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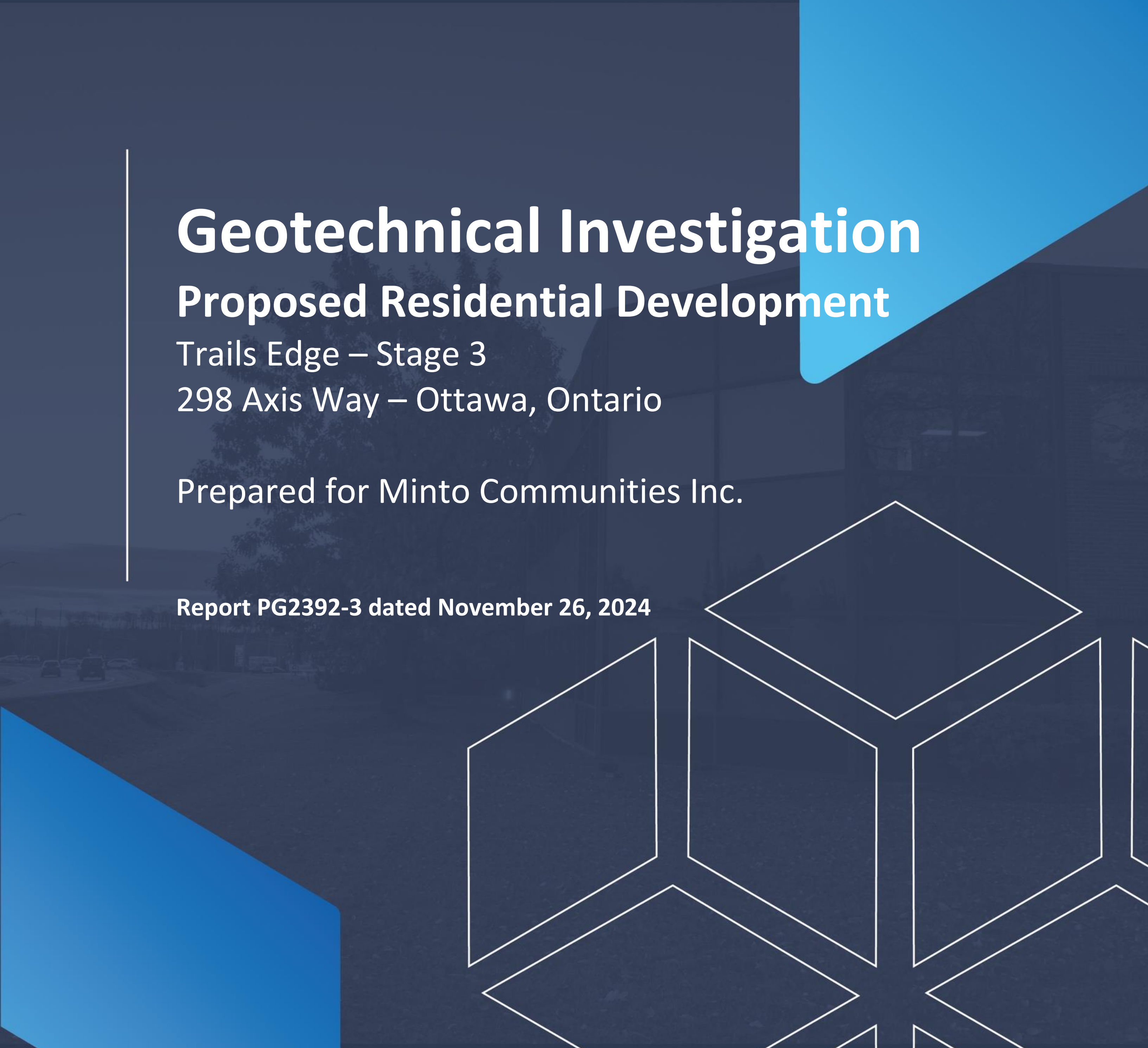

Geotechnical Investigation

Proposed Residential Development

Trails Edge – Stage 3
298 Axis Way – Ottawa, Ontario

Prepared for Minto Communities Inc.

Report PG2392-3 dated November 26, 2024

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Minto Communities Inc. to conduct a geotechnical investigation for Stage 3 of the proposed Trails Edge residential development to be located along Brian Coburn Boulevard between Fern Casey Street and Axis Way in the City of Ottawa, Ontario (reference should be made to Figure 1 - Key Plan presented in Appendix 2 of this report).

The objective of the geotechnical investigation was to:

- Determine the subsoil and groundwater conditions at this site by means of test holes.

- Provide geotechnical recommendations pertaining to the 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 the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the available conceptual drawings, it is expected that the proposed development will consist of residential townhouse style dwellings. It is anticipated the townhouses will consist of slab-on-grade and partial basement-style structures.

Associated driveways, local roadways, and landscaped areas are also anticipated to form part of the proposed development. It is further understood that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on May 7, 2020, and consisted of advancing a total of four (4) boreholes to a maximum depth of 6.4 m below existing ground surface. The test hole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground utilities and site features. Previous investigations were completed for the overall development, in which a combination of test pits and boreholes were advanced to a maximum depth of 9.6 m below existing grade. The test hole locations are shown on Drawing PG2392-4 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drilling rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedures consisted of auguring to the required depths at the selected location and sampling the overburden.

Sampling and In Situ Testing

Soil samples from current investigation were recovered using a 50 mm diameter split-spoon sampler or 73 mm diameter thin-walled Shelby tubes in combination with a piston sampler. Auger cuttings samples were recovered of surficial soils. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. The Shelby tubes were sealed at both ends. All samples were transported to our laboratory. The depths at which the auger, split-spoon and Shelby tube samples were recovered from the test holes are shown as AU, SS and TW, respectively, on the applicable Soil Profile and Test Data sheets in Appendix 1.

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

Undrained shear strength testing was carried out in cohesive soils at all test hole locations using a field vane apparatus.

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT) completed at borehole BH 4-20 from the current investigation and BH 10, BH 11, and BH 11-8 from the previous investigations. 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. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

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

Groundwater

Flexible polyethylene standpipes were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Groundwater level observations are discussed in Section 4.3 and presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum for the current investigation. However, the locations and the ground surface elevations at each test hole location were determined for the applicable 2012 test holes by Annis O’Sullivan Vollebekk Limited, and for the previous test holes by Stantec Geomatics. All test holes have been surveyed with respect to a geodetic datum and are provided with geodetic elevations.

The location of the test holes and ground surface elevation at each test hole location are presented on Drawing PG2392-4 – Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. From the current investigation, fifteen (15) split spoon samples were submitted for moisture content testing. Among these samples, a total of one (1) shrinkage test, one (1) grain-size distribution analysis, and four (4) Atterberg limit tests were completed on selected soil samples.

It should be noted that a soil sample was submitted for a unidimensional consolidation testing within BH 11 from a previous investigation.

The results of the testing are discussed in Subsection 4.2 and presented in Appendix 1 of this report. The results of the unidimensional consolidation testing are presented on the Consolidation Test sheets in Appendix 1.

3.4 Analytical Testing

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

4.0 Observations

4.1 Surface Conditions

The subject site is located along the most northern section of the Trails Edge residential development and is currently vacant and grass covered across the majority of the site. The site is relatively flat with a slight downslope towards the west portion of the site. It should be noted that the site is approximately at grade with neighboring properties and adjacent roadways.

The site is bordered to the south by existing residential blocks followed by Axis Way, to the east and west by vacant lands followed by Fern Casey Street and Compass Street, respectively and to the north by Brian Coburn Boulevard.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test hole locations consisted of topsoil and/or fill material, underlain by a silty clay deposit.

The fill was generally observed to consist of brown silty clay with trace sand, gravel and/or organics and extended to an approximate depth of 0.6 m below the ground surface at test hole BH 3-20 and BH 4-20.

The topsoil and/or fill was observed to be underlain by a native silty clay deposit. The hard to stiff, brown silty clay layer was observed to extend to approximate depths ranging between 2.9 to 3.3 m below existing ground surface. The brown silty clay layer was observed to be underlain by a layer of firm grey silty clay.

DCPT testing was conducted in BH 4-20 from the current investigation and BH 10, BH 11, and BH 11-8 from the previous investigations. Practical refusal to DCPT was encountered at a depth ranging from 21.3 and 26.2 m below ground surface.

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.

Atterberg Limit and Shrinkage Tests

Atterberg limits testing, as well as associated moisture content testing, was completed on recovered silty clay samples at selected locations throughout the subject site. The results of the Atterberg limits are presented in Table 1 and on the Atterberg Limits Results sheet in Appendix 1.

Table 1 – Summary of Atterberg Limits Tests

Sample	Depth (m)	LL (%)	PL (%)	PI (%)	Classification
BH 1-20 SS3	1.8	64	28	36	CH
BH 2-20 SS3	1.8	65	29	36	CH
BH 3-20 SS3	1.8	71	32	39	CH
BH 4-20 SS3	1.8	72	31	41	CH

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; CL: Inorganic Clay of Low Plasticity; CH: Inorganic Clay of High Plasticity

The results of the moisture content tests are presented on the Soil Profile and Test Data Sheet in Appendix 1.

The results of the shrinkage limit test of the tested silty clay sample (BH 4-20) indicate a shrinkage limit of 24 and a shrinkage ratio of 1.65, respectively.

Grain Size Distribution and Hydrometer Testing

Grain size distribution (sieve and hydrometer analysis) was also completed on one (1) selected soil sample. The results of the grain size analysis are summarized in Table 2 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 2 – Summary of Grain Size Distribution Analysis

Sample	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 3-20 SS4	3.3	0.0	0.2	28.5	71.3

Consolidation Testing

During the previous investigations, two (2) consolidation tests were completed within the boundaries of the subject site. The results of the consolidation tests from the previous investigation are presented in Table 3.

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 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	Elevation (m)	p'_c (kPa)	p'_o (kPa)	C_{cr}	C_c	Q
BH 9	TW 3	82.63	106	53	0.021	4.008	A
BH 11	TW 4	82.85	85	53	0.027	2.735	P

* - 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 given the natural variations o the in-situ soils and limited sample size.

Reference should be made to Consolidation Test data sheets provided in Appendix 1 of this report.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of interbedded limestone and shale of the Lindsay Formation, with an overburden drift thickness of 25 to 50 m depth.

4.3 Groundwater

Groundwater levels were measured at the installed standpipes at each borehole location of the current investigation on May 29, 2020. The measured groundwater level at each location is presented in Table 4.

It should be noted that surface water can become trapped within a backfilled borehole column, which can lead to higher-than-normal groundwater level readings.

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

Table 4 – Summary of Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Measured Groundwater Level		Dated Recorded
		Depth (m)	Elevation (m)	
Groundwater Levels Based on Current Investigation (Report PG2392-3)				
BH 1-20	87.02	0.85	86.17	May 29, 2020
BH 2-20	86.94	5.69	81.25	May 29, 2020
BH 3-20	87.08	3.67	83.41	May 29, 2020
BH 4-20	87.57	4.28	83.29	May 29, 2020
Groundwater Levels Based on Previous Investigation (Report PG2392-1)				
BH 10	86.97	2.30	84.67	August 17, 2011
BH 11	87.17	2.30	84.87	February 9, 2012
Groundwater Levels Based on Previous Investigation (Report PG0861)				
BH 11-08	87.14	0.61	86.53	August 28, 2008
TP 11-08	87.14	1.00	86.14	August 28, 2008

Note: The ground surface elevation at each borehole location was referenced to a geodetic datum

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. The proposed buildings may be founded on conventional shallow foundations placed on an undisturbed, very stiff to stiff silty clay or Paterson-reviewed and -approved engineered fill bearing surface.

Due to the presence of the silty clay deposit, the subject site is subject to grade raise restrictions. The permissible grade raise recommendations are discussed in Subsection 5.3.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing significant amounts of organic materials, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities. Disturbance of the subgrade may result in having to sub-excavate the disturbed material and the placement of additional suitable fill material.

Fill Placement

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

Site-excavated soil could be placed as general landscaping fill and to build up areas that are to be paved. Workable site-excavated material, free of organics and deleterious materials should be spread in maximum 300 mm thick loose lifts and compacted by several passes of a suitably sized sheepsfoot vibratory roller and reviewed by Paterson personnel at the time of construction.

Frozen material may not be considered for this purpose. This process should be reviewed and approved by Paterson field personnel upon completion of each lift and who are experienced in reviewing the placement of soil fill in this manner.

Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite drainage membrane, such as CCW MiraDRAIN 2000 or Delta-Teraxx.

5.3 Foundation Design

Bearing Resistance Values

Footings placed on an undisturbed, soil bearing surface can be designed using the following bearing resistance values provided in Table 5 in the following page.

Table 5 - Bearing Resistance Values

Bearing Surface	**Bearing Resistance Values (kPa)**	
	SLS	**ULS**
Stiff Brown Silty Clay	150	225
Firm Grey Silty Clay	75	110

Note: Strip and pad footings, up to 3 and 6 m wide, respectively, can be designed using the bearing resistance values provided for an undisturbed, silty clay bearing surface.

Bearing resistance values for footing design should be confirmed on a per lot basis by the Paterson personnel at the time of construction.

