Geotechnical Engineering

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Geotechnical Investigation

Proposed Residential Buildings
715 Mikinak Road
Ottawa, Ontario

Prepared For

Ottawa Community Housing

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Report: PG5354-1

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Ottawa Community Housing to conduct a geotechnical investigation for the proposed residential development to be located 715 Mikinak Road in the City of Ottawa (refer to Figure 1 - Key Plan 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 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.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of three multi-storey residential buildings. It is expected that one basement/underground parking will be associated to the buildings. Associated access lanes, parking area, walkways, and landscaped areas are expected for the proposed development. The subject site is surrounded by roadways with Hemlock Road to the north, Michael Stoqua Street to the east, Barielle-Snow Street to the west, and Mikinak Road to the south.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

A previous field which included the subject site was completed on November 11, 2004 by DST. A total of 2 boreholes with monitoring wells were advanced to a maximum depth of 5.2 m. The locations of the test holes from the previous investigation are shown on Drawing PG5354-1 - Test Hole Location Plan included in Appendix 2.

The current field program was completed on June 15 and 16, 2020 by Others, which included a total of 13 boreholes. The boreholes were advanced to a maximum depth of 8.3 m. 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. The locations of the test holes are shown on Drawing PG5354-1 - Test Hole Location Plan included in Appendix 2.

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 presented in Appendix 1 of this report.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags, and rock cores were placed in cardboard boxes. All samples were transported to our laboratory for further examination and classification. The depths at which the auger and split spoon samples were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets presented 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. This testing was done in general accordance with ASTM D1586-11 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Undrained shear strength testing was conducted in cohesive soils using a field vane apparatus.

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

Groundwater

PVC groundwater monitoring wells were installed within borehole BH 1-20, BH 6-20, BH 12-20 and BH 13-20 to permit monitoring of the groundwater level subsequent to the completion of the sampling program.

Previously installed monitoring wells were also observed and water levels measured during the field program. The locations of borehole BH8-1, BH 18-1 and BH18-2 are shown on Drawing PG5354-1 - Test Hole Location Plan included in Appendix 2.

3.2 Field Survey

The boreholes were selected, located and surveyed in the field by Others. The ground surface elevations at the test hole locations were referenced to a temporary benchmark (TBM). The TBM used was the top of spindle of the fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An assumed elevation of 100.00 m was assigned to the TBM. The locations and ground surface elevation at each test hole location are presented on Drawing PG5354-1 - 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 3 soil samples were submitted for hydrometer analysis from different sections of the site to provide a general coverage. The Grain Size Distribution sheets are provided in Appendix 1.

Furthermore, Atterberg Limits testing was also conducted which included 3 representative soil samples from different sections of the site to provide a general coverage. The Atterberg Limits testing sheets are provided in Appendix 1.

4.0 Observations

4.1 Surface Conditions

The aforementioned site is located in a former residential neighborhood. The majority of the subject section of the site was occupied by single residential homes and linked by asphalt covered roadways. By 2008, all structures within the subject section of the site were demolished while leaving the bulk of the asphalt covered roadways and municipal services intact.

The location of the former structures are illustrated on the 1991 aerial photograph provided on Figure 2 - 1991 Arial Photograph - in Appendix 2.

Currently, 715 Mikinak Road is vacant. The subject site is bordered by Hemlock Road to the north, Michael Stoqua Street to the east, Barielle-Snow Street to the west, and Mikinak Road to the south. The site is generally at grade with neighbouring properties and appears to be at grade with the existing roadways.

4.2 Subsurface Profile

The subsurface profile at the borehole and test hole locations in the subject site consists of fill material which generally extends to approximate depths of 0.3 to 1.4 m below the existing ground surface. The fill material was observed to vary from crushed stone to silty clay, with occasional gravel, asphalt and other debris. A firm, brown to grey silty clay deposit was encountered underlying the fill, extending to depths ranging from 3 m at the northwest end of the site to approximately 8 m at the southwest end of the site. A compact to dense glacial till deposit was encountered underlying the silty clay at the northwest end of the site, extending to depths ranging from approximately 3.6 m. Brown silty sand was observed at ground surface to a depth of approximately 1.4 m at the southeast end of the of the site, with stiff to firm, brown to grey silty clay underlying the brown silty sand. The glacial till deposit was generally observed to consist of a compact to dense, brown silty clay with sand, gravel, cobbles, and boulders.

Practical refusal to augering was generally encountered at depths ranging between approximately 3.6 to 8.3 m below existing ground surface.

Bedrock

Based on available geological mapping, the bedrock in this area consists of interbedded limestone and dolomite of the Gull River formation with an overburden drift thickness of 2 to 10 m.

Atterberg Limit and Shrinkage Tests

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

Table 1 - Summary of Atterberg Limits Results

Borehole	Depth (m)	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH 4-20	2.10	78	39	39	MH
BH 5-20	2.10	80	36	44	CH
BH 8-20	2.10	85	34	51	CH

Note: CH: Inorganic Clays of High Plasticity MH: Inorganic Silts of High Plasticity

4.3 Groundwater

Groundwater level readings were recorded on June 24, 2020, at the borehole locations. The groundwater level readings are presented in Table 2 below. Long-term groundwater level can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level is expected between 4 to 5 m depth. It should be noted that groundwater levels are subject to seasonal fluctuations, therefore, the groundwater levels could vary at the time of construction.

Table 2 - Summary of Groundwater Level Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1-20	98.58	4.62	Dry	June 15, 2020
BH 6-20	97.90	6.39	91.51	June 15, 2020
BH 12-20	93.82	4.58	Dry	June 16, 2020
BH 13-20	98.85	5.30	93.55	June 16, 2020

Note:
* - Denotes borehole instrumented with a 51 mm diameter monitoring well.
- The ground surface elevations at each borehole location were provided by Lopers and Associates.

Groundwater level readings from existing wells installed in 2018 were recorded on June 24, 2020, at the borehole locations. The groundwater level readings are presented in Table 3 below.

Table 3 - Existing Well Groundwater Readings

Borehole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH8-1	99.07	5.41	93.66	June, 2020
BH18-2	98.72	5.13	93.59	June, 2020
BH18-1	98.62	5.03	93.59	June, 2020

Note:
* - Denotes borehole instrumented with a 51 mm diameter monitoring well.
- The ground surface elevations at each borehole location were provided by Lopers and Associates.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. It is expected that the proposed buildings will generally be founded on conventional footings bearing on the undisturbed, hard to stiff silty clay, compact to dense glacial till, and/or clean, surface sounded bedrock. If the building loads exceed the bearing resistance values provided for conventional spread footing foundations, consideration can be given to a raft foundation. Due to the presence of a the silty clay deposit encountered at the site, a permissible grade raise restriction is required for the subject site.

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

5.2 Site Grading and Preparation

Stripping Depth

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

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only a small quantity of bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings, and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in the proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries or claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing surrounding structures. The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Excavation side slopes in sound bedrock can be carried out using near vertical sidewalls. A minimum 1 m horizontal ledge should be left between the bottom of the overburden excavation and the top of the bedrock surface to provide an area to allow for potential sloughing. The 1 m horizontal ledge set back can be eliminated with a shoring program which has drilled piles extending below the proposed founding elevation.

Lean Concrete In-Filled Trenches

Where bedrock is encountered below the design underside of footing elevation, consideration should be given to excavating vertical trenches to expose the underlying bedrock surface and backfilling with lean concrete (15 MPa 28-day compressive strength). Typically, the excavation sidewalls will be used as the form to support the concrete. The additional width of the concrete poured against an undisturbed trench sidewall will suffice in providing a direct transfer of the footing load to the underlying bedrock.

The effectiveness of this operation will depend on the ability of maintaining vertical trenches until the lean concrete can be poured. It is suggested that once the bottom of the excavation is exposed, an assessment should be completed to determine the water infiltration and stability of the excavation sidewalls extending to the bedrock surface.

The trench excavation should be at least 150 mm wider than all sides of the footing at the base of the excavation. The excavation bottom should be relatively clean using the hydraulic shovel only (workers will not be permitted in the excavation below a 1.5 m depth). Once approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation.

Footings placed on lean concrete filled trenches extending to the bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of 1,500 kPa.

