 3.05m	3.05						
4.0			4		100	1-1-1-1	0 ppm	M, I, P, B, F1, F2, V
4.2			5		100	1	0 ppm	
4.4	End of Borehole at 4.57meters	95.08 / 4.57						

WELL DIAGRAM

Casing Type: Flush Mount
Ground Level to TOC: -0.24 (m)



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LAB ANALYSIS:

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I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

G Grab Sample
Split Spoon

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-3

BOREHOLE LOG

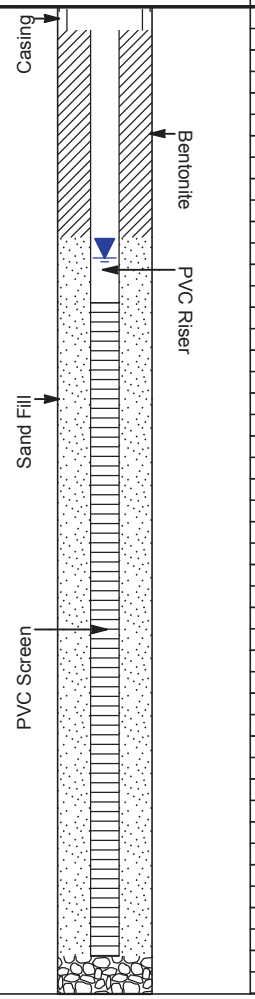
PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035700 **EASTING** 463982
DRILL DATE 2/9/16
GROUND ELEVATION 99.77 masl **TOC ELEVATION** 99.66 masl
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL 1.06 mbtoc (09/02/2016)
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION 98.6 mbgs (09/02/2016)

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS
0.0	**GRAVEL**, FILL, no staining, no odour		1	G	100		0 ppm	M, I, P, B, F1, F2, V
1.0		98.72 / 1.05	X		5	3-2-2-2		
1.0	**CLAY**, NATIVE, light brown, soft to firm, moist, no staining, no odour, inferred to commence at 1.05 mbgs		2		100	1-2-3-3	0 ppm	
2.3	Becoming soft to very soft and saturated at 2.32m	2.32	3		100	2-2-2-2	0 ppm	
3.2			4		100	1-2-2-1	0 ppm	M, I, P, B, F1, F2, V
4.0			5		100		0 ppm	
4.6	End of Borehole at 4.60meters	95.17 / 4.60						

WELL DIAGRAM

Casing Type: Flush Mount
Ground Level to TOC: -0.11 (m)



NOTES:

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toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

G Grab Sample
Split Spoon

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-4

BOREHOLE LOG

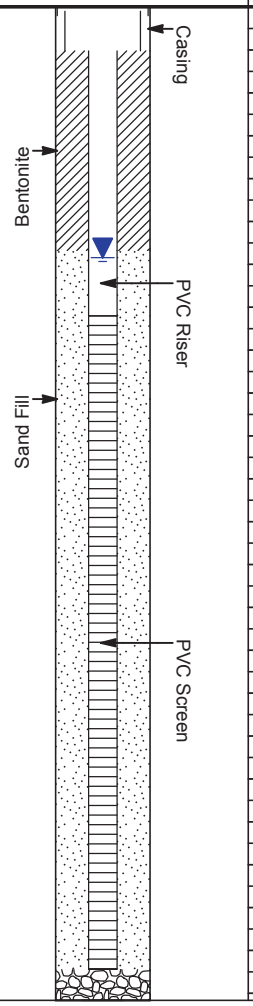
PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035687 **EASTING** 463995
DRILL DATE 2/9/16
GROUND ELEVATION 99.76 masl **TOC ELEVATION** 99.56 masl
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL 0.97 mbtoc (18/02/2016)
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION 98.59 mbgs (18/02/2016)

DEPTH (m)	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS
0.2 – 1.2	**GRAVEL**, FILL, no staining, no odour		1	G	100		0 ppm	M, I, P, B, F1, F2, V
			X	X	0	5-3-3-3		
1.2 – 3.0	**CLAY**, NATIVE, light orangeish grey, stiff to firm, no odour, no staining	98.45 / 1.31	2	X	90	2-4-5-6	0 ppm	
			3	X	100	2-2-3-3	0 ppm	
3.0 – 4.6	**CLAY**, light grey, soft to very soft, no staining, no odour	96.71 / 3.05	4	X	100	1-2-1-2	0 ppm	M, I, P, B, F1, F2, V
			5	X	100	1-1-1-1	0 ppm	
	End of Borehole at 4.63meters	95.13 / 4.63						

WELL DIAGRAM

Casing Type: Flush Mount
Ground Level to TOC: -0.20 (m)



NOTES:

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mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

G Grab Sample
X Split Spoon

Note: Any decisions/actions made by a third party based on this log are the sole responsibility of the third party. ARCADIS accepts no liability for third party decisions/actions made based on this log.

ARCADIS Canada
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LOG NO: BH16-5

BOREHOLE LOG

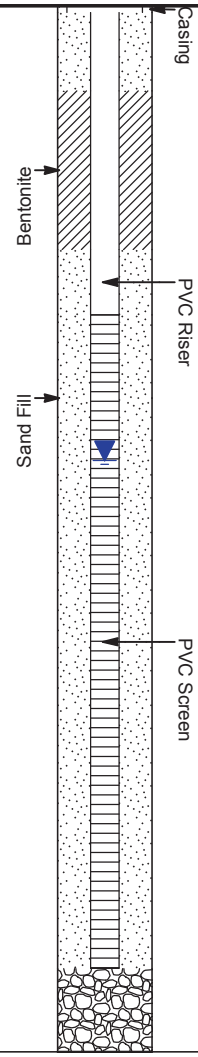
PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035673 **EASTING** 463997
DRILL DATE 2/16/16
GROUND ELEVATION 100.01 masl **TOC ELEVATION** 100.02 masl
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL 2.13 mbtoc (01/03/2016)
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION 97.89 mbgs (01/03/2016)

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS
0.2		**CONCRETE**, Augered through concrete surface	99.78						
0.4		**GRAVELLY SAND**, FILL, brown, dry, no staining, no odour	0.23						
0.6				1		50		0 ppm	M, I, P, B, F1, F2, V
0.8									
1.0			98.88						
1.2		**CLAY**, NATIVE, grey, moist to wet, no staining, no odour	1.13						
1.4									
1.6				2		100		0 ppm	
1.8									
2.0									
2.2									
2.4									
2.6				3		100		0 ppm	
2.8									
3.0									
3.2									
3.4									
3.6									
3.8									
4.0									
4.2				4		100		0 ppm	M, I, P, B, F1, F2, V
4.4									
4.6									
4.8			95.13						
		End of Borehole at 4.88meters	4.88						

WELL DIAGRAM

Casing Type: Flush Mount
Ground Level to TOC: 0.01 (m)



NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-6

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035655 **EASTING** 463945
DRILL DATE 2/17/16
GROUND ELEVATION 99.79 masl **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**SANDY GRAVEL**, FILL, brown, loose, dry, no staining, no odour		1		100		0 ppm	M, I, P, B, F1, F2, V		0.2
0.4											0.4
0.6											0.6
0.8											0.8
1.0			98.78 / 1.01								1.0
1.2		**CLAY**, NATIVE, grey, compact, no staining, no odour		2		100		0 ppm			1.2
1.4											1.4
1.6											1.6
1.8											1.8
2.0											2.0
2.2											2.2
2.4											2.4
2.6				3		75		0 ppm	M, I		2.6
2.8											2.8
3.0											3.0
3.2											3.2
3.4											3.4
3.6			96.13 / 3.66								3.6