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 footings. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance values at ULS.

The bearing resistance value at SLS, provided 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. Above the groundwater level, adequate lateral support is provided to the in-situ bearing medium soils 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.

Permissible Grade Raise Recommendations

Based on the undrained shear strength testing results, consolidation testing and experience with the local silty clay deposit, a permissible grade raise restriction of **1.5 m** is recommended for grading in close proximity to housing within the subject site. A permissible grade raise restriction of 1.8 m is recommended for roadways.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements. Provided sufficient time is available to induce the required settlements, consideration could be given to surcharging the study area. Alternatively, consideration could also be given to undertaking a test fill pile program to further assess the currently recommended permissible grade raise recommendations in conjunction with a supplemental investigation.

A post-development groundwater lowering of 0.5 m within the underlying clay deposit was assumed for our calculations where the groundwater table was interpreted to be located with the silty clay deposit.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class E** for the shallow foundations at the subject site. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-On-Grade and Basement Slab Construction

With the removal of all topsoil and deleterious materials within the footprint of the proposed building, a soil subgrade approved by Paterson personnel at the time of construction, is considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab (outside the zone of influence of the footings).

For structures with basement slabs, it is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone. For any structures with slab-on-grade construction, the upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone compacted to a minimum of 98% of the materials SPMDD.

All grade raise fill used to raise the subgrade to the underside of the slab-on-grade should be placed in maximum 300 mm thick loose lifts. Soil fill reviewed and approved by Paterson during the construction phase would be advised to be compacted using a suitably sized vibratory sheepsfoot roller. Reference should be made to Section 5.2 of this report for additional information pertaining to slab-on-grade construction.

5.6 Pavement Design

For design purposes, the pavement structures presented in Tables 6 and 7 below are recommended for the design of driveways, driveways, local residential roadways, and access lanes. It should be understood the pavement structures provided in Table 6 and Table 7 are not intended for construction truck traffic without requiring additional measures to prepare the base and subbase layers for the placement of asphalt. This is discussed further in this subsection of the report.

Table 6 - Recommended Pavement Structure - Car Only Parking Areas and 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 soil or OPSS Granular B Type I or II material placed over in situ soil.	

Table 7 - Recommended Pavement Structure - Local Residential Roadways and Access Lanes

Thickness (mm)	Material Description
40	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil 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. For residential driveways and car only parking areas, an Ontario Traffic Category A will be used. For local roadways, an Ontario Traffic Category B should be used for design purposes.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program and is discussed further in the following portion of this report.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable compaction equipment, noting that excessive compaction can result in subgrade softening.

Temporary Access Roads and Construction Traffic

Provisions should be carried for remediating site conditions during the time of construction that would impact the construction of the above-noted design pavement structure (i.e., heavy truck traffic rutting and compromising subgrade soils, placement of subbase layers shortly following periods of spring thaw, snowmelt and rainfall events, over service trenches for utilities and poorly compacted backfill, etc.). These recommendations would be site- and situation specific and only able to be confirmed at the time of construction. It should be noted that the above-noted pavement structures are not intended to support construction traffic without carrying provisions for scarifying contaminated stone (i.e., stone mixed with non-crushed stone soils).

For planning purposes, temporary construction access paths and working pads may be considered as 500 mm of a combination of OPSS Granular B Type I or Type II crushed stone and blast-rock covered with a minimum 50 to 100 mm thick layer of OPSS Granular B Type II or OPSS Granular A crushed stone (to provide suitable surface for tires) over a subgrade surface reviewed and approved by Paterson field personnel.

This structure could be re-used to meet the requirements of the pavement structures provided in Table 6 and Table 7 (i.e., scarify material with high-fines content and replace with clean stone fill provided the remaining granulars are reviewed and approved to be left in place by Paterson personnel). Temporary access roads that would be later used for permanent conditions should be underlain by a layer of woven geotextile layers to limit pumping of fines into the base and subbase layers during the construction period.

Provisions should be carried to suitably compact trench backfill placed over services. Since it is anticipated this material would consist of workable brown silty clay (and not wet, non-workable grey silty clay) would be recommended to place this material in maximum 400 mm thick loose lifts compacted using a suitably sized vibratory sheepsfoot roller making several passes under the supervision of Paterson field personnel. Where trench backfill is placed in a less suitable manner, provisions should be carried to proof-roll (re-compact) the surface using the above-noted compaction equipment and providing a layer of bi-axial geogrid to increase the stiffness of the subgrade soils.

These efforts would be reviewed, approved and advised upon by Paterson field staff during the construction program.

Pavement Structure Drainage

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

Where silty clay is anticipated at the pavement subgrade level, consideration should be given to installing subdrains during the pavement construction. The subdrain inverts should be approximately 300 mm below subgrade level, and the subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Basement and Partial Basement Structures

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed structures provided with a basement level. 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 clear stone should be wrapped in a non-woven geotextile. The pipe should have a positive outlet, such as a gravity connection to the storm sewer or sump pump pit. The foundation walls are recommended to be covered with a drainage geocomposite, such as CCW MiraDRAIN 2000 or Delta-Teraxx, connected to the perimeter foundation drainage system.

Foundation Backfill

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 granular material) or site-generated workable soils placed in maximum 400 mm thick loose lifts and compacted using suitably sized compaction equipment. If consideration is given to backfilling the structures with crushed stone, Paterson should be advised of this during the tendering stage to review and advise on impacts to grade raise restrictions.

Slab-on-Grade Structures

Foundation Drainage

The perimeter foundation drainage system identified for basement structures is considered optional for slab-on-grade structures. Consideration should be given to implementing it below areas supporting hardscaping/settlement sensitive structures (i.e., driveways and pathways) to maintain the service life of these structures.

In areas where hard-scaping or pavement structures will abut the building footprint, the system should consist of a 100 to 150 mm diameter perforated corrugated plastic pipe wrapped in a geosock and surrounded by 150 mm of 10 mm clear crushed stone. The clear stone should be wrapped in a non-woven geotextile. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

The perimeter drainage pipe may be placed against the structure and with the invert placed a minimum of 600 mm below proposed finished grade (i.e., within the subgrade fill and below the crushed stone fill for the hardscaping) and against the building footprint upon Paterson-reviewed and-approved compacted soil backfill to ensure adequate drainage of the overlying granular fill layer is provided from precipitation events and/or spring meltwater.

In this configuration, provided the backfill overlying the pipe consists of crushed stone fill associated with the hardscaping, a composite foundation drainage board will not be required. The installation of the perimeter drainage system should be reviewed by Paterson personnel at the time of construction.

Foundation Backfill

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 granular material) or site-generated workable soils placed in maximum 400 mm thick loose lifts and compacted using suitably sized compaction equipment. If consideration is given to backfilling the structures with crushed stone, Paterson should be advised of this during the tendering stage to review and advise on impacts to grade raise restrictions.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or a combination of soil cover in conjunction with foundation insulation, should be provided in this regard.

Other exterior unheated footings, such as those for isolated exterior piers and retaining walls, are more prone to deleterious movement associated with frost action. These should be provided with a minimum 2.1 m thick soil cover (or insulation equivalent).

6.3 Excavation Side Slopes

Temporary Side Slopes

The side slopes of excavations in the overburden materials should be either 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 excavation to be undertaken by open-cut methods (i.e., unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back to 1H:1V or flatter. The flatter slope is required for excavations below groundwater level. The brown and grey clay subsoils at this site are considered to be mainly a Type 2 and Type 3 soil, respectively, according to the Occupational Health and Safety Act and Regulations for Construction Projects.

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

Excavation side slopes around the building excavation should be protected from erosion by surface water and rainfall events by the use of secured tarpaulins spanning the length of the side slopes, or other means of erosion protection along their footprint. Efforts should also be made to maintain dry surfaces at the bottom of the excavation footprints and along the bottom of side slopes. Additional measures may be recommended at the time of construction by Paterson.

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.

The pipe bedding for the sewer and water pipes placed on a relatively dry, undisturbed soil subgrade surface should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm.

The material should be placed in a maximum 225 mm thick loose lifts and compacted to a minimum of 99% of its SPMDD. The bedding material should extend at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 225 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

It should generally be possible to re-use the workable (not wet, grey silty clay) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet site-generated fill will be difficult to re-use, as the high-water contents make compacting impractical without an extensive drying period. Due to its high natural water content, the wet grey silty clay will be difficult, if not impractical, to compact without an extensive drying period and is not recommended for this purpose where site services are located below future roadways.

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 400 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 (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, sub bedding and cover material. The clay seals should consist of relatively dry and compactable silty clay placed in maximum 225 mm thick loose layers and compacted using suitably sized vibratory compaction equipment and inspected by Paterson field personnel at the time of placement. 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.

The location of the clay seals should be advised by Paterson during the servicing plan review and associated design stage.

6.5 Groundwater Control

Groundwater Control for Building Construction

Due to the relatively impervious nature of the silty clay and existing groundwater level, it is anticipated that groundwater infiltration into the excavations should be low to medium and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all subgrades, regardless of the source, to prevent disturbance to the founding medium.

Permit to Take Water

A temporary Ministry of 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 of 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, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR).

Long-term Groundwater Control

Provided recommendations such as clay seals and landscaping are followed during the design and construction stages, it is not anticipated the proposed development will negatively impact the groundwater table surrounding the area of the subject site and associated structures and infrastructure from a geotechnical perspective.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In 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/pile caps/grade beams are protected with sufficient soil cover to prevent freezing at founding level.

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

The trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. Also, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

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

6.8 Landscaping Considerations

Tree Planting Considerations

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. Grain size distribution and hydrometer testing were also completed on selected soil sample at BH 3-20.

The above noted soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Subsection 4.2 and in Appendix 1.

Based on the results of our review, the two tree planting setback areas are present within the proposed development. The two areas are detailed below and have been outlined in Drawing PG2392-6 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - Low to Medium Potential for Soil Volume Change

A low to medium plasticity clay (corresponding to a low to medium potential for soil volume change) soil was encountered between anticipated underside of footing elevations and 3.5 m below preliminary finished grade as per City Guidelines at the areas outlined in Drawing PG2392-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the modified plasticity limit does not exceed 40% in these areas. The following tree planting setbacks are recommended for this area.

Large trees (mature height over 14 m) can be planted within these areas 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 may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met.

Area 2 - High Potential for Soil Volume Change

A high plasticity clay soil (corresponding to low to medium potential for soil volume change) was encountered between anticipated underside of footing elevations and 3.5 m below anticipated finished grade as per City Guidelines at the areas outlined in Drawing PG2392-6 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the plasticity index limit generally exceeds 40% within BH 4-20. The following tree planting setbacks are recommended for these high sensitivity areas.

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 7.5m) 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 center 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 uncompacted 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 for the front side of the house and the front 2 m of the sidewalls of the house are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
- Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Swimming Pools, Hot Tubs and Decks

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

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.

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

7.0 Recommendations

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

- Review preliminary and detailed grading, servicing plan(s) from a geotechnical perspective.

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

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

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

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

8.0 Statement of Limitations

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

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

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

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

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
November 26, 2024
D. J. PETAHTEGOOSE
100568013
PROVINCE OF ONTARIO

Chris Elms, B. Eng.

Drew Petahtegoose, P. Eng.