Vibration Considerations

Construction operations could cause vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain a cooperative environment with the residents.

Two parameters determine the recommended vibration limit, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). These guidelines are for current construction standards. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people. A pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill used for grading purposes beneath the proposed buildings should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be tested and approved prior to delivery to the site. It should be placed in lifts no greater than 300 mm in thickness and compacted using suitable compaction equipment for the specified lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

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

5.3 Foundation Design

It is expected that the proposed buildings and exterior structures, if present, will generally be founded on conventional spread footing foundations founded on the bedrock, on concrete filled trenches extending to bedrock, undisturbed the glacial till deposit and/or the stiff to firm silty clay deposit.

Conventional Spread Footings

Bearing resistance values are provided in Table 4, below, for footings placed on a bearing surface consisting of undisturbed, hard to stiff silty clay, glacial till, or clean, surface sounded bedrock. Footings supported on undisturbed, hard to stiff silty clay and compact to dense glacial till, designed using the bearing resistance values at SLS provided in Table 4, will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. Footings placed on clean, surface sounded bedrock will be subjected to negligible settlements.

An undisturbed soil bearing surface consists of a surface from which all organic materials 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. A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Table 4 - Bearing Resistance Values

Bearing Surface	Factored Bearing Resistance Values at ULS (kPa)	Bearing Resistance Values at SLS (kPa)
Hard to Very Stiff Silty Clay	250	150
Glacial Till	400	250
Clean Surface Sounded Bedrock	3000	1500

Notes:
- ULS - Ultimate Limit States
- SLS - Serviceability Limit States
- A geotechnical resistance factor of 0.5 was applied to the provided bearing resistance values at ULS

For adjacent footings where one is bearing on bedrock and the other is bearing on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also, for a given footing supported on both soil and bedrock, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the subexcavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

Permissible Grade Raise Recommendations

Permissible grade raise recommendations have been determined for the proposed development based on the undrained shear strength values observed within the silty clay deposit during our field investigation. Based on our findings, our preliminary permissible grade raise recommendations are presented in Drawing PG5354-2 - Permissible Grade Raise in Appendix 2.

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 the insitu soils above 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. In sound, unfractured bedrock, a 1H:6V slope may be used.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the subject site. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code (OBC) 2012 for a full discussion of the earthquake design requirements.

A higher seismic site class, (**Class A or B)**, is be available for foundations placed on or near bedrock. However, this higher site class would have to be confirmed by site specific shear wave velocity testing.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, such as those containing organic materials, within the footprint of the proposed buildings, the native soil or bedrock surface will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

It is expected that the basement area for the proposed multi-storey building will be mostly parking and the recommended pavement structure noted in Subsection 5.7 will be applicable. However, if storage or other uses of the lower level are proposed where a concrete floor slab will be used, it is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a bulk (drained) unit weight of 20 kN/m^3.

However, undrained conditions are anticipated (i.e. below the groundwater level). Therefore, the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Lateral Earth Pressures

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil (0.5)
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45-a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32 g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Design

Car only parking areas, access lanes and local roadways are anticipated within the subject site. The proposed pavement structures are shown in Tables 5 and 6.

Table 5 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 6 - Recommended Pavement Structure - Access Lanes and Local Roadways	
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 fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or fill

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable compaction equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed buildings. The system should consist of a 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 underground parking structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Sub-Slab Drainage

It is anticipated that sub-slab drainage will be required to control water infiltration. For preliminary design purposes, we recommend that 150 mm perforated pipes be placed at 6 to 9 m centres underlying the basement slab. The spacing of the sub-slab drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose. A waterproofing system should be provided to the elevator pits (pit bottom and walls).

6.2 Protection of Footings Against Frost Action

Perimeter footings, of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 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, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

The parking garage may require protection against frost action depending on the founding depth. Unheated structures, such as the access ramp wall footings, may be required to be insulated against the deleterious effect of frost action. A minimum of 2.1 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

The effectiveness of this operation will depend on the ability of maintaining vertical trenches until the lean concrete can be poured. It is suggested that once the bottom of the excavation is exposed, an assessment should be completed to determine the water infiltration and stability of the excavation sidewalls extending to the bedrock surface.

The trench excavation should be at least 150 mm wider than all sides of the footing at the base of the excavation. The excavation bottom should be relatively clean using the hydraulic shovel only (workers will not be permitted in the excavation below a 1.5 m depth). Once approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation.

Footings placed on lean concrete filled trenches extending to the bedrock surface can be designed using a factored bearing resistance value at ultimate limit states (ULS) of 1,500 kPa. A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The side slopes of excavations in the 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 the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

Unsupported Side Slopes

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be

mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

In bedrock, almost vertical side slopes can be used provided that all loose rock and blocks with unfavourable weak planes are removed or stabilized.

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.

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.

Temporary Shoring

The design and approval of the temporary shoring system will be the responsibility of the shoring contractor and the shoring designer who is a licensed professional engineer and is hired by the shoring contractor. It is the responsibility of the shoring contractor to ensure that the temporary shoring system is in compliance with safety requirements, designed to avoid any damage to adjacent structures and include dewatering control measures. In the event that subsurface conditions differ from the approved design during the actual installation, it is the responsibility of the shoring contractor to commission the required experts to re-assess the design and implement the required changes. Furthermore, the design of the temporary shoring system should take into consideration a full hydrostatic condition which can occur during significant precipitation events.

The temporary shoring system could consist of a soldier pile and lagging system or steel sheet piles. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be included to the earth pressures described below. This system could be cantilevered, anchored or braced. The shoring system is recommended to be adequately supported to resist toe failure, if required, by means of extending the piles into the bedrock through pre-augered holes, if a soldier pile and lagging system is the preferred method.

The earth pressures acting on the temporary shoring system may be calculated with the following parameters.

Table 7 - Soil Parameters for Shoring System Design	
Parameters	**Values**
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Unit Weight (γ), kN/m^3	20
Submerged Unit Weight (γ), kN/m^3	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible. The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be calculated full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

6.4 Pipe Bedding and Backfill

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

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. 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 or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 95% of the material's standard Proctor maximum dry density.

It should generally be possible to re-use the site materials above the cover material if the operations are carried out in dry weather conditions.

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) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material standard Proctor maximum dry density.

6.5 Groundwater Control

Due to the relatively impervious nature of the overlying silty clay at the site, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Where excavations are extended within the glacial till and/or bedrock surface below the long term groundwater level, the groundwater infiltration is anticipated to be moderate to high. Generally, pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

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 MOECC review of the PTTW application.

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.

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 are protected with sufficient soil cover to prevent freezing at founding level.

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

6.7 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 was completed for the recovered silty clay samples at selected locations throughout the subject site. The soil samples were recovered from elevations 2.1 m below the current ground surface elevation. The results of our testing are presented in Table 1 in Subsection 4.2 and in Appendix 1.

Based on the results of our testing, two areas have been outlined in Drawing PG5354-3 - Tree Planting Setback Recommedations presented in Appendix 2. **Area 1** defines areas of **high plasticity silty clay** (Plasticity index > 40%) and **Area 2** defines areas of **low to medium plasticity silty clay** (Plasticity index < 40%). In accordance with the City of Ottawa guidelines, the 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) in Area 2. As per the guideline, trees in Area 1 shall be planted with a minimum setback equal to the mature height of the tree.

However, based on Paterson's experience with housing constructed over low to medium and high sensitivity soils in the Ottawa area, a tree planting setback of 4.5 m from tree to foundation is recommended for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) for both areas of the subject site provided that the following conditions are met.

- ❑ The underside of footing (USF) is 2.1m 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 un-compacted when backfilling in street tree planting locations.

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

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

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

7.0 Recommendations

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

- ❏ Review of the grading plan from a geotechnical perspective.
- ❏ 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 the geotechnical consultant.