End of Borehole at 3.66meters

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-7

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035714 **EASTING** 463900
DRILL DATE 2/17/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, and sand, brown, loose, dry, no staining, no odour					0 ppm			0.2
0.4										0.4
0.6		**SILT**, NATIVE, dark brown, compact, dry, no staining, no odour 0.58	1		100			M, I, P, B, F1, F2, V, Pes		0.6
0.8										0.8
1.0		**CLAY**, grey, compact, moist, no staining, no odour 0.94								1.0
1.2							0 ppm			1.2
1.4										1.4
1.6										1.6
1.8			2		100					1.8
2.0										2.0
2.2										2.2
2.4										2.4
2.6							0 ppm			2.6
2.8										2.8
3.0			3		80			M, I		3.0
3.2										3.2
3.4										3.4
3.6										3.6
		End of Borehole at 3.66meters 3.66								

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-8

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035658 **EASTING** 463998
DRILL DATE 2/17/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, and sand, brown, no staining, no odour	1		100		0 ppm	M, I, P, B, F1, F2, V, Pes		0.2
0.4										0.4
0.6										0.6
0.8										0.8
1.0		**CLAY**, NATIVE, grey, moist, no staining, no odour 0.82								1.0
1.2										1.2
1.4			2		90		0 ppm			1.4
1.6										1.6
1.8										1.8
2.0										2.0
2.2										2.2
2.4										2.4
2.6			3		80		0 ppm	M, I		2.6
2.8										2.8
3.0										3.0
3.2										3.2
3.4										3.4
3.6		End of Borehole at 3.66meters 3.66								3.6

NOTES:

masl = Meters Above Sea Level
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toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-9

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035688 **EASTING** 463959
DRILL DATE 2/17/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, and sand, brown, dry, no staining, no odour	1		100		0 ppm	M, I, P, B, F1, F2, V		0.2
0.4										0.4
0.6										0.6
0.8										0.8
1.0		**CLAY**, NATIVE, trace gravel, grey, moist, no staining, no odour 0.94								1.0
1.2			2		100		0 ppm			1.2
1.4										1.4
1.6		**CLAY**, grey, moist, no staining, no odour 1.52								1.6
1.8										1.8
2.0										2.0
2.2										2.2
2.4										2.4
2.6			3		60		0 ppm	M, I		2.6
2.8										2.8
3.0										3.0
3.2										3.2
3.4										3.4
3.6		End of Borehole at 3.66meters 3.69								3.6

NOTES:

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LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-10

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035701 **EASTING** 464035
DRILL DATE 2/16/16
GROUND ELEVATION 99.65 masl **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, some sand, dry, no staining, no odour						0 ppm			0.2
0.4											0.4
			99.10								
0.6		**CLAY**, NATIVE, with gravel, grey, moist, no staining, no odour	0.55	1		100					0.6
0.8											0.8
1.0											1.0
1.2			98.43								1.2
		CLAY, trace gravel, grey, moist, no staining, no odour	1.22					0 ppm			
1.4											1.4
1.6											1.6
1.8				2		80			M, I, P, B, F1, F2, V		1.8
2.0											2.0
2.2											2.2
2.4											2.4
2.6								0 ppm			2.6
2.8											2.8
3.0				3		100			M, I		3.0
3.2											3.2
3.4											3.4
3.6			95.99								3.6
		End of Borehole at 3.66meters	3.66								

NOTES:

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toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-11

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035752 **EASTING** 464048
DRILL DATE 2/16/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, cement-like dust light brown, dry, no staining, no odour, Augered through first 2 feet. Frozen					0 ppm			0.2
0.4										0.4
0.6			1		80			M, I		0.6
0.8		**SAND**, FILL, and gravel, brown, dry, no staining, no odour 0.70								0.8
1.0										1.0
1.2		**CLAY**, NATIVE, trace gravel, grey, compact, moist, no staining, no odour 1.22					0 ppm			1.2
1.4										1.4
1.6										1.6
1.8			2		100					1.8
2.0										2.0
2.2										2.2
2.4							0 ppm			2.4
2.6										2.6
2.8										2.8
3.0			3		100			M, I		3.0
3.2										3.2
3.4										3.4
3.6										3.6

End of Borehole at 3.66meters 3.66

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-12

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035790 **EASTING** 463950
DRILL DATE 2/17/16
GROUND ELEVATION 99.4 masl **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**SAND**, FILL, and gravel, brown, dry, no staining, no odour						0 ppm			0.2
0.4											0.4
0.6			98.79	1		100			M, I, P, B, F1, F2, V, Pes		0.6
0.8		**CLAY**, NATIVE, with gravel, grey, dry, no staining, no odour	0.61								0.8
1.0			98.47								1.0
1.2		**CLAY**, grey, moist, no staining, no odour	0.93					0 ppm			1.2
1.4											1.4
1.6											1.6
1.8				2		100					1.8
2.0											2.0
2.2											2.2
2.4											2.4
2.6								0 ppm			2.6
2.8											2.8
3.0				3		90			M, I		3.0
3.2											3.2
3.4											3.4
3.6			95.74								3.6
		End of Borehole at 3.66meters	3.66								

NOTES:

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toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-13

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035805 **EASTING** 464034
DRILL DATE 2/16/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**SAND**, cement-like dust light brown, fine grained, no staining, no odour					0 ppm			0.2
0.4										0.4
0.6			1		80			M, I, P, B, F1, F2, V, Pes		0.6
0.8		**GRAVEL**, FILL, and sand, trace clay, brown, no staining, no odour 0.61								0.8
1.0										1.0
1.2										1.2
1.4							0 ppm			1.4
1.6		**CLAY**, NATIVE, grey, moist, no staining, no odour 1.55	2		100					1.6
1.8										1.8
2.0										2.0
2.2										2.2
2.4										2.4
2.6							0 ppm			2.6
2.8										2.8
3.0			3		100			M, I		3.0
3.2										3.2
3.4										3.4
3.6										3.6
		End of Borehole at 3.66meters 3.66								

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

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LOG NO: BH16-14

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Direct Push
NORTHING 5035825 **EASTING** 464070
DRILL DATE 2/17/16
GROUND ELEVATION 99.34 masl **TOC ELEVATION**
LOGGED BY Chris Davis **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (mbsl) / DEPTH (mbgs)	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**GRAVEL**, FILL, and sand, brown, frozen, no staining, no odour						0 ppm			0.2
0.4											0.4
0.6			98.76 / 0.58	1		80			M, I, P, B, F1, F2, V		0.6
0.8		**GRAVEL**, FILL, and sand, trace clay, brown, moist, no staining, no odour									0.8
1.0			98.33 / 1.01								1.0
1.2		**CLAY**, NATIVE, trace gravel, grey, moist, no staining									1.2
1.4								0 ppm			1.4
1.6			97.72 / 1.62								1.6
1.8		**CLAY**, grey, moist, no staining, no odour		2		100					1.8
2.0											2.0
2.2											2.2
2.4											2.4
2.6								0 ppm			2.6
2.8											2.8
3.0				3		80			M, I		3.0
3.2											3.2
3.4											3.4
3.6			95.68 / 3.66								3.6

End of Borehole at 3.66meters

NOTES:

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toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

Note: Any decisions/actions made by a third party based on this log are the sole responsibility of the third party. ARCADIS accepts no liability for third party decisions/actions made based on this log.