Report Distribution:

☐ Minto Communities Inc. (Digital copy)
☐ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

UNIDIMENSIONAL CONSOLIDATION TEST RESULTS

GRAIN SIZE DISTRIBUTION AND HYDROMETER TESTING RESULTS

ATTERBERG LIMITS TESTING RESULTS

ANALYTICAL TESTING RESULTS

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Residential Development - Trail's Edge
Renaud Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

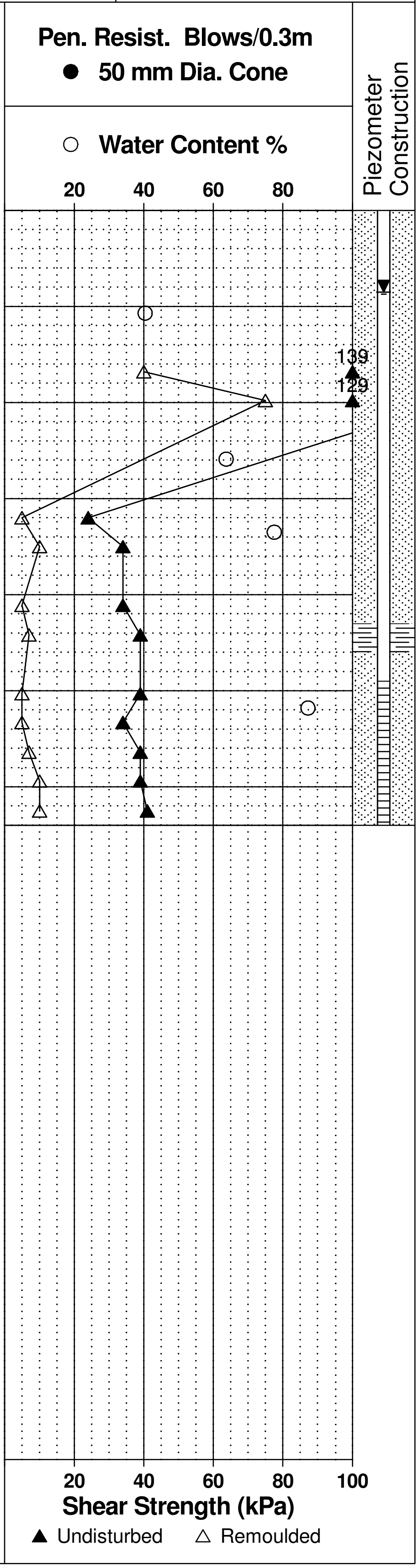
DATE May 7, 2020

FILE NO. PG2392

HOLE NO. BH 1-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
Brown **SILTY CLAY,** trace sand and organics 0.60		AU	1		
Very stiff to stiff, brown **SILTY CLAY**		SS	2	92	6
- firm and grey by 3.0m depth		SS	3	100	P
6.40					
End of Borehole					
(GWL @ 0.85m - May 29, 2020)					

DEPTH (m)	ELEV. (m)
0	87.02
1	86.02
2	85.02
3	84.02
4	83.02
5	82.02
6	81.02



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Residential Development - Trail's Edge
Renaud Road, Ottawa, Ontario

DATUM Geodetic

FILE NO. PG2392

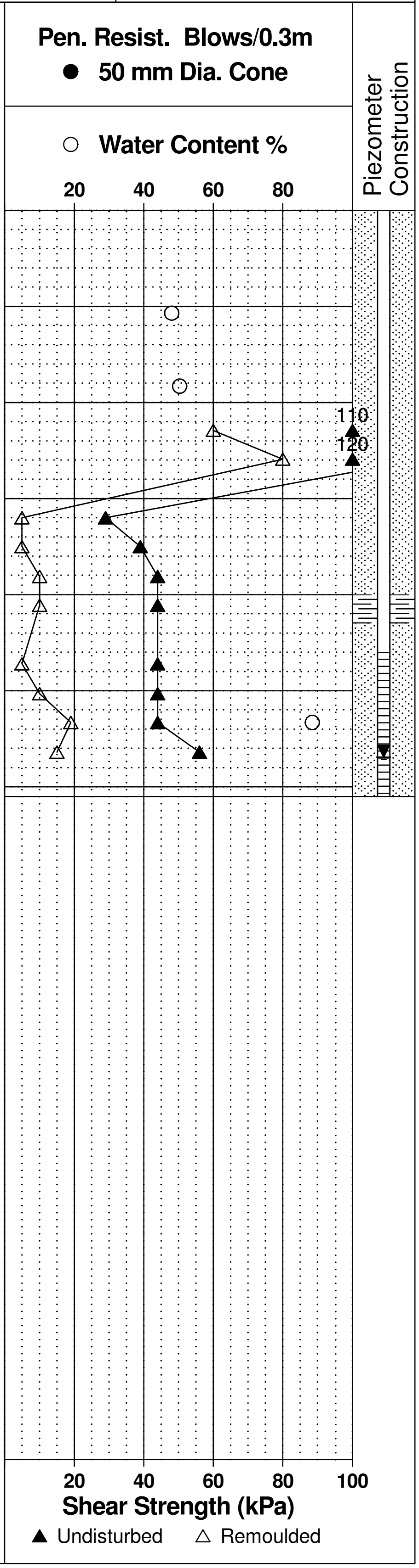
REMARKS

HOLE NO. BH 2-20

BORINGS BY Track-Mount Power Auger

DATE May 7, 2020

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	86.94
Brown **SILTY CLAY,** trace organics 0.60	AU	1				
	SS	2	100	6	1	85.94
Very stiff to stiff, brown **SILTY CLAY**	SS	3	100	5	2	84.94
- firm to stiff and grey by 3.0m depth					3	83.94
					4	82.94
					5	81.94
6.10					6	80.94
End of Borehole						
(GWL @ 5.69m - May 29, 2020)						



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Residential Development - Trail's Edge
Renaud Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 7, 2020

FILE NO. PG2392

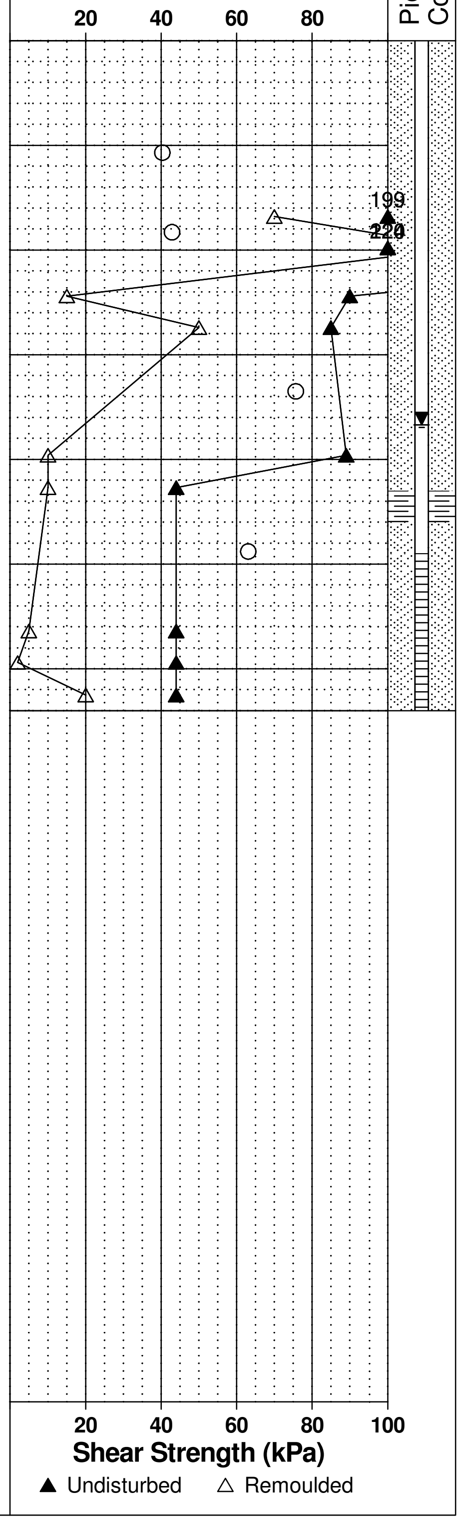
HOLE NO. BH 3-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.08
TOPSOIL 0.10							
FILL: Brown silty clay, trace sand and organics 0.60		AU	1				
		SS	2	100	8	1	86.08
		SS	3	100	P		
						2	85.08
Hard to stiff, brown **SILTY CLAY**							
- firm and grey by 3.0m depth						3	84.08
		SS	4	100	P		
						4	83.08
		SS	5	100	P		
						5	82.08
						6	81.08
6.40							
End of Borehole							
(GWL @ 3.67m - May 29, 2020)							

Pen. Resist. Blows/0.3m

● **50 mm Dia. Cone**

○ **Water Content %**



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Residential Development - Trail's Edge
Renaud Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

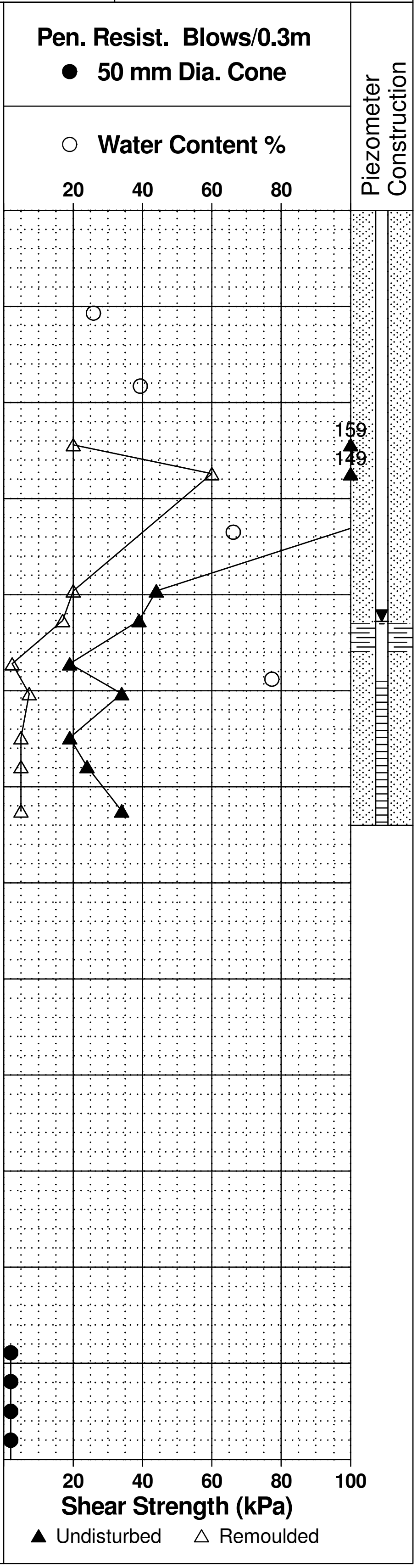
DATE May 7, 2020

FILE NO. PG2392

HOLE NO. BH 4-20

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty clay, trace organics, gravel and cobbles 0.60	AU	1		
Brown **SILTY CLAY,** trace sand and organics 1.52	SS	2	58	9
Very stiff to stiff, grey-brown **SILTY CLAY** - firm and grey by 3.0m depth	SS	3	100	7
	SS	4	100	2
6.40				
Dynamic Cone Penetration Test commenced at 6.40m depth. Cone pushed to 11.3m depth.				

DEPTH (m)	ELEV. (m)
0	87.57
1	86.57
2	85.57
3	84.57
4	83.57
5	82.57
6	81.57
7	80.57
8	79.57
9	78.57
10	77.57
11	76.57
12	75.57
13	74.57



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SOIL PROFILE AND TEST DATA

Supplemental Geotechnical Investigation
Proposed Residential Development - Trail's Edge
Renaud Road, Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE May 7, 2020

FILE NO. PG2392

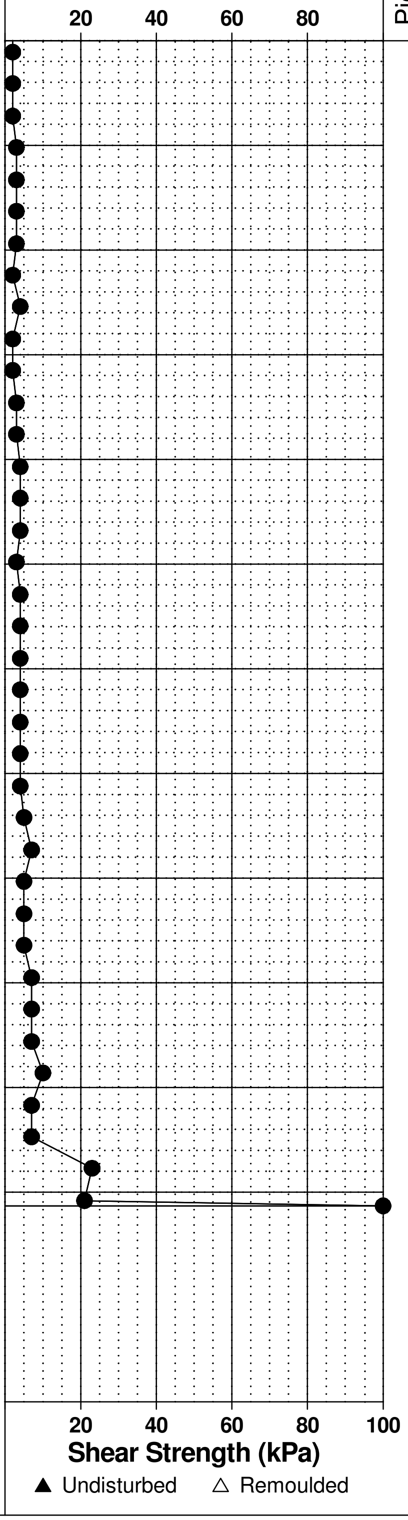
HOLE NO. BH 4-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						13	74.57
						14	73.57
						15	72.57
						16	71.57
						17	70.57
						18	69.57
						19	68.57
						20	67.57
						21	66.57
						22	65.57
						23	64.57
24.13						24	63.57
End of Borehole Practical DCPT refusal at 24.13m depth. (GWL @ 4.28m - May 29, 2020)							