8.0 Statement of Limitations

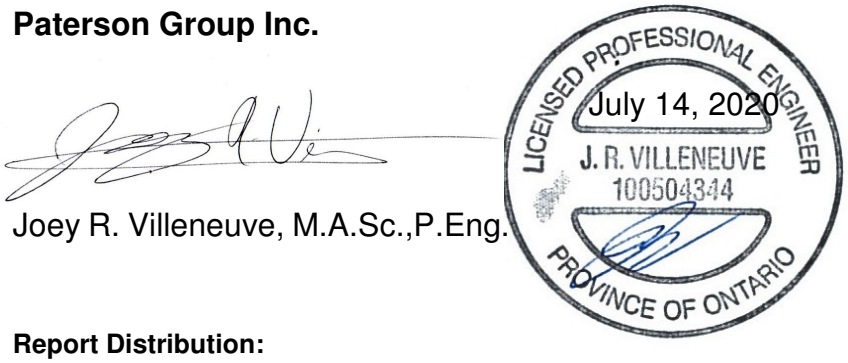
The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

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 Ottawa Community Housing 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.



Joey R. Villeneuve, M.A.Sc.,P.Eng. David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Ottawa Community Housing
- ❑ Paterson Group

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

TEST HOLE LOG SHEETS BY OTHERS

GRAIN SIZE DISTRIBUTION ANALYSIS

ATTERBERG LIMITS TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5354

REMARKS

HOLE NO. BH 1-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	98.58		
		AU	1						
		SS	2	25	30	1	97.58		
Loose to dense, grey **SILTY SAND** with gravel, trace clay		SS	3	25	17	2	96.58		
		SS	4	33	50+				
		SS	5	50	9	3	95.58		
3.94		SS	6	89	50+				
End of Borehole									
Practical refusal to augering at 3.94m depth									
(BH dry - June 24, 2020)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5354

REMARKS

HOLE NO. BH 2-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	98.16		
FILL: Brown silty sand and gravel with organics		AU	1						
1.07		SS	2	75	13	1	97.16		
Firm, grey **SILTY CLAY**		SS	3	100	13	2	96.16		
		SS	4	100	8				
3.00						3	95.16		
Loose to dense, brown **SILTY SAND** with gravel		SS	5	52	32				
3.63									
End of Borehole									
Practical refusal to augering at 3.63m depth									

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5354

REMARKS

HOLE NO. BH 3-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.94		
Compact to dense, brown **SILTY SAND** with gravel, trce clay		AU	1						
0.60						1	96.94		
		SS	2	42	28				
		SS	3	50	12	2	95.94		
Firm, grey **SILTY CLAY**		SS	3	25	12				
		SS	4	25	5	3	94.94		
4.17		SS	5	46	50+	4	93.94		
End of Borehole									
Practical refusal to augering at 4.17m depth									

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5354

REMARKS

HOLE NO. BH 4-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.89		
Compact, brown **SILTY SAND** with gravel, some organics		AU	1						
1.07		SS	2	100	13	1	96.89		
		SS	3	100	16	2	95.89		
		SS	4	100	13				
Very stiff to firm, grey **SILTY CLAY**		SS	5	100	10	3	94.89		
		SS	6	100	6	4	93.89		
4.50									
End of Borehole Practical refusal to augering at 4.50m depth									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

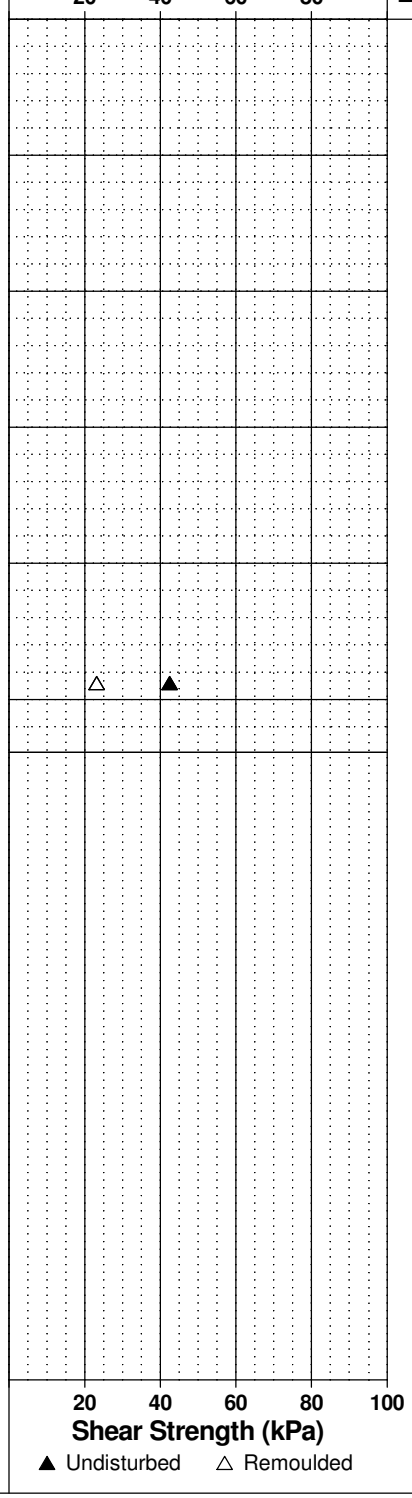
FILE NO. PG5354

REMARKS

HOLE NO. BH 5-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.84		
Loose, brown **SILTY SAND** with gravel		AU	1						
0.60						1	96.84		
		SS	2	0	16				
		SS	3	100	12	2	95.84		
Stiff to firm, grey **SILTY CLAY**		SS	4	100	7				
		SS	5	100	4	3	94.84		
		SS	6	100	2	4	93.84		
						5	92.84		
5.39		SS	7	100	50+				
End of Borehole									
Practical refusal to augering at 5.39m depth									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

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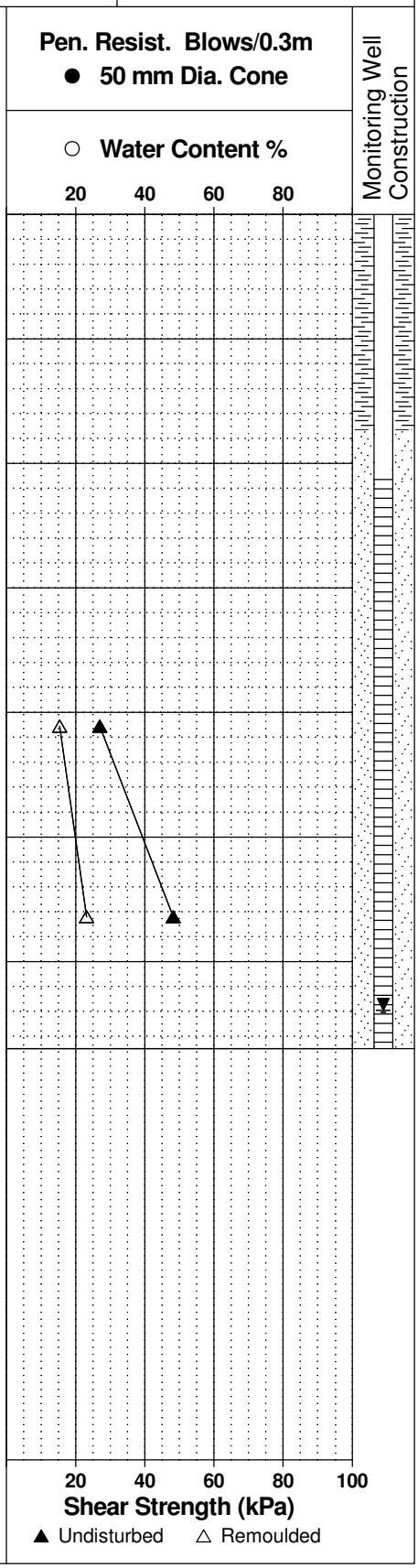
FILE NO. PG5354

REMARKS

HOLE NO. BH 6-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.90
Loose, brown **SILTY SAND** with gravel, some organics		AU	1				
0.90						1	96.90
		SS	2	100	14		
		SS	3	100	10	2	95.90
		SS	4	100	6		
		SS	5	100	3	3	94.90
Firm, grey **SILTY CLAY**						4	93.90
		SS	6	100	W	5	92.90
		SS	7	100	W	6	91.90
6.70							
End of Borehole							
Practical refusal to augering at 6.70m depth							
(GWL @ 6.39m - June 24, 2020)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