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-15

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035694 **EASTING** 464096
DRILL DATE 2/9/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**TOPSOIL/ORGANICS**, rootlets, with vegetation, no staining, no odour								0.2
0.4										0.4
0.6		**CLAY**, NATIVE, dark to light grey, stiff to firm, moist, no staining, no odour 0.43								0.6
0.8										0.8
1.0			1		80	2-3-6-6		M, I, P, B, F1, F2, V, Pes		1.0
1.2										1.2
1.4										1.4
1.6										1.6
1.8			2		100	2-3-4-4				1.8
2.0										2.0
2.2										2.2
2.4										2.4
2.6			3			3-2-2-2		M, I		2.6
2.8										2.8
3.0										3.0

End of Borehole at 3.11meters 3.11

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

Note: Any decisions/actions made by a third party based on this log are the sole responsibility of the third party. ARCADIS accepts no liability for third party decisions/actions made based on this log.

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-16

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035737 **EASTING** 464128
DRILL DATE 2/9/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**TOPSOIL/ORGANICS**, roots, moist, no staining, no odour								0.2
0.4										0.4
0.6		**CLAY**, NATIVE, light grey, stiff to very soft, moist, no staining, no odour 0.46								0.6
0.8			1		90	2-3-6-5	0 ppm	M, I		0.8
1.0										1.0
1.2										1.2
1.4			2		100	2-2-2-3	0 ppm			1.4
1.6										1.6
1.8										1.8
2.0										2.0
2.2			3			1-1	0 ppm	M, I		2.2
2.4										2.4
2.6										2.6
2.8										2.8
		End of Borehole at 2.93meters 2.93								

NOTES:
masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:
M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:
☒ Split Spoon

Note: Any decisions/actions made by a third party based on this log are the sole responsibility of the third party. ARCADIS accepts no liability for third party decisions/actions made based on this log.

ARCADIS Canada
329 Churchill Avenue North
Ottawa, ON K1Z 5B8
Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

LOG NO: BH16-17

BOREHOLE LOG

PROJECT NUMBER 450271-000
CLIENT FirstGroup America
PROJECT NAME 1830 Trim Road Phase II ESA
PROJECT LOCATION 1830 Trim Road Property, Ottawa, Ontario

DRILLING CONTRACTOR Downing
PROJECTION NAD Zone 18
DRILLING METHOD Auger with Continuous Split Spoon Sampling
NORTHING 5035800 **EASTING** 464118
DRILL DATE 2/9/16
GROUND ELEVATION **TOC ELEVATION**
LOGGED BY Alisha Williamson **CHECKED BY** TA
GROUND WATER LEVEL ( )
HOLE DIAMETER 0.203 " **WELL DIAMETER** 0.051 "
GROUND WATER ELEVATION mbgs ( )

DEPTH (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	RECOVERY %	BLOW COUNTS	RKI READINGS	LAB ANALYSIS	WELL DIAGRAM	DEPTH (m)
0.2		**TOPSOIL/ORGANICS**, roots, grasses, no staining, no odour								0.2
0.4		**TOPSOIL**, dark brown, dry, iron oxide staining, no odour 0.37								0.4
0.6										0.6
0.8							0 ppm			0.8
1.0			1		90	3-5-8-7		M, I, P, B, F1, F2, V, Pes		1.0
1.2										1.2
1.4										1.4
1.6		**TOPSOIL**, dark brown, dry, iron oxide staining, manure odour 1.52					0 ppm			1.6
1.8			2		50	2-3-2-4				1.8
2.0										2.0
2.2							0 ppm			2.2
2.4										2.4
2.6			3			4-5-6-6		M, I		2.6
2.8										2.8

End of Borehole at 2.99meters 2.99

NOTES:

masl = Meters Above Sea Level
mbgs = Meters Below Ground Surface
toc = Top of Casing
ppm = Parts Per Million
LEL = Lower Explosive Limit

LAB ANALYSIS:

M = Metals
I = Inorganics
V = VOC's
B = BTEX
P = PAH
F1 = PHC F1
F2 = PHC F2-F4
PCB = PCB's
Pes = Pesticides

SAMPLE TYPE:

☒ Split Spoon

Note: Any decisions/actions made by a third party based on this log are the sole responsibility of the third party. ARCADIS accepts no liability for third party decisions/actions made based on this log.

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Telephone: Tel 613 721 055
Fax: Fax 613 721 0029

Date:	12-May-16	**Test Pit: TP16-1**	SAMPLES			
Logged by:	S. Hannington		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Method:	Backhoe					
Location:	E 464012, N 5035821, Zone 18 N					
Depth (m)	Description					
0 - 0.1	**Topsoil** brownish grey, dry		-	-	-	-
0.1 - 0.6	**Sand and Gravel Fill** brown, dry		-	-	-	-
0.6 - 2.0	**Silty Clay** greenish grey,oxidized, soft to stiff and blocky at 2.0 m bgs, dry		Grab	TP16-1-1	0.7	chromium and electrical conductivity
			Grab	TP16-1-2	1.7	chromium and electrical conductivity
End Depth 2.0 m bgs						

Date:	12-May-16	**Test Pit: TP16-2**	SAMPLES			
Logged by:	S. Hannington		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Method:	Backhoe					
Location:	E 464039, N 5035819, Zone 18 N					
Depth (m)	Description					
0 - 1.0	**Sand and Gravel Fill** brownish grey, dry		Grab	TP16-2-1 (Dup-3)	1	chromium and electrical conductivity
1.0 - 2.0	**Silty Clay** brownish grey, dry		Grab	TP16-2-2	1.7	chromium and electrical conductivity
End Depth 2.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-3**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463976, N 5035786, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.7	**Sand and Gravel Fill** brownish grey, dry					
0.7 - 2.0	**Silty Clay** greenish grey, some oxidation, soft to stiff and blocky, dry	Grab	TP16-3-1 (Dup-1)	0.7	chromium and electrical conductivity	
		Grab	TP16-3-2	1.9	chromium and electrical conductivity	
End Depth 2.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-4**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 464023, N 5035776, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 1.0	**Sand and Gravel Fill** brownish grey, water seeping in at 1.0 m bgs	Grab	TP16-4-1 (Dup-2)	0.4	FOC (for Dup-2 only), chromium and electrical conductivity	
1.0 - 2.0	**Silty Clay** greenish grey, soft, wet	Grab	TP16-4-2	1.9	chromium and electrical conductivity	
End Depth 2.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-5**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: E 464014, N 5035748, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Depth (m)	Description				
0 - 0.9	**Sand and Gravel Fill** brownish grey, dry, some water seeping 0.9 m bgs	Grab	TP16-5-1	0.7	barium and electrical conductivity
0.9 - 2.0	**Silty Clay** greenish grey, some oxidation, soft, dry	Grab	G.S.-1	1	grain size
		Grab	TP16-5-2	1.9	barium and electrical conductivity
End Depth 2.0 m bgs					