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

○ Water Content %

Piezometer Construction



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

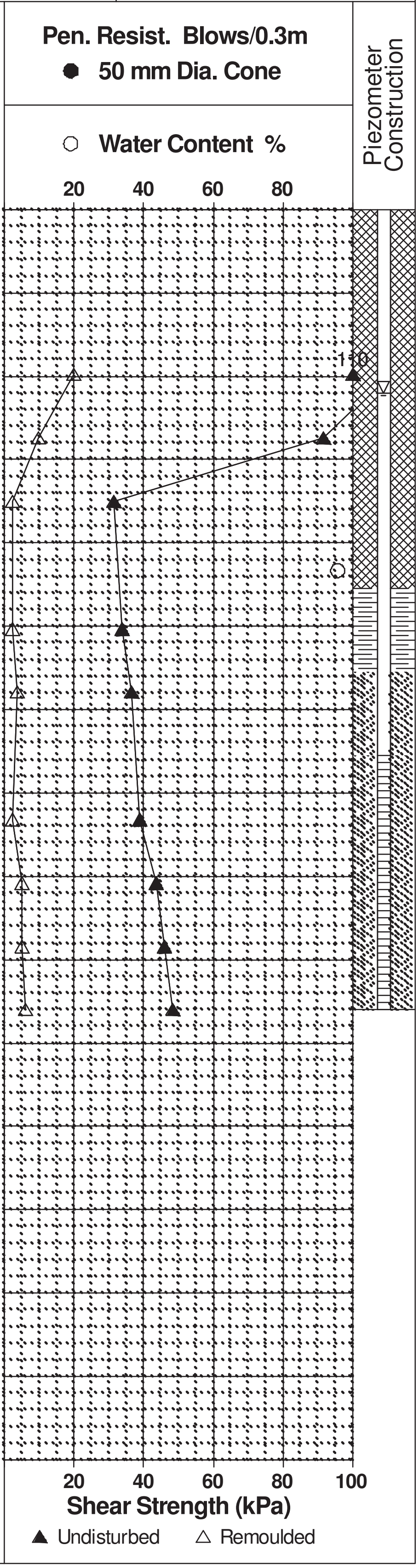
BORINGS BY CME 55 Power Auger

DATE 10 February 2012

FILE NO. PG2392

HOLE NO. BH 9

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	86.96
TOPSOIL 0.23	AU	1				
Very stiff to stiff, brown **SILTY CLAY**	SS	2	100	8	1	85.96
					2	84.96
2.90					3	83.96
Firm, grey **SILTY CLAY**	TW	3	100		4	82.96
					5	81.96
	TW	4	100		6	80.96
					7	79.96
					8	78.96
					9	77.96
9.60						
Dynamic Cone Penetration Test commenced at 9.60m depth. Cone pushed to 19.8m depth.					10	76.96
					11	75.96
					12	74.96
					13	73.96
					14	72.96
					15	71.96



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 10 February 2012

FILE NO. PG2392

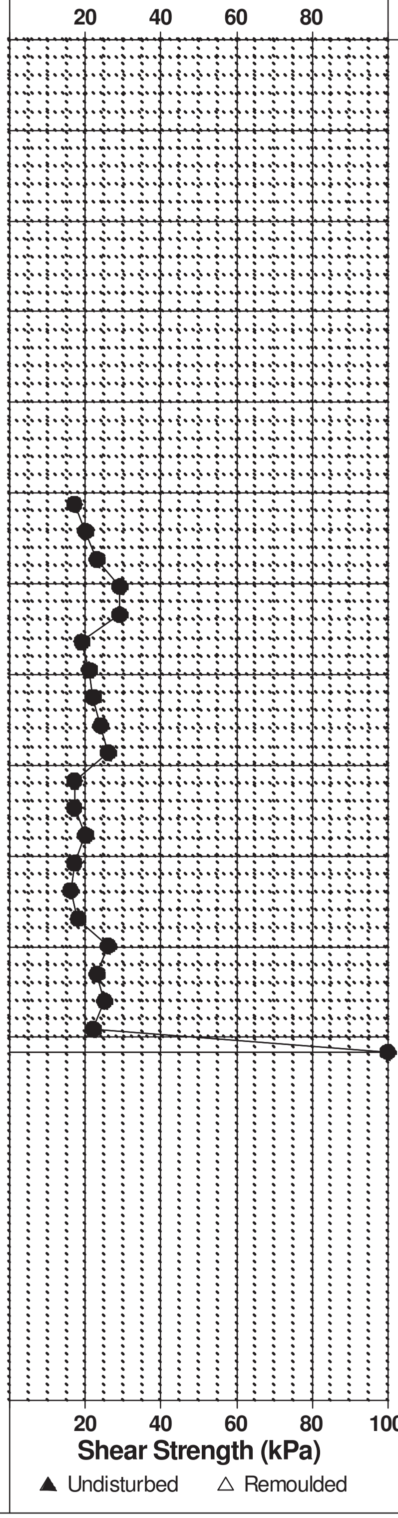
HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						15	71.96		
						16	70.96		
						17	69.96		
						18	68.96		
						19	67.96		
						20	66.96		
						21	65.96		
						22	64.96		
						23	63.96		
						24	62.96		
						25	61.96		
26.16						26	60.96		

End of Borehole

Practical DCPT refusal @ 26.16m depth.

(GWL @ 2.2m depth based on field observations)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 17 August 2011

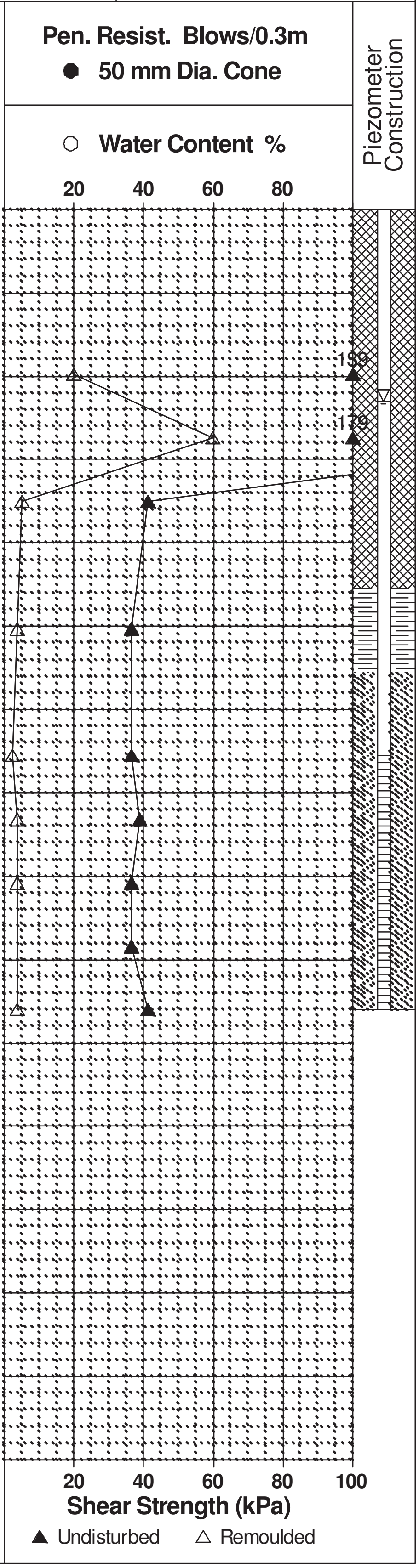
FILE NO. PG2392

HOLE NO. BH10

SOIL DESCRIPTION	
GROUND SURFACE	
TOPSOIL	0.20
Brown **SILTY CLAY** with sand, trace gravel	0.69
Very stiff to stiff, brown **SILTY CLAY**	3.30
Firm, grey **SILTY CLAY**	9.60
Dynamic Cone Penetration Test commenced @ 25.27m depth. Cone pushed to 22.7m depth.	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	92	7
TW	2		
TW	3		

DEPTH (m)	ELEV. (m)
0	86.97
1	85.97
2	84.97
3	83.97
4	82.97
5	81.97
6	80.97
7	79.97
8	78.97
9	77.97
10	76.97
11	75.97
12	74.97
13	73.97
14	72.97
15	71.97



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

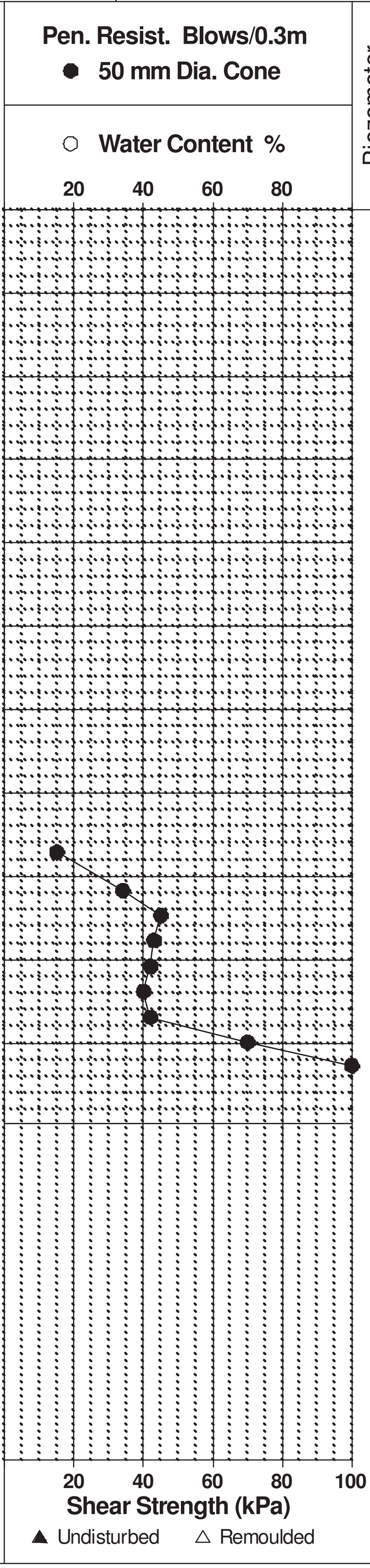
BORINGS BY CME 55 Power Auger

DATE 17 August 2011

FILE NO. PG2392

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
						15	71.97
						16	70.97
						17	69.97
						18	68.97
						19	67.97
						20	66.97
						21	65.97
						22	64.97
						23	63.97
						24	62.97
						25	61.97
25.27							
End of Borehole Practical cone refusal @ 25.27m depth (GWL @ 2.3m depth based on field observations)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

BORINGS BY CME 55 Power Auger

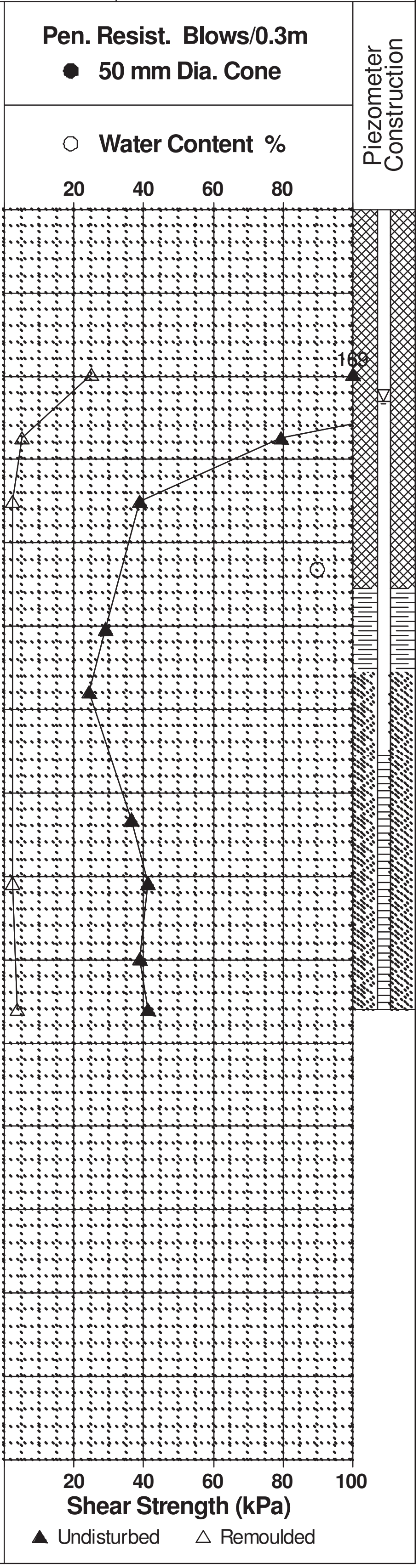
DATE 9 February 2012

FILE NO. PG2392

HOLE NO. BH11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
TOPSOIL 0.25		AU	1		
		AU	2		
Very stiff to stiff, brown **SILTY CLAY**		SS	3	83	12
2.90					
Firm, grey **SILTY CLAY**		TW	4	100	
		TW	5	100	
9.60					
Dynamic Cone Penetration Test commenced @ 9.60m depth. Cone pushed to 20.4m depth.					

DEPTH (m)	ELEV. (m)
0	87.17
1	86.17
2	85.17
3	84.17
4	83.17
5	82.17
6	81.17
7	80.17
8	79.17
9	78.17
10	77.17
11	76.17
12	75.17
13	74.17
14	73.17
15	72.17



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development-Trails Edge Phase 2
Ottawa, Ontario

DATUM Ground surface provided by Annis, O'Sullivan, Vollebekk Limited.