FILE NO. PG5354

REMARKS

HOLE NO. BH 7-20

BORINGS BY CME 55 Power Auger **DATE** June 15, 2020

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 %	Monitoring Well Construction
GROUND SURFACE									
Compact, brown **SILTY SAND** with gravel		AU	1			0	97.75		
0.60									
		SS	2	100	13	1	96.75		
		SS	3	100	9	2	95.75		
		SS	4	100	5	3	94.75		
		SS	5	100	2				
Stiff to firm, grey **SILTY CLAY**		SS	6	100	W	4	93.75		
		SS	7	100	W	5	92.75		
		SS	8	100	W				
		SS	9	100	W	6	91.75		
		SS	10	100	W	7	90.75		
						8	89.75		
8.23									
End of Borehole									
Practical refusal to augering at 8.23m depth									

Pen. Resist. Blows/0.3m: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

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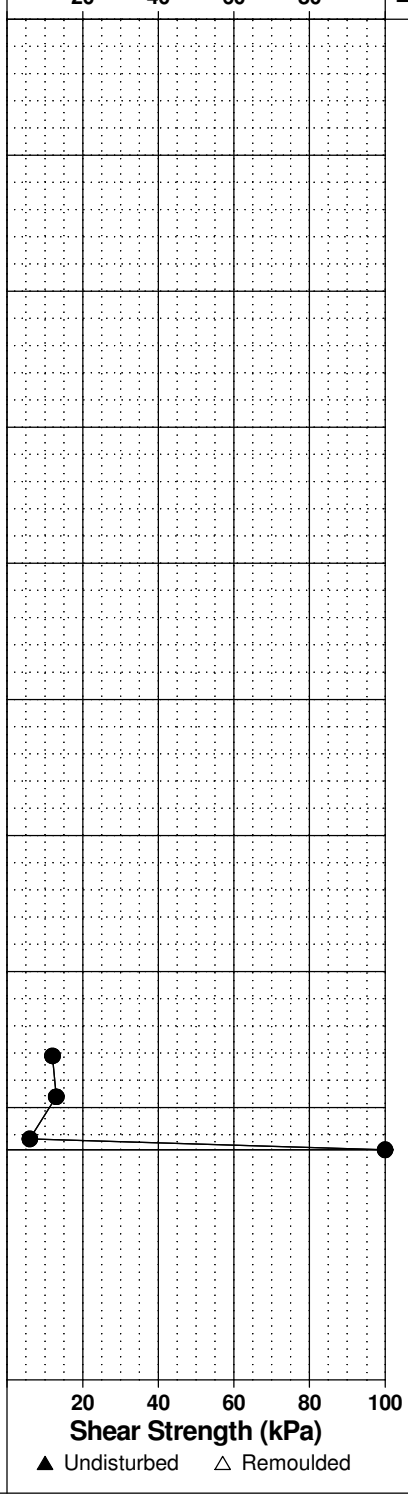
FILE NO. PG5354

REMARKS

HOLE NO. BH 8-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.45		
Compact, brown **SILTY SAND** with gravel									
0.90									
		SS	1	75	13	1	96.45		
		SS	2	75	12	2	95.45		
		SS	3	100	6				
		SS	4	100	3	3	94.45		
		SS	5	100	W	4	93.45		
Stiff to firm, grey **SILTY CLAY**		SS	6	67	W	5	92.45		
		SS	7	83	W				
6.10						6	91.45		
Dynamic Cone Penetration Test commenced at 6.10m depth. Cone pushed to 7.6m depth						7	90.45		
8.31						8	89.45		
End of Borehole									
Practical DCPT refusal at 8.31m depth.									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

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FILE NO. PG5354

REMARKS

HOLE NO. BH 9-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.61		
Compact, brown **SILTY SAND** with gravel, some clay		AU	1						
		SS	2	67	50+	1	96.61		
1.68									
		SS	3	100	18	2	95.61		
Stiff to firm, grey **SILTY CLAY**		SS	4	100	14				
						3	94.61		
		SS	5	100	8				
3.66									
End of Borehole									

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

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

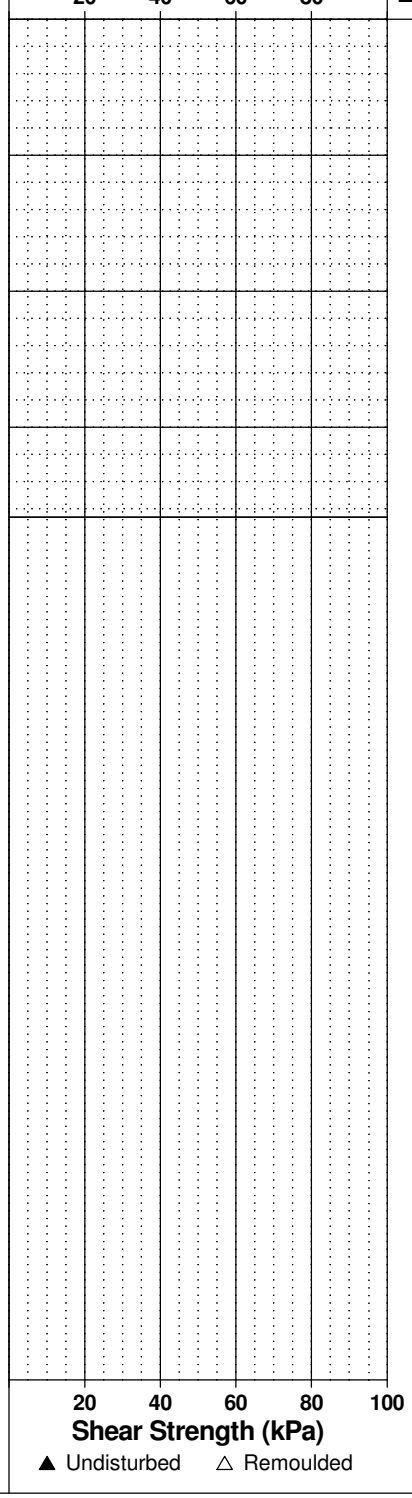
FILE NO. PG5354

REMARKS

HOLE NO. BH10-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	97.71		
		AU	1						
		SS	2	50	34	1	96.71		
FILL: Brown silty sand with gravel, trace asphalt		SS	3	50	14	2	95.71		
		SS	4	67	14				
		SS	5	33	8	3	94.71		
3.66									
End of Borehole									



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

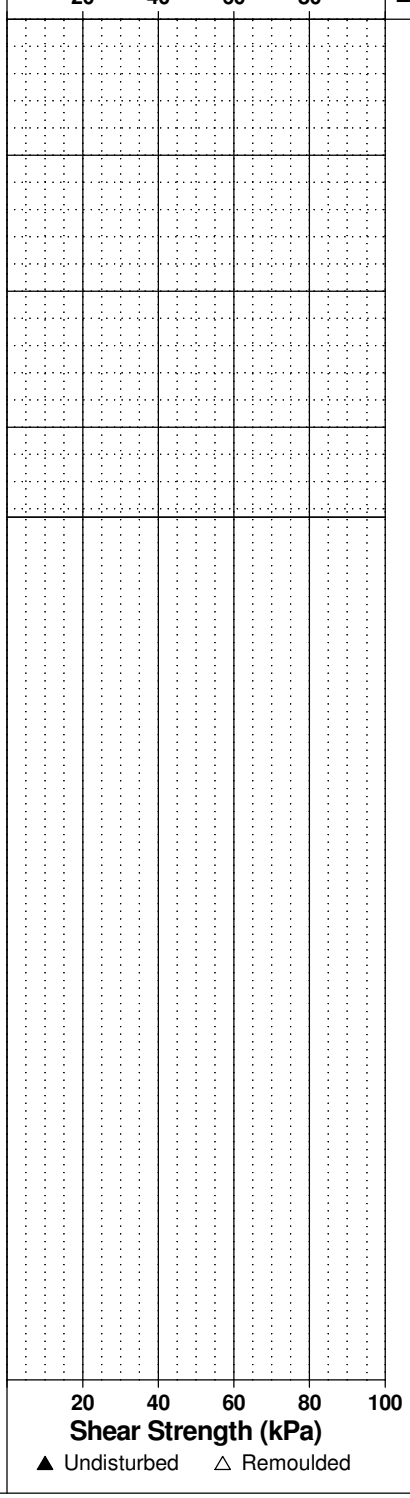
FILE NO. PG5354

REMARKS

HOLE NO. BH11-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.71
Dense, brown **SILTY SAND** with gravel		AU	1				
		SS	2	67	45	1	96.71
1.83		SS	3	50	11		
Firm, grey **SILTY CLAY**						2	95.71
2.29		SS	4	50	17		
Compact, brown **SILTY SAND** with gravel						3	94.71
		SS	5	67	22		
3.66							
End of Borehole							