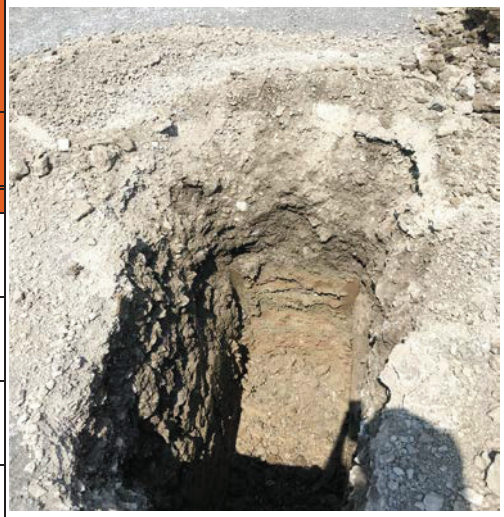
Date: 12-May-16	**Test Pit: TP16-6**	SAMPLES			
Logged by: S. Hannington Method: Backhoe Location: E 464059, N 5035754, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Depth (m)	Description				
0 - 1.0	**Sand and Gravel Fill** brownish grey, water seeping in at 1.0 m bgs	Grab	TP16-6-1	0.5	barium and electrical conductivity
1.0 - 2.0	**Silty Clay** greenish grey, wet	Grab	TP16-6-2 G.S.-2	1.3	FOC (for TP16-6-2 only), barium and electrical conductivity, grain size
		Grab	TP16-6-3	2	barium and electrical conductivity
End Depth 2.0 m bgs					

Date: 12-May-16	**Test Pit: TP16-7**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 464009, N 5035729, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.9	**Sand and Gravel Fill** brownish grey, some silty clay, dry	Grab	TP16-7-1	0.7	barium and electrical conductivity	
0.9 - 2.0	**Silty Clay** brown to greenish grey, soft, dry	Grab	TP16-7-2	2	barium and electrical conductivity	
End Depth 2.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-8**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463928, N 5035753, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.6	**Sand and Gravel Fill** brownish grey, dry	-	-	-	-	
0.6 - 1.0	**Silty Clay** brown to greenish grey, soft, dry	Grab	TP16-8-1	0.7	electrical conductivity	
End Depth 1.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-9**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463941, N 5035727, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.6	**Sand and Gravel Fill** brownish grey, dry to damp	-	-	-	-	
0.6 - 1.0	**Silty Clay** dark greenish grey, some black staining, some oxidation, damp	Grab	TP16-9-1	0.6	electrical conductivity	
End Depth 1.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-10**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463921, N 5035693, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.6	**Sand and Gravel Fill** brownish grey, dry	-	-	-	-	
0.6 - 1.0	**Silty Clay** dark greenish grey, some brown bands, some oxidation, soft, damp	Grab	TP16-10-1	0.7	electrical conductivity	
End Depth 1.0 m bgs						

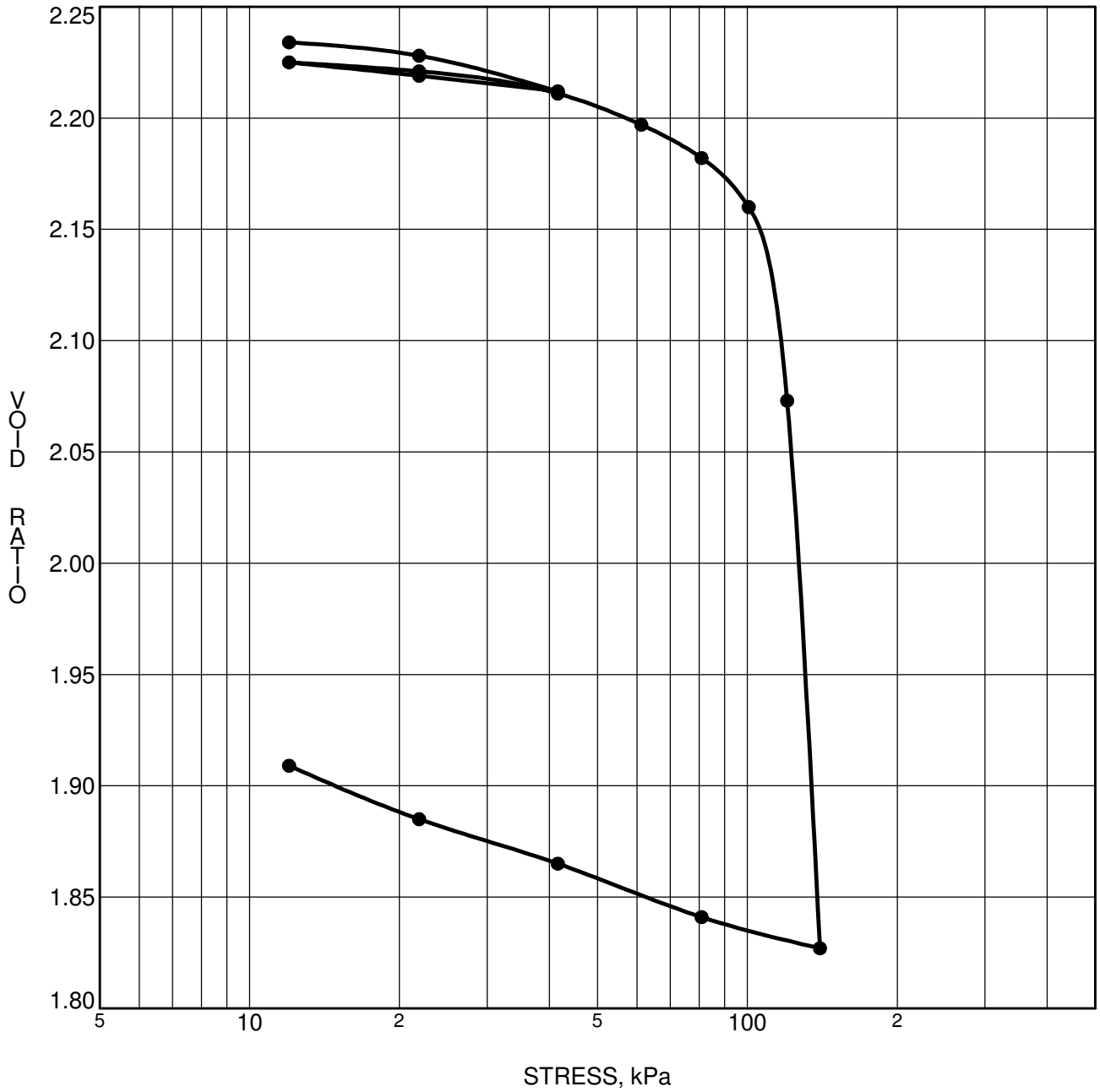
Date: 12-May-16	**Test Pit: TP16-11**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463939, N 5035674, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.7	**Sand and Gravel Fill** brownish grey, dry	-	-	-	-	
0.7 - 2.0	**Silty Clay** dark greenish grey and brown, dry	Grab	TP16-11-1	0.8	barium and electrical conductivity	
		Grab	G.S.-3	0.9	grain size	
		Grab	TP16-11-2	1.8	barium and electrical conductivity	
End Depth 2.0 m bgs						