REMARKS

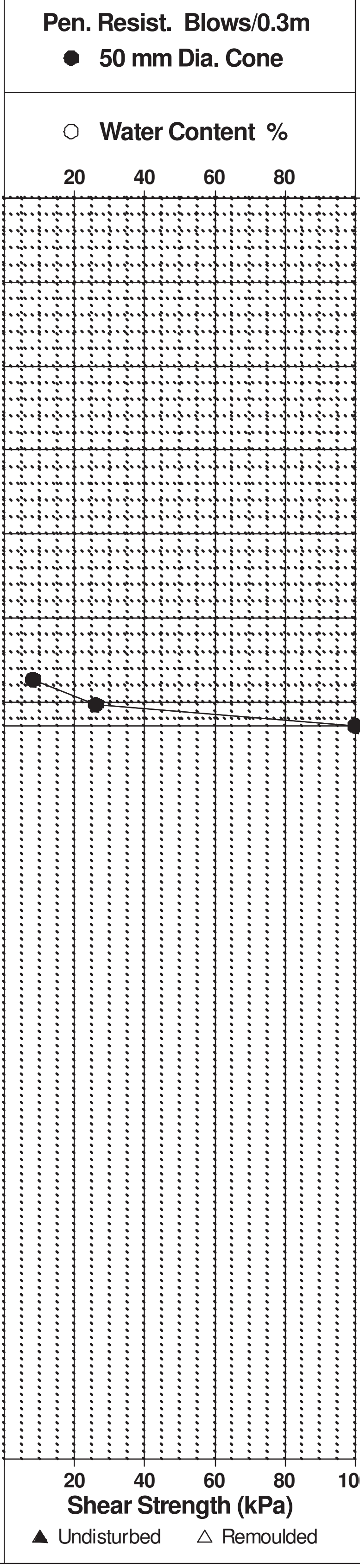
BORINGS BY CME 55 Power Auger

DATE 9 February 2012

FILE NO. PG2392

HOLE NO. BH11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						15	72.17
						16	71.17
						17	70.17
						18	69.17
						19	68.17
						20	67.17
21.28						21	66.17
End of Borehole Practical DCPT refusal @ 21.28m depth. (GWL @ 2.3m depth based on field observations)							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Renaud Road
Ottawa, Ontario

DATUM

REMARKS

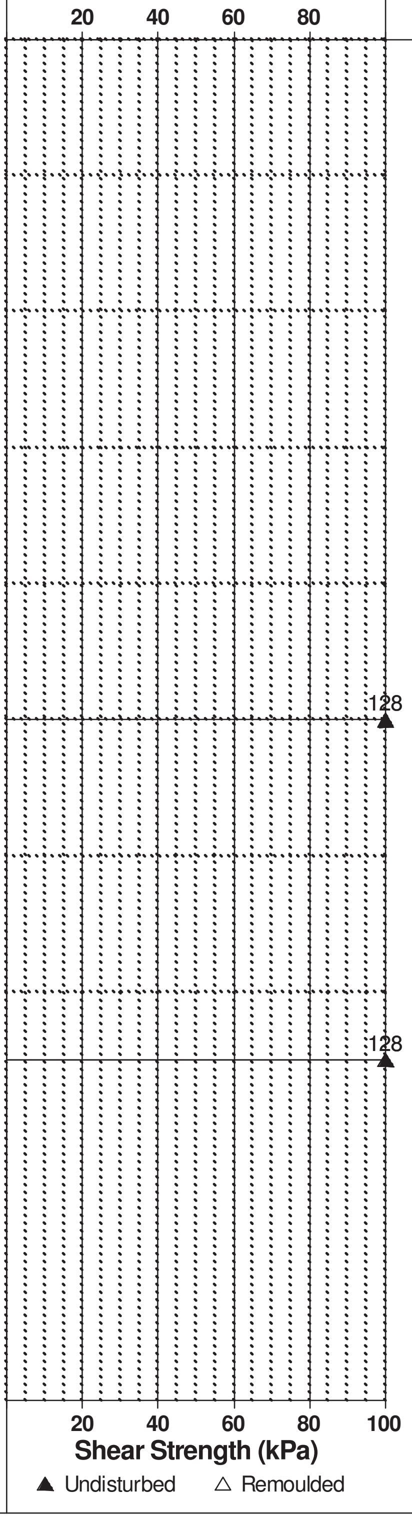
BORINGS BY Hand Auger

DATE 11 May 2009

FILE NO. PG1605

HOLE NO. HA 5-09

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			
TOPSOIL	■								
0.30									
Very stiff, brown **SILTY CLAY**	▨					1		128 ▲	
								128 ▲	
1.60									
End of Hand Auger Hole									



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Renaud Road
Ottawa, Ontario

DATUM

REMARKS

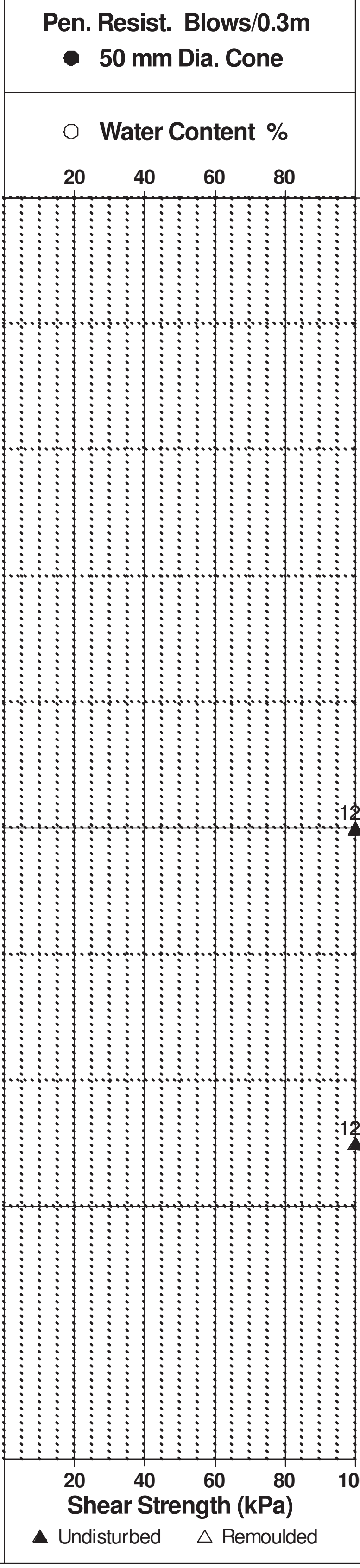
BORINGS BY Hand Auger

DATE 11 May 2009

FILE NO. PG1605

HOLE NO. HA 6-09

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0		
TOPSOIL 0.30								
Brown **SILTY CLAY** with sand 0.50								
Very stiff, brown **SILTY CLAY** 1.60						1		
End of Hand Auger Hole								



patersongroup Consulting Engineers

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

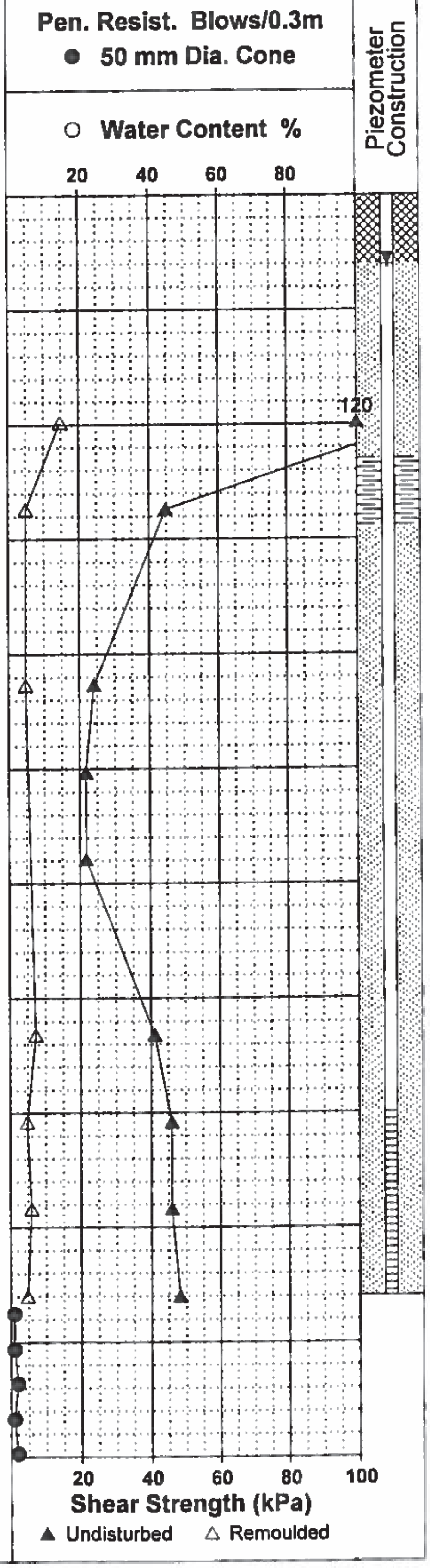
BORINGS BY CME 55 Power Auger

DATE 7 Aug 08

FILE NO. PG0861

HOLE NO. BH11-08

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	87.14
TOPSOIL 0.20						
	SS	1		9	1	86.14
Very stiff to stiff, brown **SILTY CLAY**					2	85.14
- firm and grey by 2.9m depth					3	84.14
	TW	2	88			
					4	83.14
					5	82.14
					6	81.14
	TW	3	100			
					7	80.14
					8	79.14
9.60					9	78.14
Dynamic Cone Penetration Test commenced @ 9.60m depth Inferred **SILTY CLAY**					10	77.14
					11	76.14



patersongroup Consulting Engineers

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

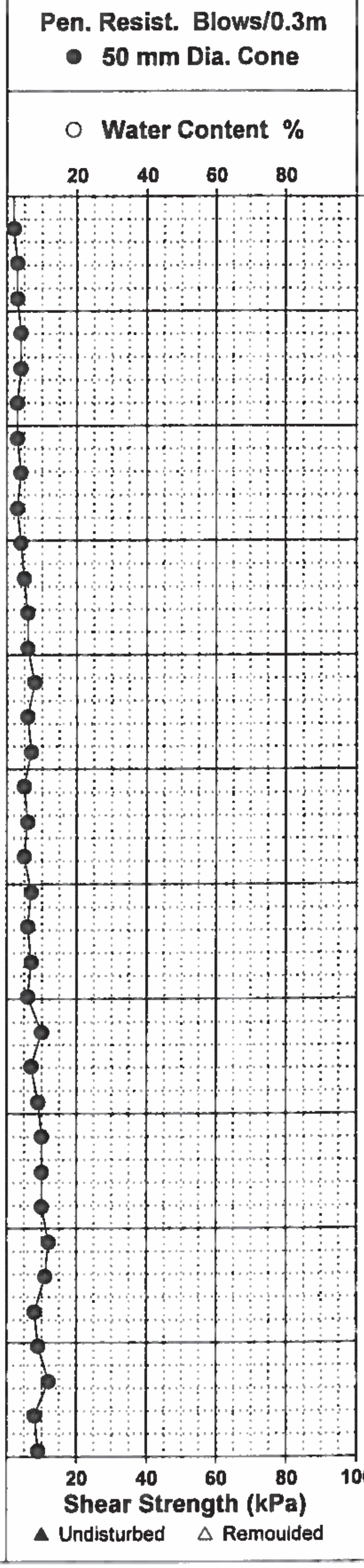
BORINGS BY CME 55 Power Auger

DATE 7 Aug 08

FILE NO. PG0861

HOLE NO. BH11-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
GROUND SURFACE		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
	▨					11	76.14
	▨					12	75.14
	▨					13	74.14
	▨					14	73.14
	▨					15	72.14
Inferred **SILTY CLAY**	▨					16	71.14
	▨					17	70.14
	▨					18	69.14
	▨					19	68.14
	▨					20	67.14
	▨					21	66.14
	▨					22	65.14



Piezometer Construction

patersongroup Consulting Engineers

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 7 Aug 08

FILE NO. PG0861

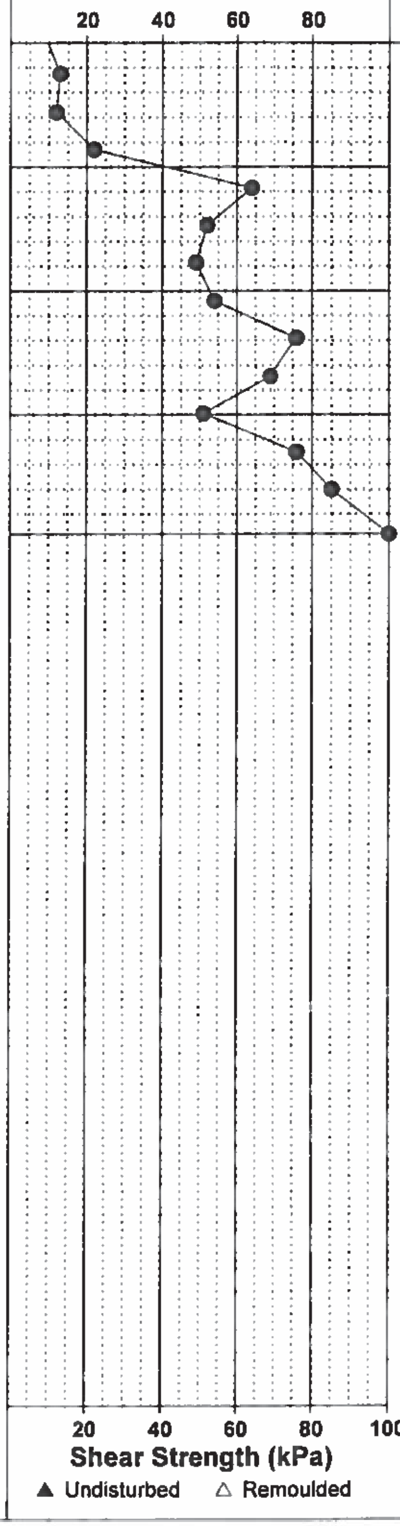
HOLE NO. BH11-08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						22	65.14
Inferred **SILTY CLAY** 22.90	▨						
Inferred **GLACIAL TILL** 25.96						23 24 25	64.14 63.14 62.14
End of Borehole Practical DCPT refusal @ 25.96m depth (GWL @ 0.61m-Aug. 28/08)							