Monitoring Well Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

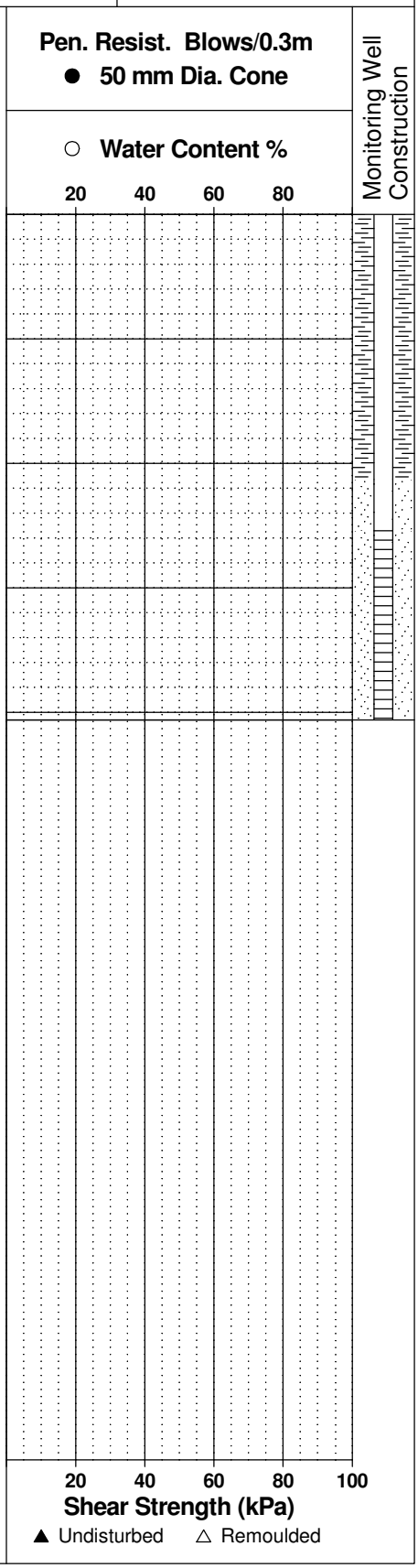
FILE NO. PG5354

REMARKS

HOLE NO. BH12-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	97.67
FILL: Brown silty sand with gravel		AU	1				
0.90							
		SS	2	17	10	1	96.67
FILL: Grey silty clay with gravel and sand, trace asphalt		SS	3	0	3	2	95.67
		SS	4	50	3		
3.05						3	94.67
FILL: Grey silty sand with gravel, trace asphalt		SS	5	33	2		
4.06		SS	6	80	50+	4	93.67
End of Borehole							
Practical refusal to augering at 4.06m depth							
(BH dry - June 24, 2020)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Building - 715 Mikinak Road
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant located on the corner of Barille-Snow Street and Hemlock Road. An arbitrary elevation of 100.00m was assigned to the TBM.

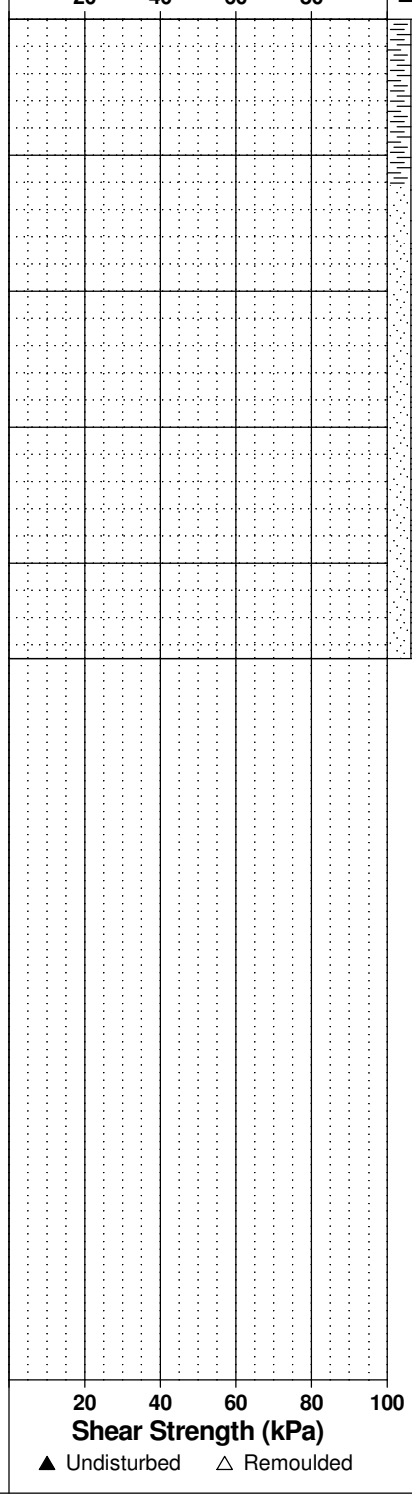
FILE NO. PG5354

REMARKS

HOLE NO. BH13-20

BORINGS BY CME 55 Power Auger **DATE** June 16, 2020

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 %	Monitoring Well Construction
GROUND SURFACE						0	98.07		
Compact to dense, brown to grey **SILTY SAND** with gravel, some clay		AU	1						
		SS	2	42	18	1	97.07		
		SS	3	25	12	2	96.07		
		SS	4	67	44				
		SS	5	100	70	3	95.07		
		SS	6	75	20	4	94.07		
4.70		SS	7	100	50+				
End of Borehole Practical refusal to augering at 4.70m depth (BH dry - June 24, 2020)									



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 relative strength of cohesionless soils is the compactness condition, 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. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water 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 at 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

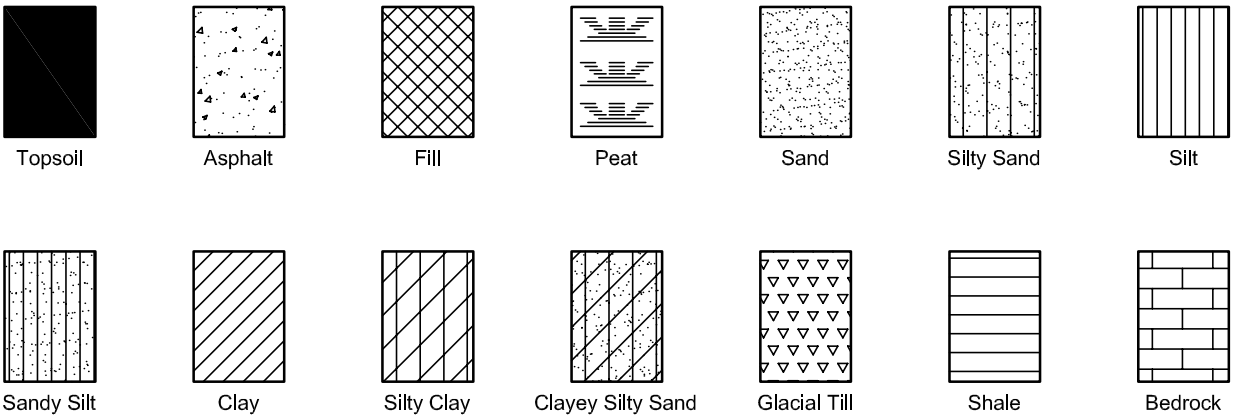
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