Date: 12-May-16	**Test Pit: TP16-12**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 463973, N 5035635 Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.7	**Sand and Gravel Fill** brownish grey, dry	-	-	-	-	
0.7 - 2.0	**Silty Clay** dark greenish grey, minor oxidation, dry	Grab	TP16-12-1	0.8	barium and electrical conductivity	
		Grab	TP16-12-2	0.9	FOC	
		Grab	TP16-12-3	1.8	barium and electrical conductivity	
End Depth 2.0 m bgs						

Date:	12-May-16	**Test Pit: TP16-13**	SAMPLES			
Logged by:	S. Hannington		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Method:	Backhoe					
Location:	E 464032, N 5035672, Zone 18 N					
Depth (m)	Description					
0 - 0.8	**Sand and Gravel Fill** brownish grey, dry		-	-	-	-
0.8 - 1.0	**Silty Clay** greenish grey to brown, dry		Grab	TP16-13-1	0.9	electrical conductivity
End Depth 1.0 m bgs						

Date:	12-May-16	**Test Pit: TP16-14**	SAMPLES			
Logged by:	S. Hannington		Type	Sample I.D.	Depth (m bgs)	Sample Analysis
Method:	Backhoe					
Location:	E 464101, N 5035795, Zone 18 N					
Depth (m)	Description					
0 - 0.5	**Topsoil** grassy surface, brown, dry		-	-	-	-
0.5 - 1.2	**Silty Clay** greenish grey, dry		Grab	TP16-14-1	0.8	cyanide
End Depth 1.2 m bgs						

Date: 12-May-16	**Test Pit: TP16-15**	SAMPLES				
Logged by: S. Hannington Method: Backhoe Location: E 464131, N 5035812, Zone 18 N		Type	Sample I.D.	Depth (m bgs)	Sample Analysis	
Depth (m)	Description					
0 - 0.5	**Topsoil** grassy surface, brown, dry	-	-	-	-	
0.5 - 1.2	**Silty Clay** greenish grey, dry	Grab	TP16-15-1	0.8	cyanide	
End Depth 1.2 m bgs						



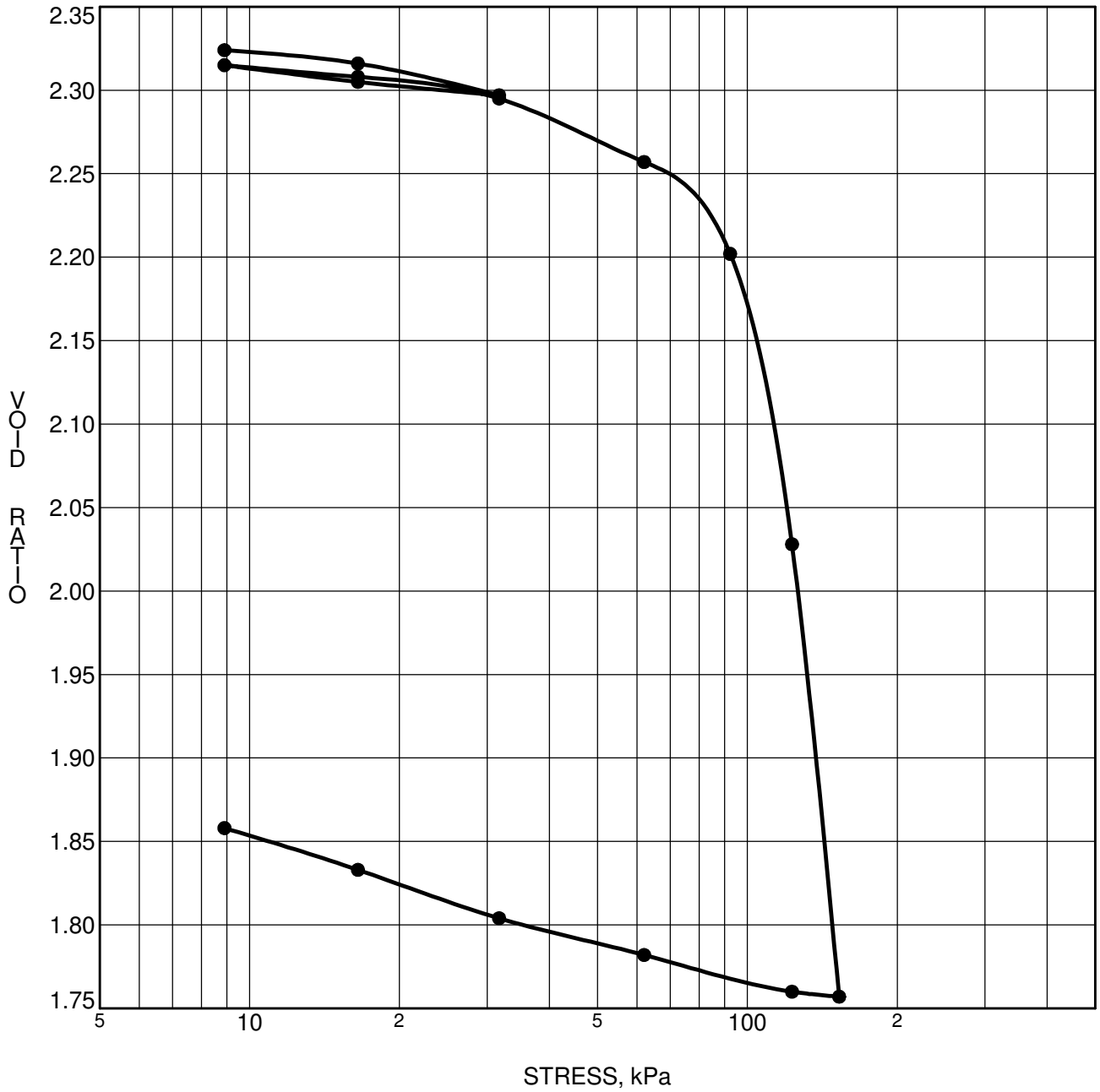
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 1-19**	p'o	**67** kPa	Ccr	**0.025**
Sample No.	**TW 7**	p'c	**114** kPa	Cc	**3.832**
Sample Depth	**5.00** m	OC Ratio	**1.7**	Wo	**81.8** %
Sample Elev.	**94.27** m	Void Ratio	**2.234**	Unit Wt.	**15.1** kN/m ^{3}

CLIENT **Mattamy Homes** FILE NO. **PG5083**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 1830 Trim Road** DATE **October 3, 2019**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