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

○ Water Content %

Piezometer Construction



patersongroup Consulting Engineers

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Renaud Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0861

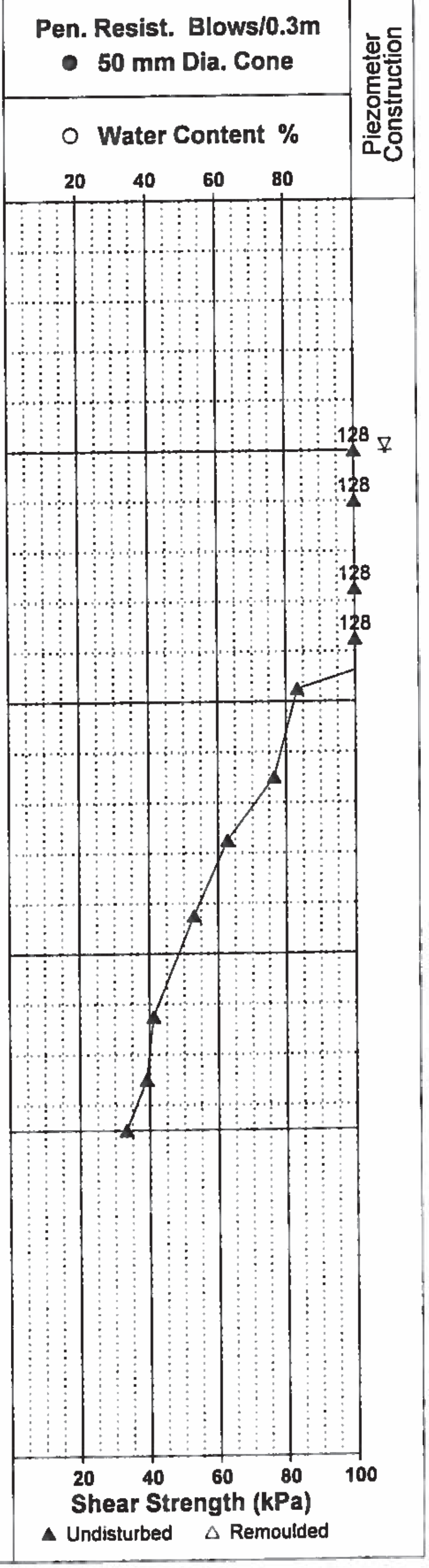
REMARKS

HOLE NO. TP11-08

BORINGS BY Hydraulic Shovel

DATE 28 Aug 08

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.14
TOPSOIL 0.20							
						1	86.14
Very stiff to stiff, brown **SILTY CLAY**							
						2	85.14
- stiff to firm and grey by 2.9m depth						3	84.14
3.70							
End of Test Pit							
(GWL @ 1.0m-Aug. 28/08)							



SYMBOLS AND TERMS

SOIL DESCRIPTION

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

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

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

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

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

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

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

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

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

ROCK DESCRIPTION

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

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

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

SAMPLE TYPES

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

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = $D60 / D10$

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

CONSOLIDATION TEST

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

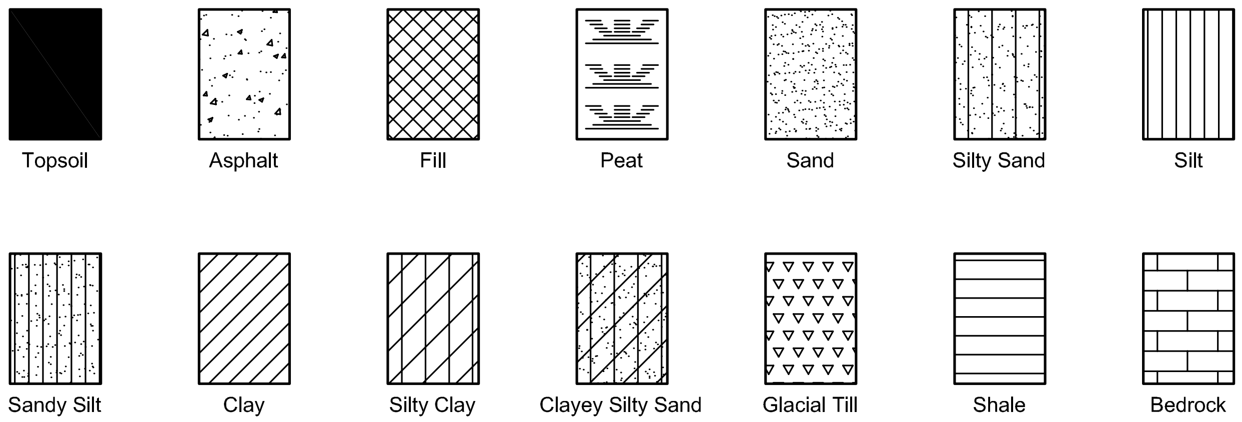
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

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

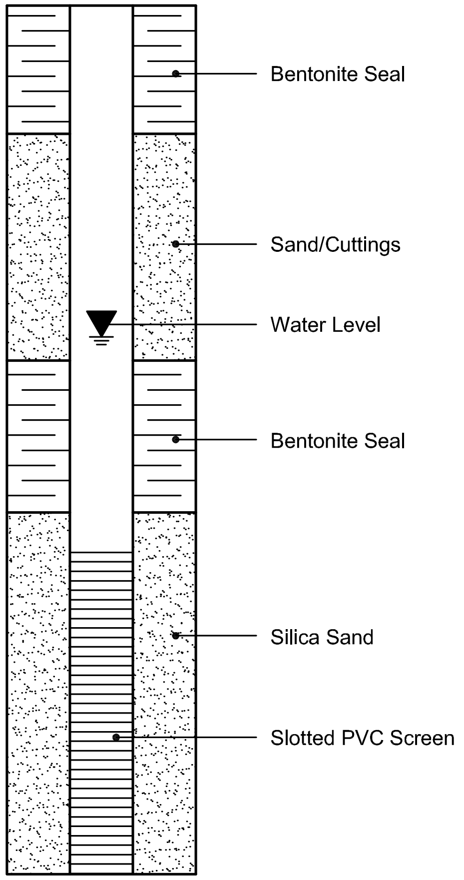
SYMBOLS AND TERMS (continued)

STRATA PLOT

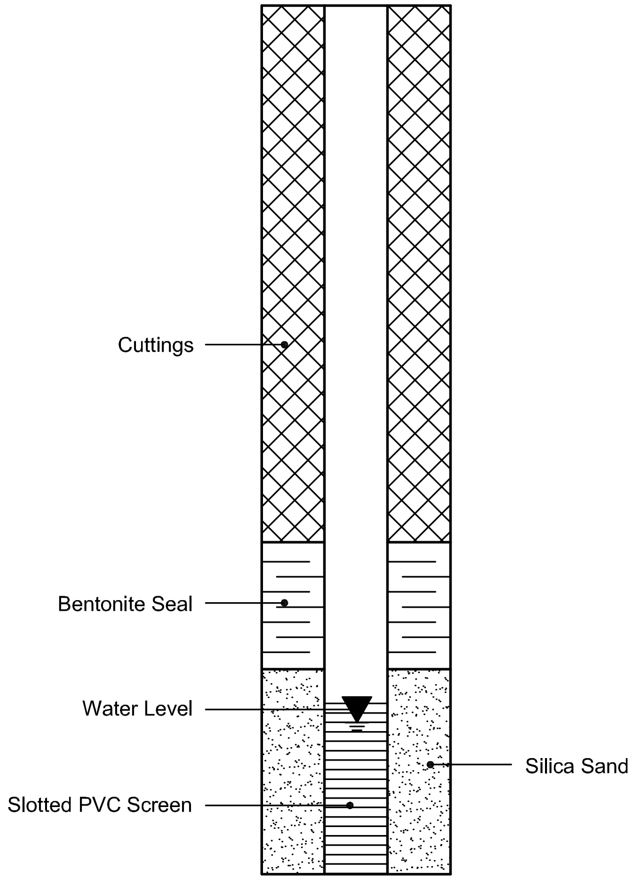


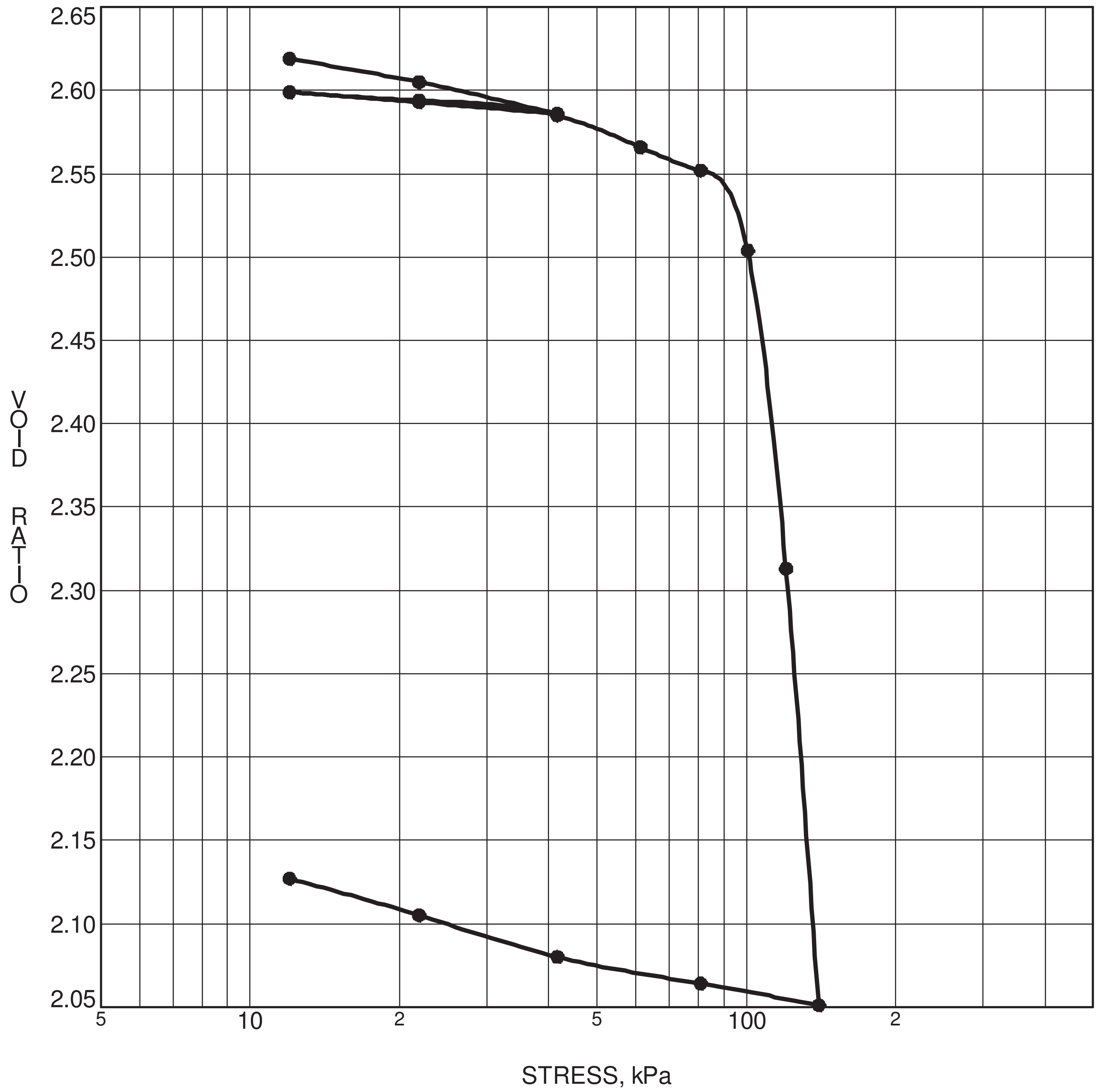
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 9**	p'_o	**53** kPa	Ccr	**0.021**
Sample No.	**TW 3**	p'_c	**106** kPa	Cc	**4.008**
Sample Depth	**4.33** m	OC Ratio	**2.0**	Wo	**95.8** %
Sample Elev.	**82.63** m	Void Ratio	**2.634**	Unit Wt.	**15.0** kN/m^3