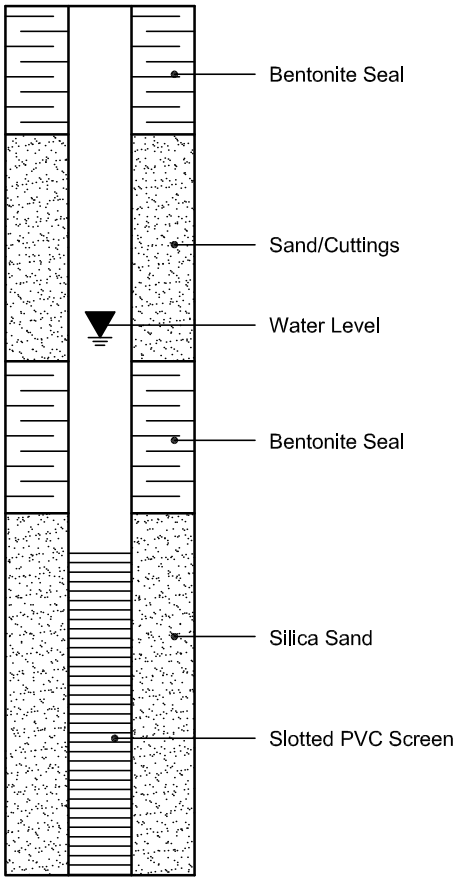
SYMBOLS AND TERMS (continued)

STRATA PLOT

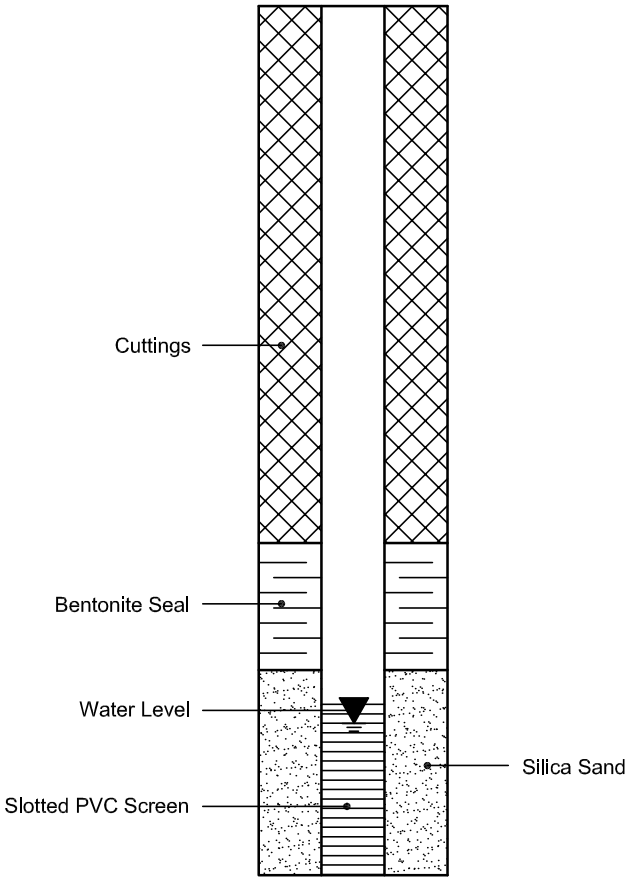


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



LOG OF BOREHOLE / MONITORING WELL BHMW7

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 11 2004**

CCGD *	SAMPLES			SUBSURFACE PROFILE					
○ RKI EAGLE (PPM) 20 40 60 80 ▫ *MINIRAE (PPM)* 5 10 15 20	PPM	No.	Type	SPT N-Value	SYMBL	MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
		SS1		10		FILL - sand and gravel, some silt, loose, brown	0.5			Groundwater level observed 2.1 m below grade on November 25, 2004.
		SS2		13		- clay, sandy, some silt, compact, olive grey	1.0			
○	55	SS3		5			1.5			
						- silt, clayey, some sand, trace gravel, loose, brown	2.0			
○	5	SS4		5		CLAY - silty, firm to stiff, olive grey				
○	5	SS5		12			2.5			
○	5	SS6		10			3.0			
○	0	SS7		12			3.5			
○	70	SS8		12		- clayey sand layer ~20 cm thick	4.0			
		SS9		>100		- trace cobbles	4.5			Strong petroleum hydrocarbon odour noted
						End of borehole at 5.2 m depth.	5.0			Sheen noted on water

GASTECBH(OTTAWA) OE04940.GPJ DST_MIN.GDT 10/3/08

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* - Catalytic Combustible Gas Detector

SAMPLE TYPE LEGEND

Auger Sample; Rock Core; Power Sample; Split Spoon Sample; Side Sampler; Thin Wall Tube; Grab Sample

APPENDIX H

LOG OF BOREHOLE / MONITORING WELL BHMW8

DST REF. No.: **OE04940**
CLIENT: **Canada Lands Company**
PROJECT: **Steam Line Decommissioning**
LOCATION: **Canadian Forces Base, Rockcliffe, Ottawa, Ontario**
SURFACE ELEV.: **--/--**

Drilling Data
METHOD: **CME 55 Track Mounted Drill Rig**
DIAMETER: **200 mm**

DATE: **November 11 2004**

CCGD * RKI EAGLE (PPM) 20 40 60 80 / MINIRAE (PPM) 5 10 15 20	PPM	SAMPLES No.	Type	SPT N-Value	SYMBL	SUBSURFACE PROFILE MATERIAL DESCRIPTION	DPTH m	ELEV m	WATER DATA	REMARKS
						SURFACE				
						ASPHALT - ~100 mm thick				
						FILL - sand and gravel, some silt, compact				
O	70	SS1		17						Groundwater level observed 2.0 m below grade on November 25, 2004.
						CLAY - silty, very stiff to stiff, olive grey	0.5			
>>O	310	SS2		18			1.0			
										Petroleum hydrocarbon odour noted
>>O	>1000	SS3		13			1.5			
							2.0			
O	30	SS4		22						
							2.5			
O	10	SS5		11						
							3.0			
O	50	SS6		9						
							3.5			
O	20	SS7		8			4.0			
O	0	SS8		11			4.5			
						End of borehole at 4.9 m depth.				

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* - Catalytic Combustible Gas Detector

SAMPLE TYPE LEGEND

Auger Sample | Rock Core | Ponar Sample
Split Spoon Sample | Side Sampler
Thin Wall Tube | Grab Sample

APPENDIX H

GASTECBH (OTTAWA) OE04940.GPJ DST_MIN.GDT 10/3/06

LOG OF BOREHOLE BH16-02

DST REF. No.: **IN-SO-026755**
CLIENT: **Canada Lands Company**
PROJECT: **Site Servicing Phase 1B**
LOCATION: **Wateridge Village, Ottawa, Ontario**
SURFACE ELEV.: **88.05 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **200 mm**
DATE: **August 26, 2016**
COORDINATES: **5035157.52** m N, **372671.86** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ / SPT (N) □ Blows/0.3m / DCPT ◆	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	88				ASPHALT - 250 mm thick					
					FILL - SAND AND GRAVEL - trace clay and silt, brown, compact	SS1		28		37 57 (6)
1.0	87		●			SS2		18		
					FILL - GRAVELLY SAND - trace clay and silt, brown, compact to dense	SS3		10		22 65 (13)
2.0	86									
						SS4		37		29 60 (11)
3.0	85		●			SS5		16		
						SS6		50+		
4.0	84				End of Borehole at 4.0 m Split Spoon Sampler and Auger Refusal on Inferred Bedrock					
5.0	83									
6.0	82									
7.0	81									

BOREHOLE (STANDARD) PHASE 1B BOREHOLES V1.3.GPJ DST_MIN.GDT 10-24-16

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thick Wall Tube
- Bentonite
- Sand

LOG OF BOREHOLE BH16-03

DST REF. No.: **IN-SO-026755**
CLIENT: **Canada Lands Company**
PROJECT: **Site Servicing Phase 1B**
LOCATION: **Wateridge Village, Ottawa, Ontario**
SURFACE ELEV.: **88.25 metres**

Drilling Data
METHOD: **Hollow Stem Auger / NQ Size Core Barrel**
DIAMETER: **200 mm**
DATE: **September 16, 2016**
COORDINATES: **5035157.56** m N, **372725.95** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ / SPT (N) □ Blows/0.3m / DCPT ◆	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
	88				ASPHALT - 75 mm thick					
					FILL - SAND AND GRAVEL - trace of clay, brown, compact	SS1		29		
1.0	87					SS2		10		
2.0	86					SS3		26		
						SS4		16		
3.0	85				TILL - Clay, some sand, trace of gravel, grey, hard	SS5		50+		
					LIMESTONE BEDROCK - Light grey RC1 = 0.61 m TCR = 87% RQD = 56%	RC1				
4.0	84									Possible 50 mm thick clay seam at 4.4 m
					RC2 = 1.55 m TCR = 95% RQD = 95%	RC2				
5.0	83									
					RC3 = 0.46 m TCR = 100% RQD = 47%	RC3				
6.0	82				End of Borehole at 6.1 m					
7.0	81									