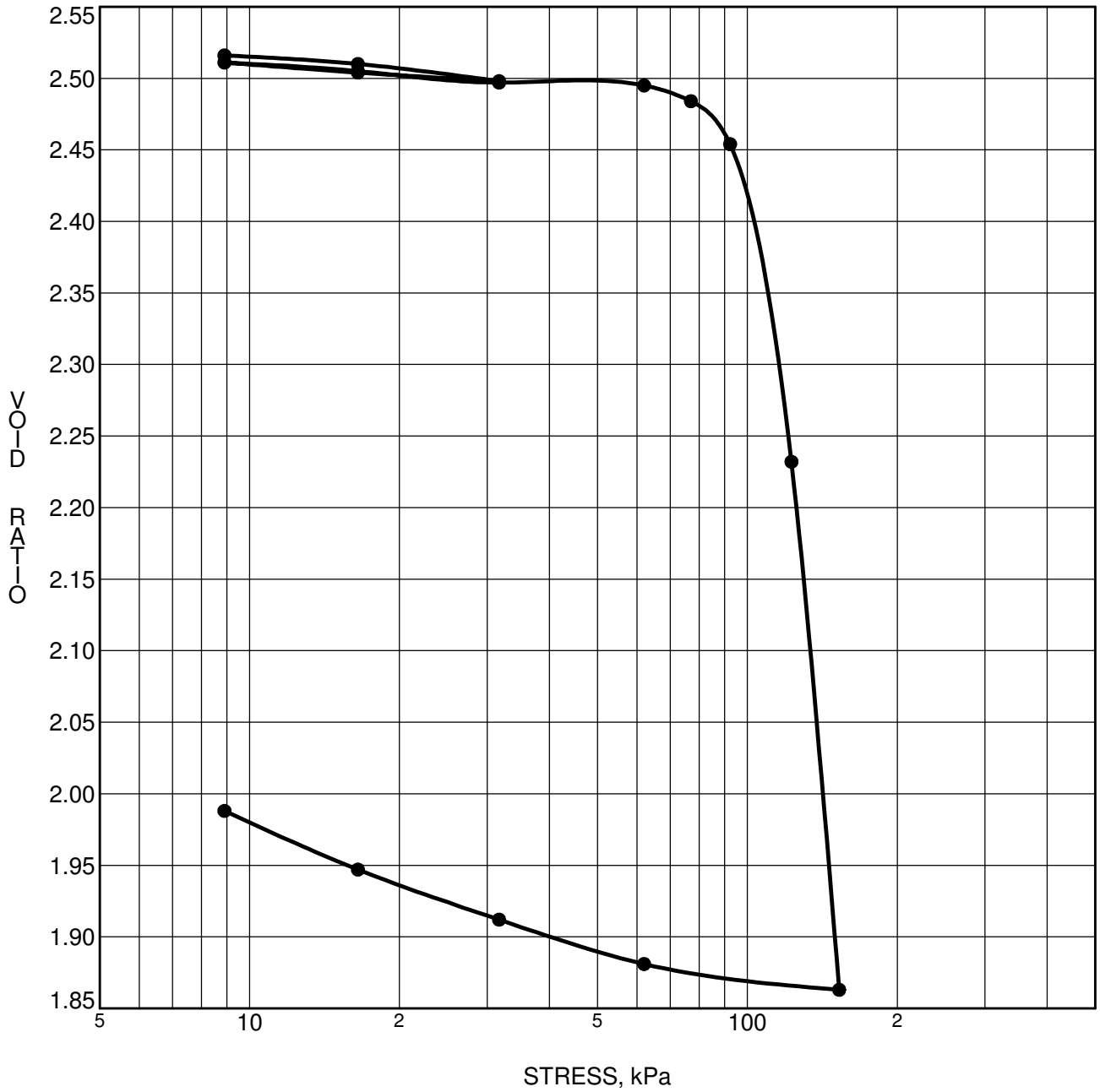
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 2-19**	p'_o	**75** kPa	Ccr	**0.035**
Sample No.	**TW 8**	p'_c	**102** kPa	Cc	**2.737**
Sample Depth	**6.20** m	OC Ratio	**1.4**	Wo	**84.6** %
Sample Elev.	**93.10** m	Void Ratio	**2.324**	Unit Wt.	**15.0** kN/m ^{3}

CLIENT **Mattamy Homes** FILE NO. **PG5083**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 1830 Trim Road** DATE **October 4, 2019**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



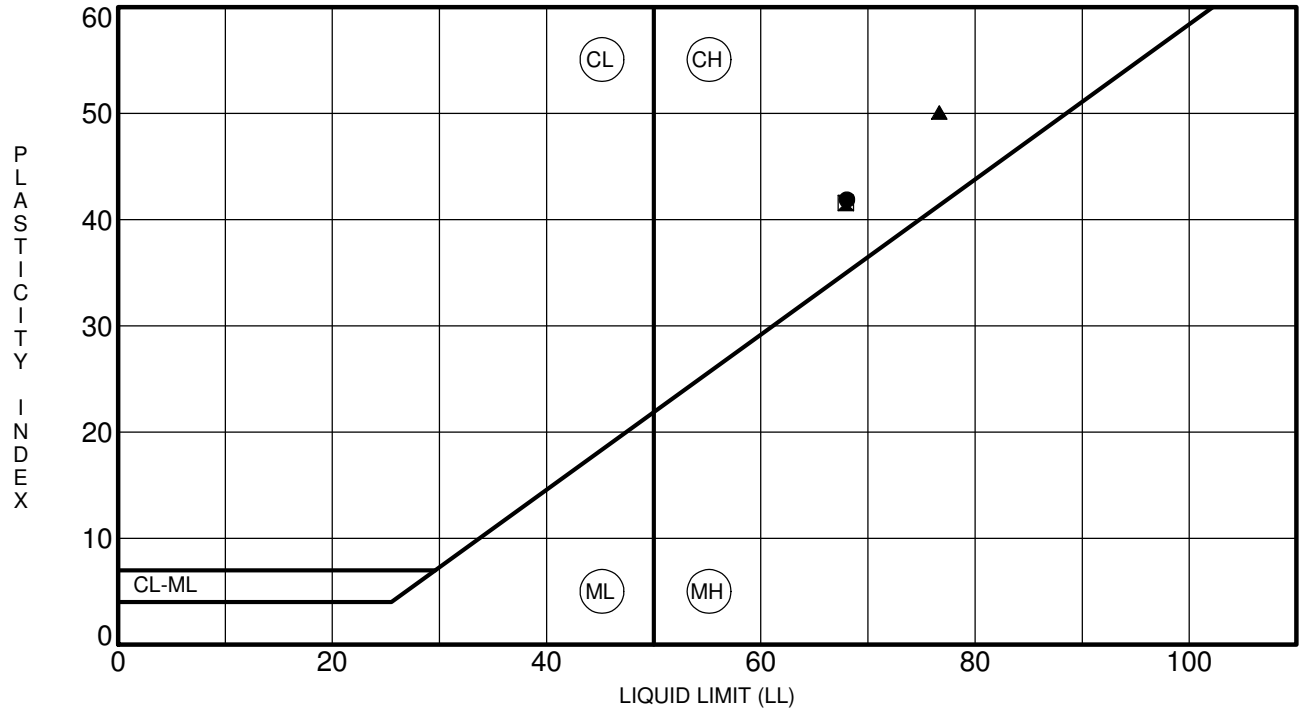
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 3-19**	p'o	**71** kPa	Ccr	**0.026**
Sample No.	**TW 7**	p'c	**110** kPa	Cc	**3.804**
Sample Depth	**5.66** m	OC Ratio	**1.5**	Wo	**91.6** %
Sample Elev.	**93.67** m	Void Ratio	**2.516**	Unit Wt.	**14.7** kN/m ^{3}

CLIENT **Mattamy Homes** FILE NO. **PG5083**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 1830 Trim Road** DATE **October 2, 2019**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST

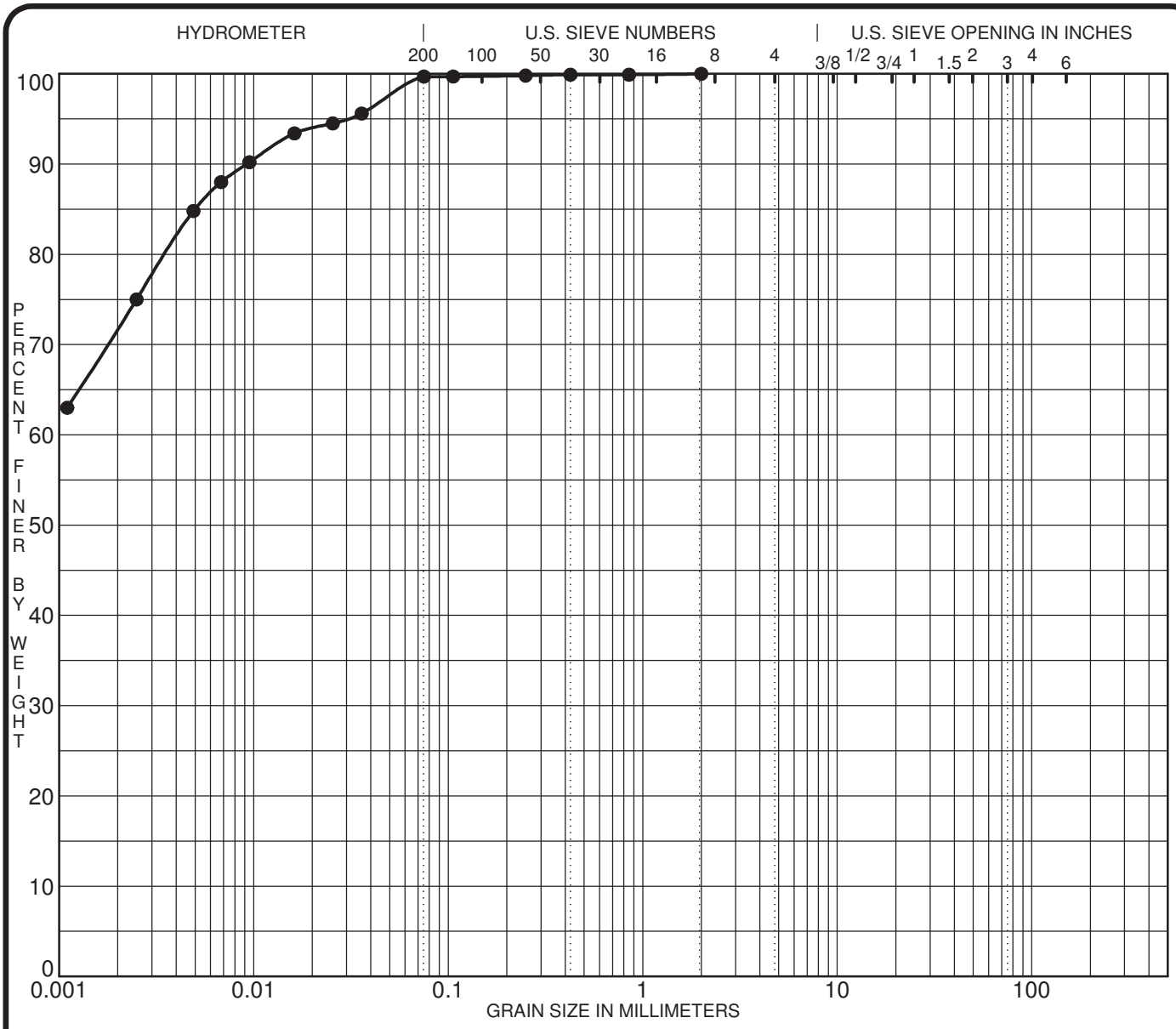


Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 1-19**	**SS 3**	**68**	**26**	**42**		**CH - Inorganic clays of high plasticity**
⧓	**BH 2-19**	**SS 4**	**68**	**26**	**42**		**CH - Inorganic clays of high plasticity**
▲	**BH 3-19**	**SS 3**	**77**	**27**	**50**		**CH - Inorganic clays of high plasticity**

CLIENT	**Mattamy Homes**	FILE NO.	**PG5083**
PROJECT	**Geotechnical Investigation - Prop. Residential Development - 1830 Trim Road**	DATE	**30 Sep 19**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **BH 2-19 SS 3**	**CH - Inorganic clays of high plasticity**						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **BH 2-19 SS 3**	**2.00**				**0.0**	**0.3**	**28.7**	**71.0**

CLIENT **Mattamy Homes** FILE NO. **PG5083**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 1830 Trim Road** DATE **30 Sep 19**

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 28303

Report Date: 07-Oct-2019

Order Date: 1-Oct-2019

Project Description: PG5083

	Client ID:	BH1 SS3 5'-7'	-	-	-
	Sample Date:	30-Sep-19 14:00	-	-	-
	Sample ID:	1940191-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	80.9	-	-	-
General Inorganics					
pH	0.05 pH Units	7.79	-	-	-
Resistivity	0.10 Ohm.m	12.1	-	-	-
Anions					
Chloride	5 ug/g dry	225	-	-	-
Sulphate	5 ug/g dry	386	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG5083-1 - TEST HOLE LOCATION PLAN