CLIENT **Minto Communities Inc.**

FILE NO. **PG2392**

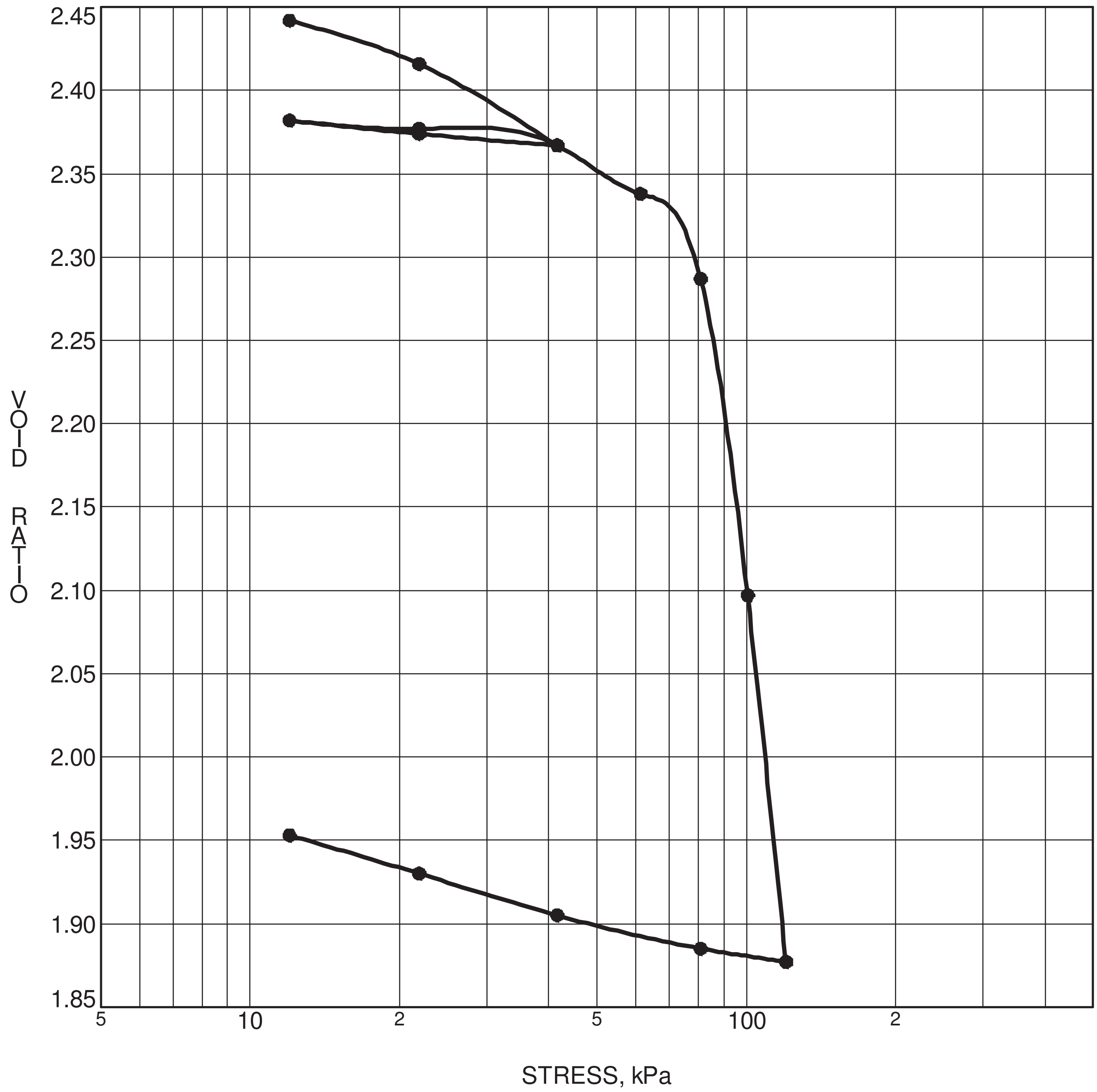
PROJECT **Geotechnical Investigation - Prop. Residential Development-Trails Edge Phase 2**

DATE **02/19/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH11**	p'$_o$	**53** kPa	Ccr	**0.027**
Sample No.	**TW 4**	p'$_c$	**85** kPa	Cc	**2.735**
Sample Depth	**4.32** m	OC Ratio	**1.6**	Wo	**89.9** %
Sample Elev.	**82.85** m	Void Ratio	**2.472**	Unit Wt.	**15.1** kN/m^3

CLIENT **Minto Communities Inc.**

FILE NO. **PG2392**

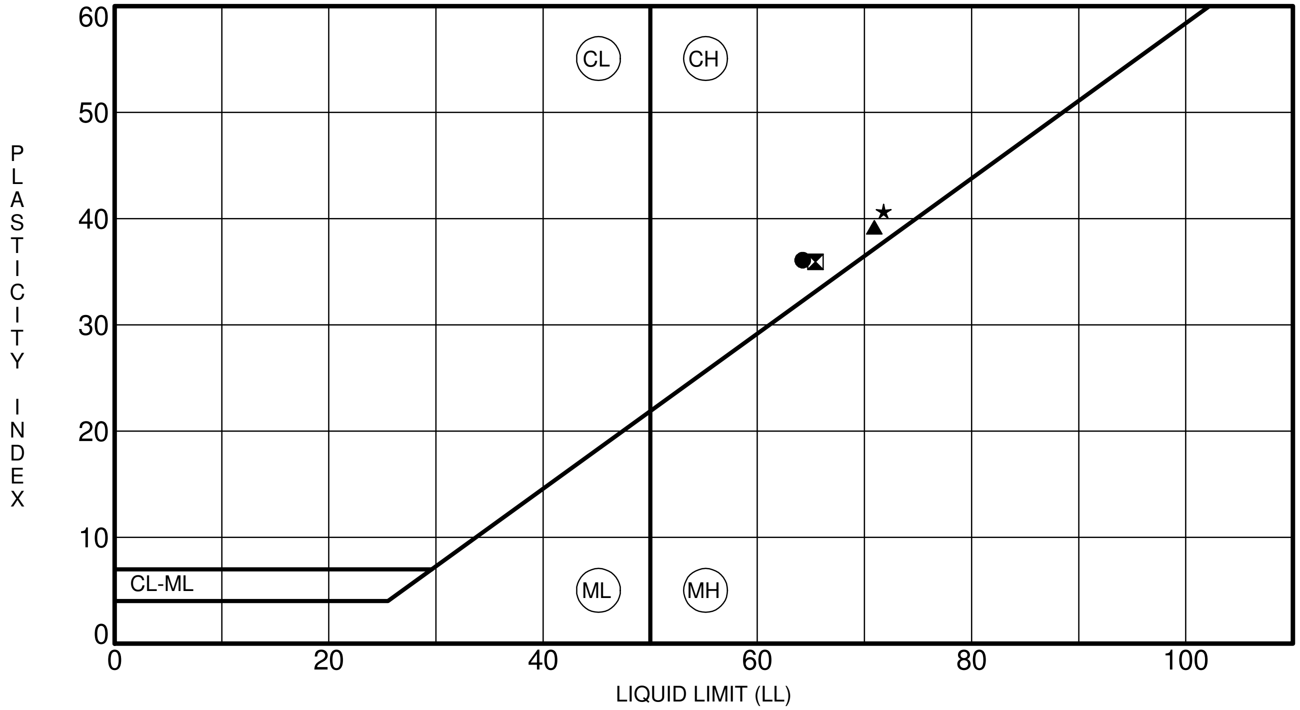
PROJECT **Geotechnical Investigation - Prop. Residential Development-Trails Edge Phase 2**

DATE **02/17/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



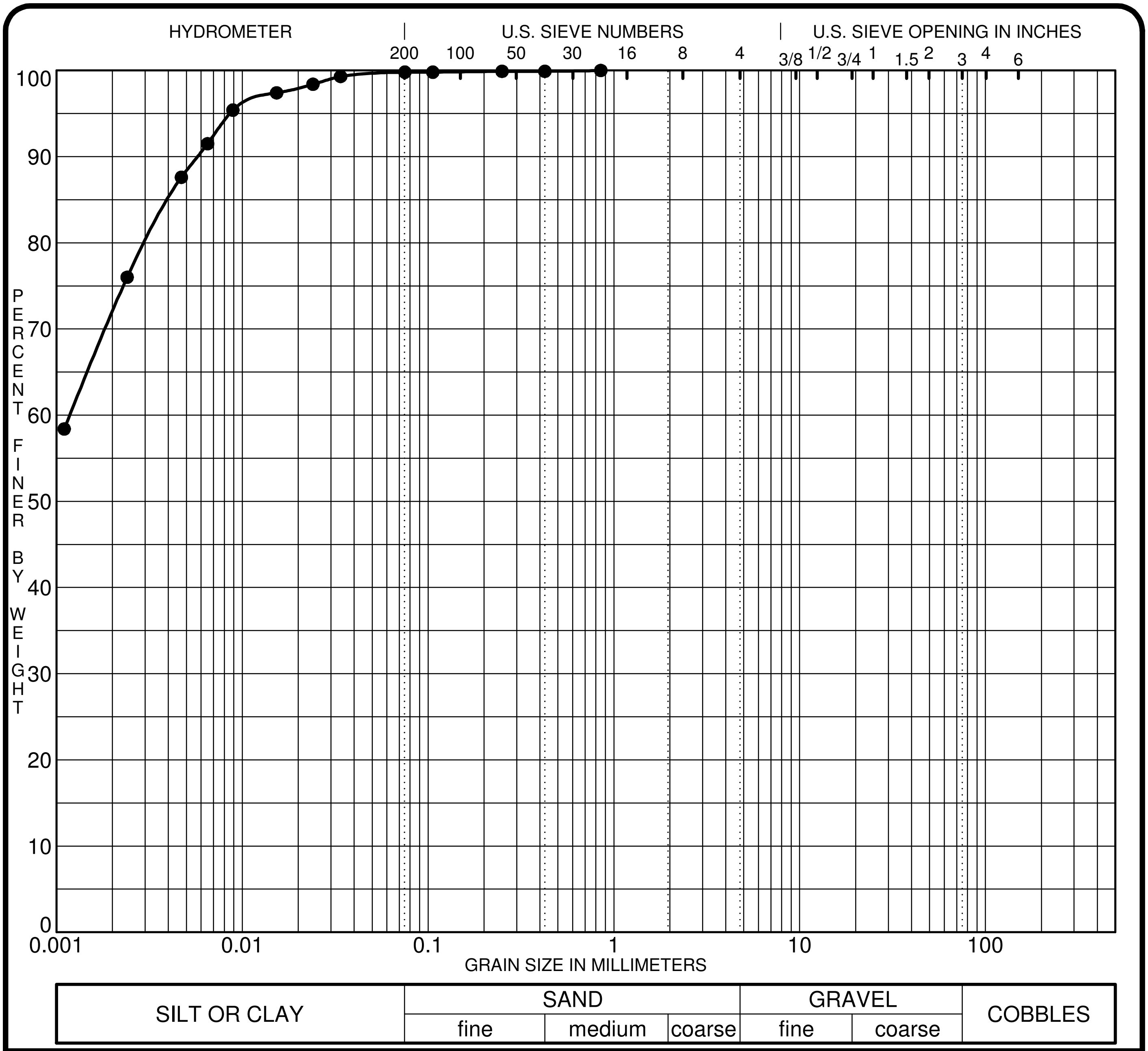
Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 1-20**	**SS 3**	**64**	**28**	**36**		**CH - Inorganic clays of high plasticity**
⧗	**BH 2-20**	**SS 3**	**65**	**29**	**36**		**CH - Inorganic clays of high plasticity**
▲	**BH 3-20**	**SS 3**	**71**	**32**	**39**		**CH - Inorganic clays of high plasticity**
★	**BH 4-20**	**SS 3**	**72**	**31**	**41**		**CH - Inorganic clays of high plasticity**

CLIENT **Minto Communities Inc.**
PROJECT **Supplemental Geotechnical Investigation -**
Proposed Residential Development - Trail's Edge

FILE NO. **PG2392**
DATE **7 May 20**

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

ATTERBERG LIMITS' RESULTS



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 3-20 SS 4**	**CH - Inorganic clays of high plasticity**						

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 3-20 SS 4**	**0.85**	**0.00**			**0.0**	**0.2**	**99.8**	

CLIENT **Minto Communities Inc.**

FILE NO. **PG2392**

PROJECT **Supplemental Geotechnical Investigation -**
Proposed Residential Development - Trail's Edge

DATE **7 May 20**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION

Order #: J2051

Certificate of Analysis

Report Date: 14-Jun-2004
Order Date: 09-Jun-2004

Client: **Paterson Group Inc.**
Client PO: **1139**
Project: **PG0270**

Matrix: Soil
Sample Date: 08/06/2004

		BH2 SS2
Parameter	MDL/Units	J2051.1
Chloride	5 ug/g	25
Sulphate	5 ug/g	50
pH	0.05 pH units	8.38
Resistivity	0.1 ohm.m	39

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2392-4 - TEST HOLE LOCATION PLAN