BOREHOLE (STANDARD) PHASE 1B BOREHOLES V1.3.GPJ DST_MIN.GDT 10-24-16

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thick Wall Tube
- Bentonite
- Sand

LOG OF BOREHOLE BH16-04

DST REF. No.: **IN-SO-026755**
CLIENT: **Canada Lands Company**
PROJECT: **Site Servicing Phase 1B**
LOCATION: **Wateridge Village, Ottawa, Ontario**
SURFACE ELEV.: **88.52 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **200 mm**
DATE: **September 2, 2016**
COORDINATES: **5035156.93** m N, **372783.61** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80; SPT (N) □ Blows/0.3m; DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0	88				ASPHALT - 75 mm thick					
					FILL - SAND AND GRAVEL - brown, compact	SS1		13		
1.0	87				CLAY - silty, trace of sand and gravel, brown (possible fill), stiff to very stiff	SS2		14		
2.0						SS3		20		
	86				TILL - sand, gravelly, trace clay, brown, compact	SS4		25		
3.0					End of Borehole at 2.7 m Split Spoon Sampler and Auger Refusal on Inferred Bedrock					
4.0	85									
	84									
5.0	83									
6.0	82									
7.0	81									

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thick Wall Tube
- Bentonite
- Sand

LOG OF BOREHOLE BH16-12

DST REF. No.: **IN-SO-026755**
CLIENT: **Canada Lands Company**
PROJECT: **Site Servicing Phase 1B**
LOCATION: **Wateridge Village, Ottawa, Ontario**
SURFACE ELEV.: **87.87 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **200 mm**
DATE: **August 31, 2016**
COORDINATES: **5035071.7** m N, **372783.61** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE W_p W W_l (20 40 60 80)	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80; SPT (N) □ Blows/0.3m; DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
0.0					ASPHALT - 75 mm thick					
					FILL - SAND AND GRAVEL - some silt, brown, loose	SS1		9		
1.0	87				CLAY - Silty, brown, hard	SS2		8		
2.0	86					SS3		12	>>✖	
						SS4		10		
3.0	85					SS5		2		
4.0	84				CLAY - Silty, grey, firm	SS6		0	✖	
						SS7		2	✖	
5.0	83				TILL - silty clay, some sand and gravel, grey					
					End of Borehole at 5.1 m Split Spoon Sampler and Auger Refusal on Inferred Bedrock					
6.0	82									
7.0	81									
	80									

BOREHOLE (STANDARD) PHASE 1B BOREHOLES V1.3.GPJ DST_MIN.GDT 10-24-16

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thick Wall Tube
- Bentonite
- Sand

LOG OF BOREHOLE BH16-13

DST REF. No.: **IN-SO-026755**
CLIENT: **Canada Lands Company**
PROJECT: **Site Servicing Phase 1B**
LOCATION: **Wateridge Village, Ottawa, Ontario**
SURFACE ELEV.: **87.66 metres**

Drilling Data
METHOD: **Hollow Stem Auger**
DIAMETER: **200 mm**
DATE: **August 26, 2016**
COORDINATES: **5035075.11** m N, **372672.07** m E

DEPTH (m)	ELEV. (m)	Water Data	% MOISTURE (W_p W W_l) 20 40 60 80	Symbol	MATERIAL DESCRIPTION	SAMPLE #	SAMPLE TYPE	'N' VALUE	VANE (kPa) ✖ 20 40 60 80; SPT (N) □ Blows/0.3m; DCPT ◆ 20 40 60 80	REMARKS & GRAINSIZE DISTRIBUTION (%) GR SA SI CL
					ASPHALT - 75 mm thick					
					TOPSOIL - 50 mm thick					
	87				FILL - SAND - gravelly, trace clay and silt, brown, compact	SS1		13		22 67 (11)
1.0					CLAY - Silty, brown, stiff to hard	SS2		8		
	86					SS3		10	>>✖	
2.0										
	85									
3.0						SS4		2		
	84									
4.0						SS5		0	✖	
	83				CLAY - Silty, grey, soft to stiff				✖	
5.0						SS6		0		
	82					SS7		0	✖	
6.0					TILL - Silty clay, grey, stiff	SS8		14		
	81				End of Borehole at 6.7 m					
7.0										
	80									

BOREHOLE (STANDARD) PHASE 1B BOREHOLES V1.3.GPJ DST_MIN.GDT 10-24-16

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SAMPLE TYPE LEGEND

- Auger Sample
- Split Spoon Sample
- Bulk Sample
- Rock Core
- Hiller Peat Sampler
- 70mm Thick Wall Tube
- Bentonite
- Sand

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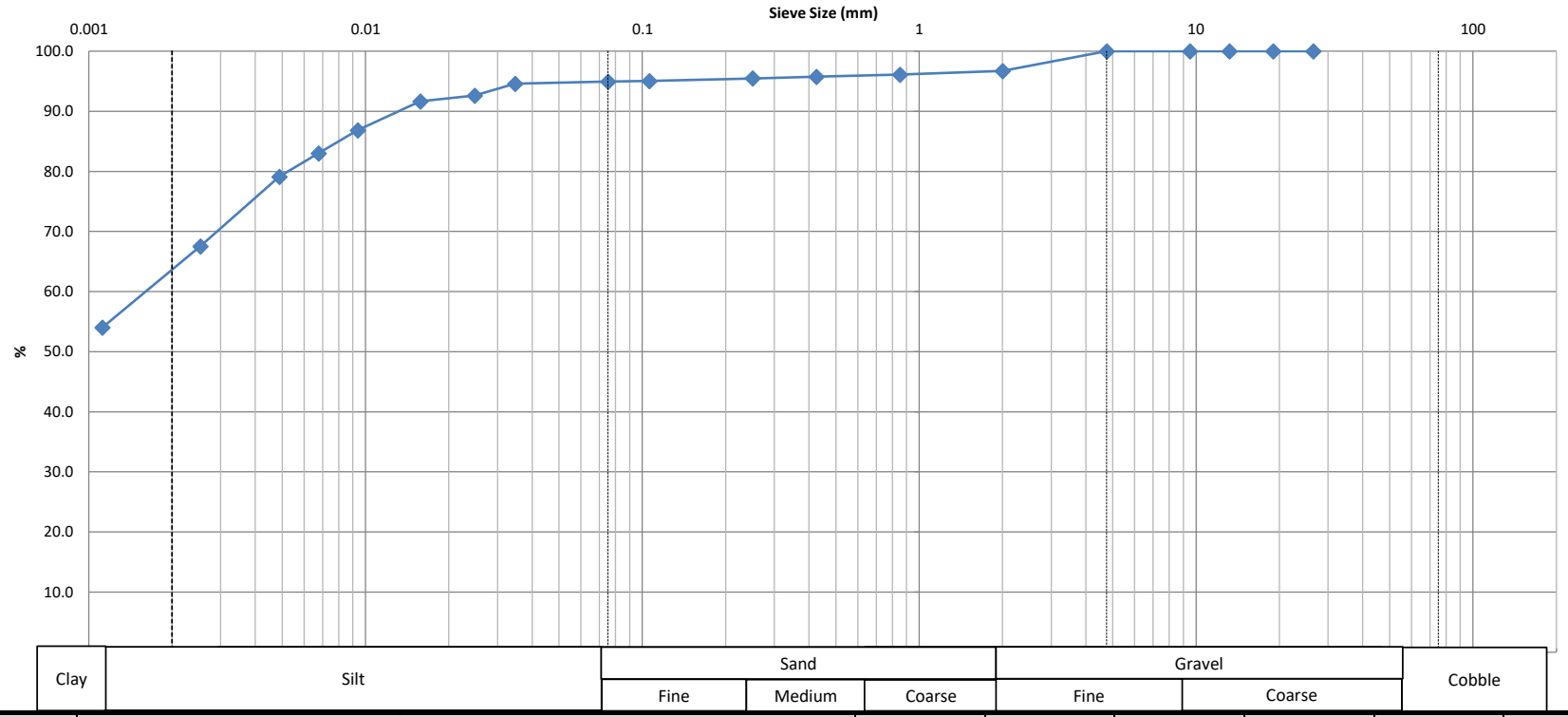
SIEVE ANALYSIS **ASTM C136**