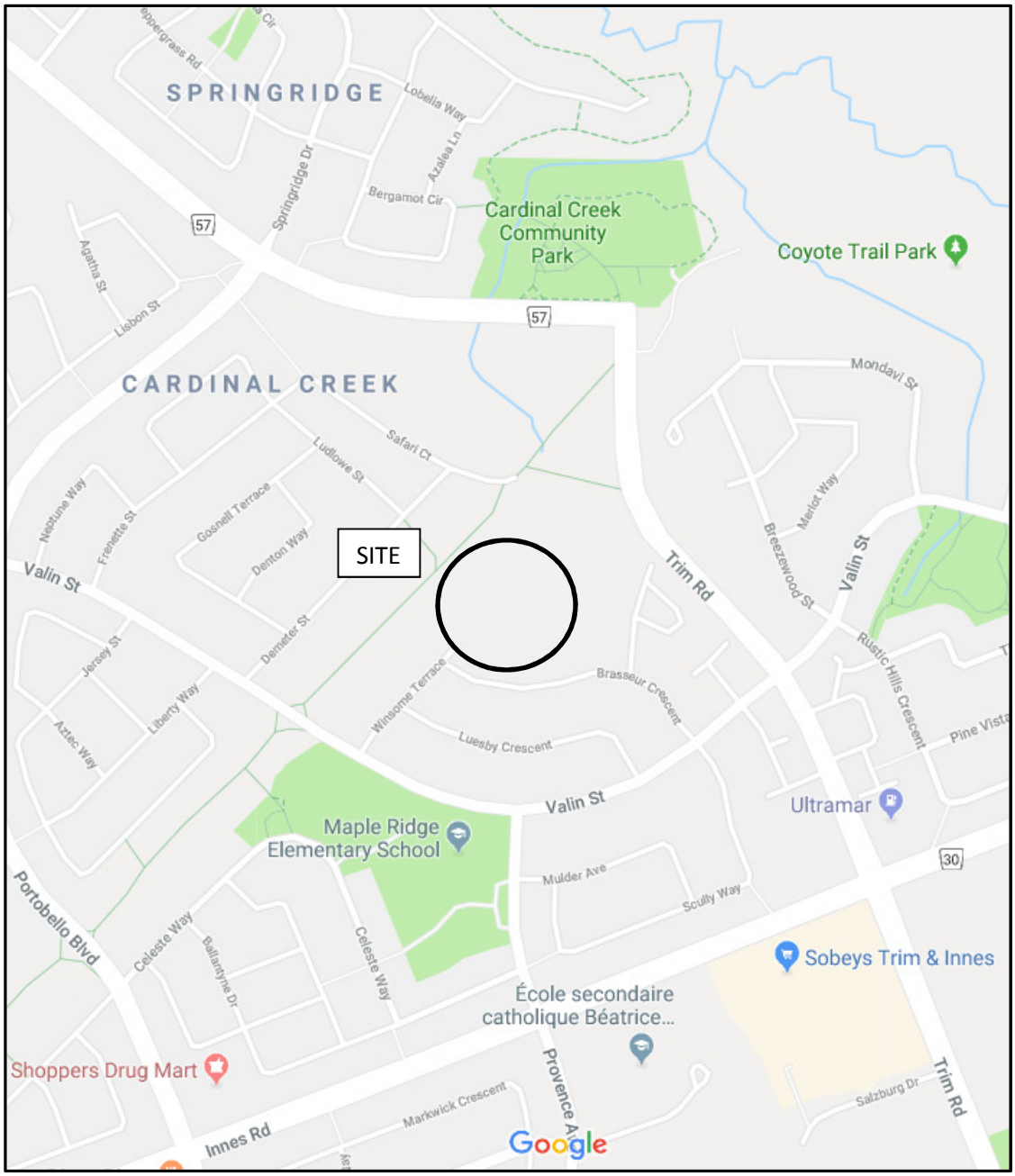
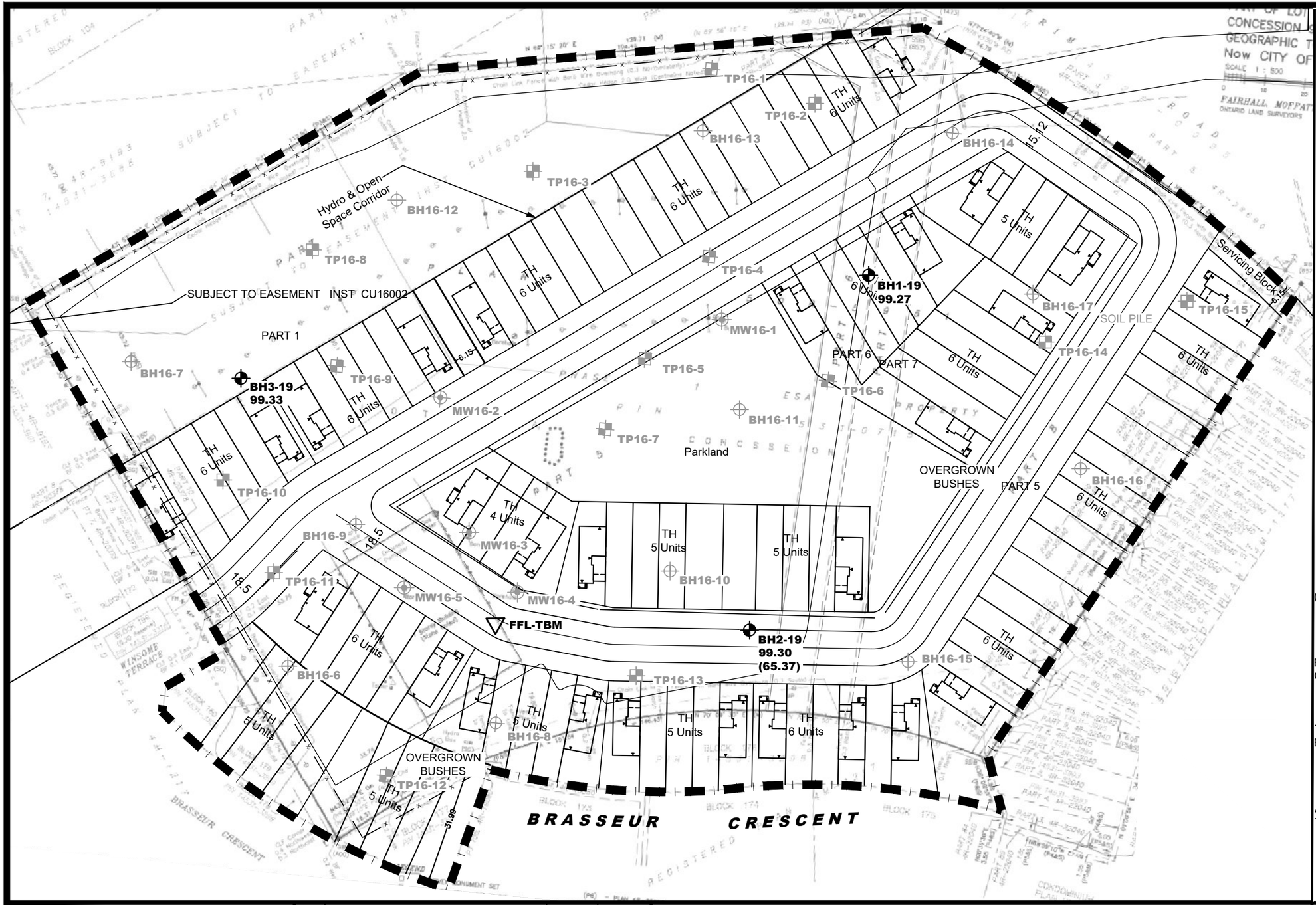


FIGURE 1

KEY PLAN



LEGEND:

- BOREHOLE LOCATION (PATERSON GROUP, CURRENT STUDY)
- TEST PIT LOCATION (BY OTHERS, MAY 2016)
- BOREHOLE LOCATION (BY OTHERS, FEBRUARY 2016)
- MONITORING WELL LOCATION (BY OTHERS, FEBRUARY 2016)
- 99.30 GROUND SURFACE ELEVATION (m)
- (89.55) PRACTICAL REFUSAL TO DCPT ELEVATION (m)

BASE PLAN PROVIDED BY ARCADIS CANADA.
CONCEPTUAL PLAN PROVIDED BY MATTAMY HOMES

TBM- FINISHED FLOOR LEVEL OF THE EXISTING BUILDING.

AN ARBITRARY ELEVATION OF 100.00m WAS ASSIGNED TO THE TBM.

SCALE: 1:1000

0 10 20 30 40 50m 75m

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL
2	UPDATED TO LATEST CONCEPTUAL PLAN	12/03/2020	RG
1	UPDATED TO LATEST CONCEPTUAL PLAN	28/02/2020	RG

MATTAMY HOMES

GEOTECHNICAL INVESTIGATION
1830 TRIM ROAD-PROPOSED RESIDENTIAL DEVELOPMENT
OTTAWA, ONTARIO

Title:
TEST HOLE LOCATION PLAN

Scale: 1:1000	Date: 10/2019
Drawn by: YA	Report No.: PG5083-1
Checked by: RG	Dwg. No.: PG5083-1
Approved by: DJG	Revision No.: 2

11x17

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