DRAWING PG2392-6 – TREE PLANTING SETBACK RECOMMENDATIONS

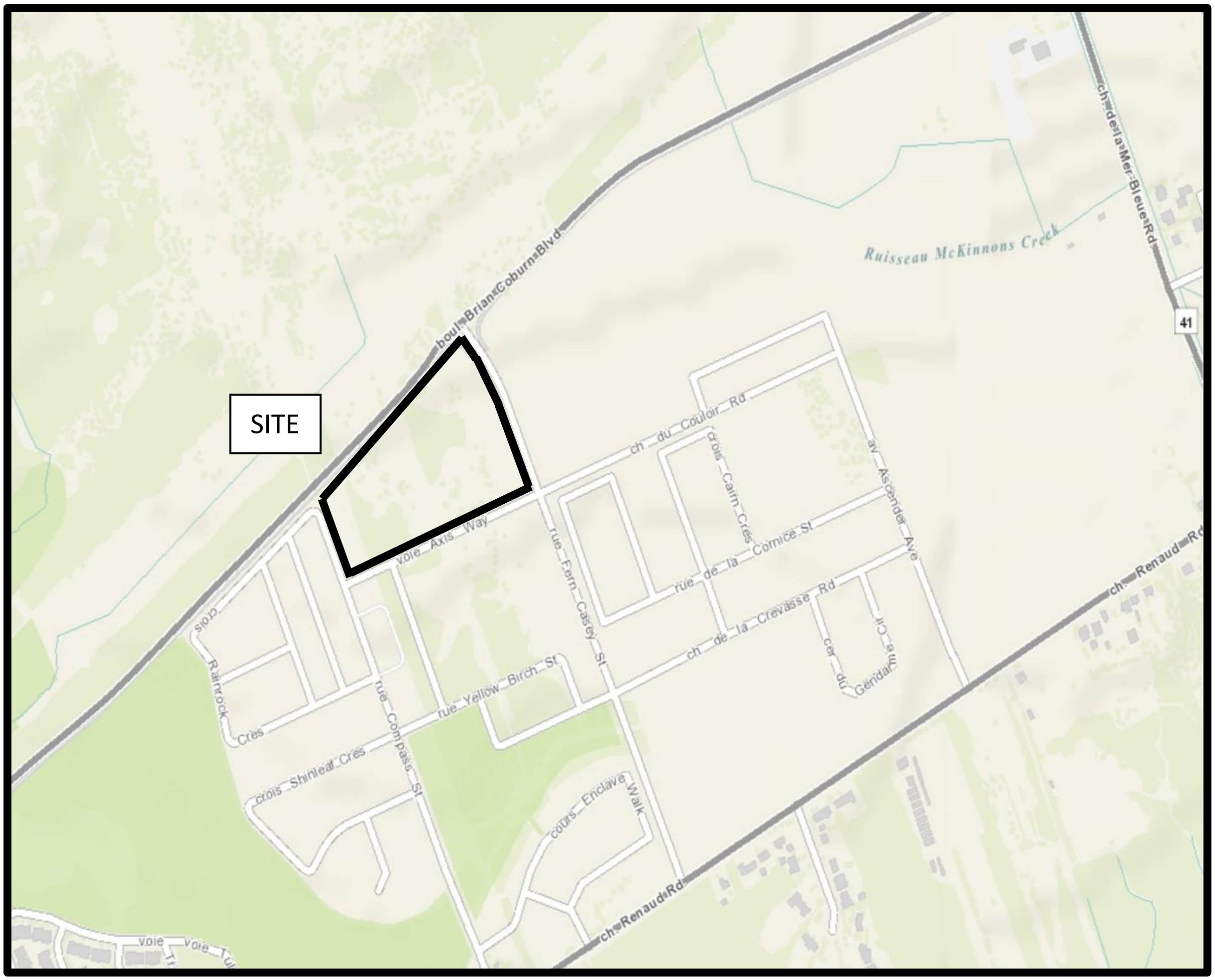
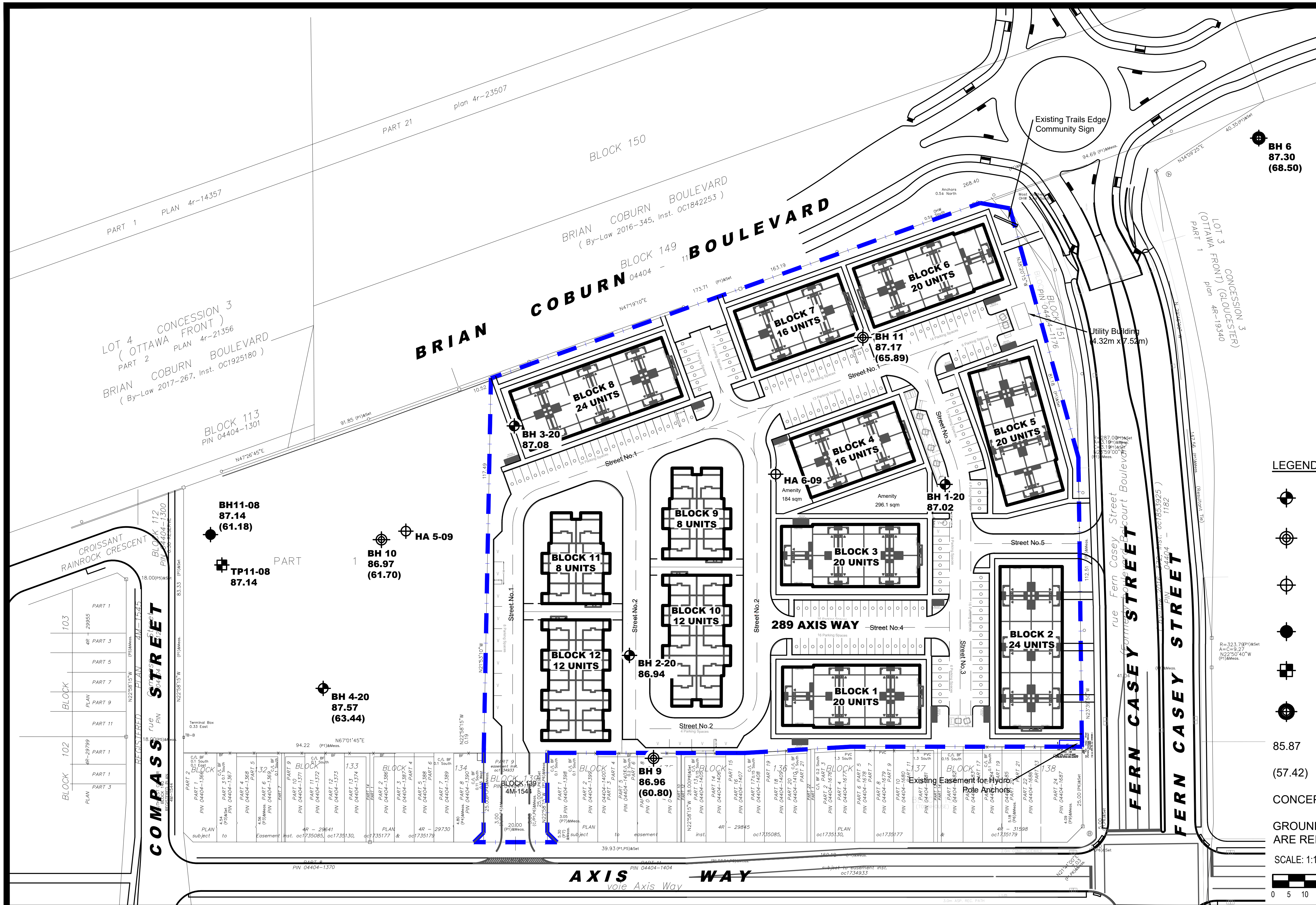


FIGURE 1

KEY PLAN

PATERSON
GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381



LEGEND:

⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG2392-02, 2020)
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG2392-01, 2012)
⊕	HAND AUGER HOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG1605-02, 2009)
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0861-02, 2008)
⊞	TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP REPORT PG0861-02, 2008)
⊕	BOREHOLE LOCATION BY OTHERS (JDPA REPORT G8533, 2002)
85.87	GROUND SURFACE ELEVATION (m)
(57.42)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY MINTO COMMUNITIES INC.

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1250

0 5 10 15 20 25 50 75m

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

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	21/11/2024	DP

MINTO COMMUNITIES INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
TRAIL'S EDGE STAGE 3 - 298 AXIS WAY

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250	Date: 06/2020
Drawn by: YA	Report No.: PG2392-2
Checked by: DP	Dwg. No.: PG2392-4
Approved by: FA	Revision No.: 1

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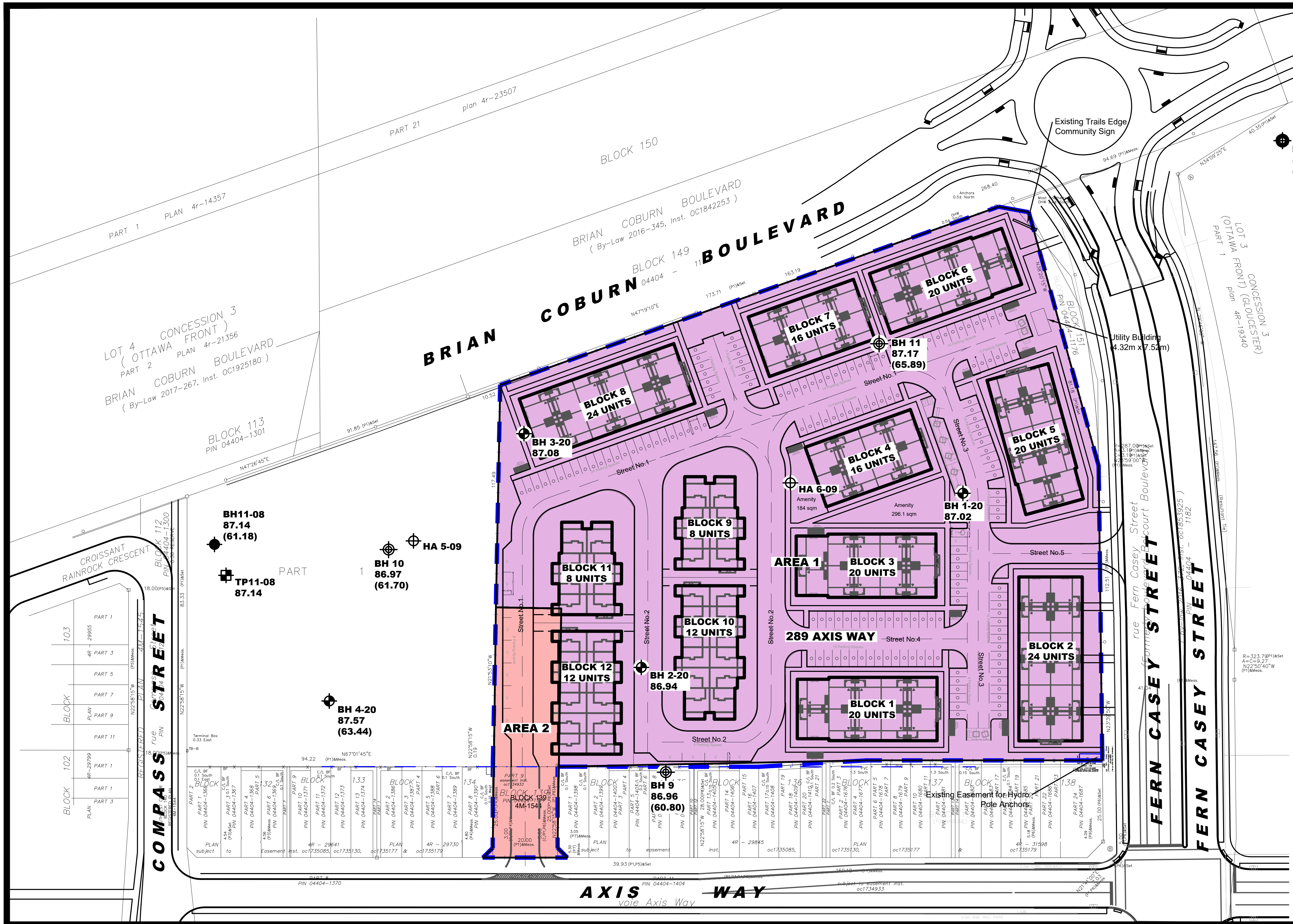

TREE PLANTING SETBACKS:

🟪	AREA 1 - LOW TO MEDIUM SENSITIVITY SILTY CLAY AREA - MINIMUM TREE PLANTING SETBACK = 4.5 m
🟥	AREA 2 - HIGH SENSITIVITY SILTY CLAY AREA - MINIMUM TREE PLANTING SETBACK = 7.5 m

LEGEND:

⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG2392-02, 2020)
⊕	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG2392-01, 2012)
⊕	HAND AUGER HOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG1605-02, 2009)
●	BOREHOLE LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT PG0861-02, 2008)
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CONCEPTUAL PLAN PROVIDED BY MINTO COMMUNITIES INC.

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:1250

0 5 10 15 20 25 50 75m

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

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	21/11/2024	DP

MINTO COMMUNITIES INC.

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
TRAIL'S EDGE STAGE 3 - 298 AXIS WAY

OTTAWA, ONTARIO

Title:

TREE PLANTING SETBACK RECOMMENDATIONS

Scale: 1:1250
Drawn by: YA
Checked by: DP
Approved by: FA
Date: 06/2020
Report No.: PG2392-2
Dwg. No.: PG2392-6
Revision No.: 1

11x17

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