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO:	PG 5354
CONTRACT NO.:		BH OR TP No.:	BH8 SS4	LAB NO:	17097
PROJECT:	715 Mikinak Rd.			DATE RECEIVED:	22-Jun-20
				DATE TESTED:	24-Jun-20
DATE SAMPLED:	15-Jun-20			DATE REPORTED:	29-Jun-20
SAMPLED BY:	Luke Lopers			TESTED BY:	DB



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		35.5					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	5.1	31.4	63.5

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO.:	PG 5354
PROJECT:	715 Mikinak Rd.	BH OR TP No.:	BH8 SS4	DATE SAMPLED	15-Jun-20
LAB No. :	17097	TESTED BY:	DB	DATE RECEIVED	22-Jun-20
SAMPLED BY:	Luke Lopers	DATE REPT'D:	29-Jun-20	DATE TESTED:	24-Jun-20

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
100.3	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	45.60	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.93	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	141.20	91.20
		CORRECTED	0.912	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5		0.0	**100.0**
19	**0**	0.0	**100.0**
13.2	**0.0**	0.0	**100.0**
9.5	**0.0**	0.0	**100.0**
4.75	**0.0**	0.0	**100.0**
2.0	**3.3**	3.3	**96.7**
Pan	**97.0**		
0.850	**0.31**	3.9	**96.1**
0.425	**0.50**	4.3	**95.7**
0.250	**0.64**	4.5	**95.5**
0.106	**0.85**	4.9	**95.1**
0.075	**0.92**	5.1	**94.9**
Pan	**0.93**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:54	54.0	5.0	23.0	0.0346	97.8	**94.6**
2	8:55	53.0	5.0	23.0	0.0248	95.8	**92.6**
5	8:58	52.5	5.0	23.0	0.0158	94.8	**91.7**
15	9:08	50.0	5.0	23.0	0.0094	89.8	**86.8**
30	9:23	48.0	5.0	23.0	0.0068	85.8	**83.0**
60	9:53	46.0	5.0	23.0	0.0049	81.8	**79.1**
250	1:03	40.0	5.0	23.0	0.0025	69.8	**67.5**
1440	8:53	33.0	5.0	23.0	0.0011	55.9	**54.0**

COMMENTS:

Moisture = 35.5%

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.

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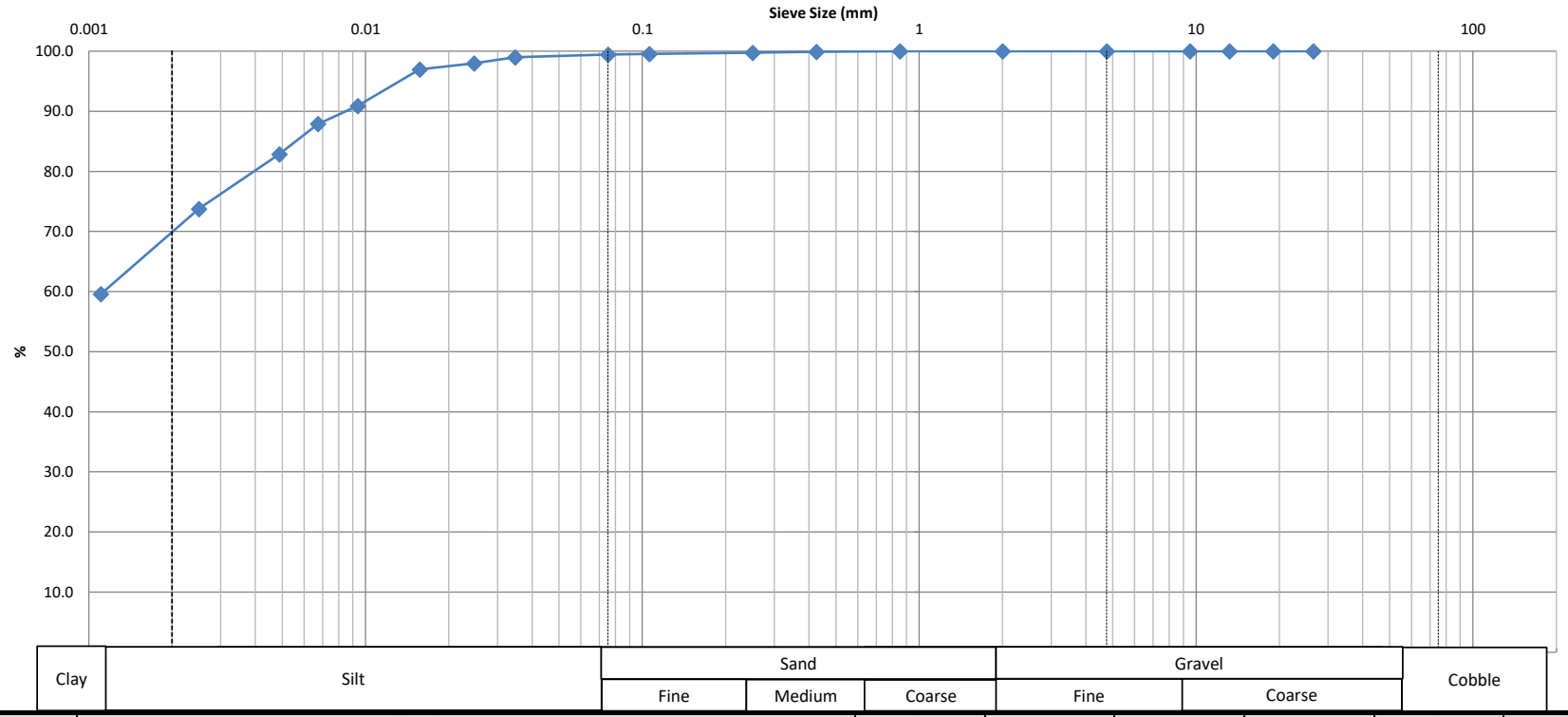
SIEVE ANALYSIS **ASTM C136**

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO:	PG 5354
CONTRACT NO.:		BH OR TP No.:	BH4 SS4	LAB NO:	17095
PROJECT:	715 Mikinak Rd.			DATE RECEIVED:	22-Jun-20
				DATE TESTED:	24-Jun-20
DATE SAMPLED:	15-Jun-20			DATE REPORTED:	29-Jun-20
SAMPLED BY:	Luke Lopers			TESTED BY:	DB



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						28.2					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	0.6		29.4		70.0	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO.:	PG 5354
PROJECT:	715 Mikinak Rd.	BH OR TP No.:	BH4 SS4	DATE SAMPLED	15-Jun-20
LAB No. :	17095	TESTED BY:	DB	DATE RECEIVED	22-Jun-20
SAMPLED BY:	Luke Lopers	DATE REPT'D:	29-Jun-20	DATE TESTED:	24-Jun-20

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
109.6	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	46.53	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.30	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	143.05	93.05
		CORRECTED	0.931	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5		0.0	**100.0**
19	**0**	0.0	**100.0**
13.2	**0.0**	0.0	**100.0**
9.5	**0.0**	0.0	**100.0**
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**109.6**		
0.850	**0.00**	0.0	**100.0**
0.425	**0.05**	0.1	**99.9**
0.250	**0.13**	0.3	**99.7**
0.106	**0.24**	0.5	**99.5**
0.075	**0.29**	0.6	**99.4**
Pan	**0.30**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:27	54.0	5.0	23.0	0.0346	99.0	**99.0**
2	8:28	53.5	5.0	23.0	0.0246	98.0	**98.0**
5	8:31	53.0	5.0	23.0	0.0157	97.0	**97.0**
15	8:41	50.0	5.0	23.0	0.0094	90.9	**90.9**
30	8:56	48.5	5.0	23.0	0.0067	87.9	**87.9**
60	9:26	46.0	5.0	23.0	0.0049	82.8	**82.8**
250	12:36	41.5	5.0	23.0	0.0025	73.7	**73.7**
1440	8:26	34.5	5.0	23.0	0.0011	59.6	**59.6**

COMMENTS:

Moisture = 28.2%

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.

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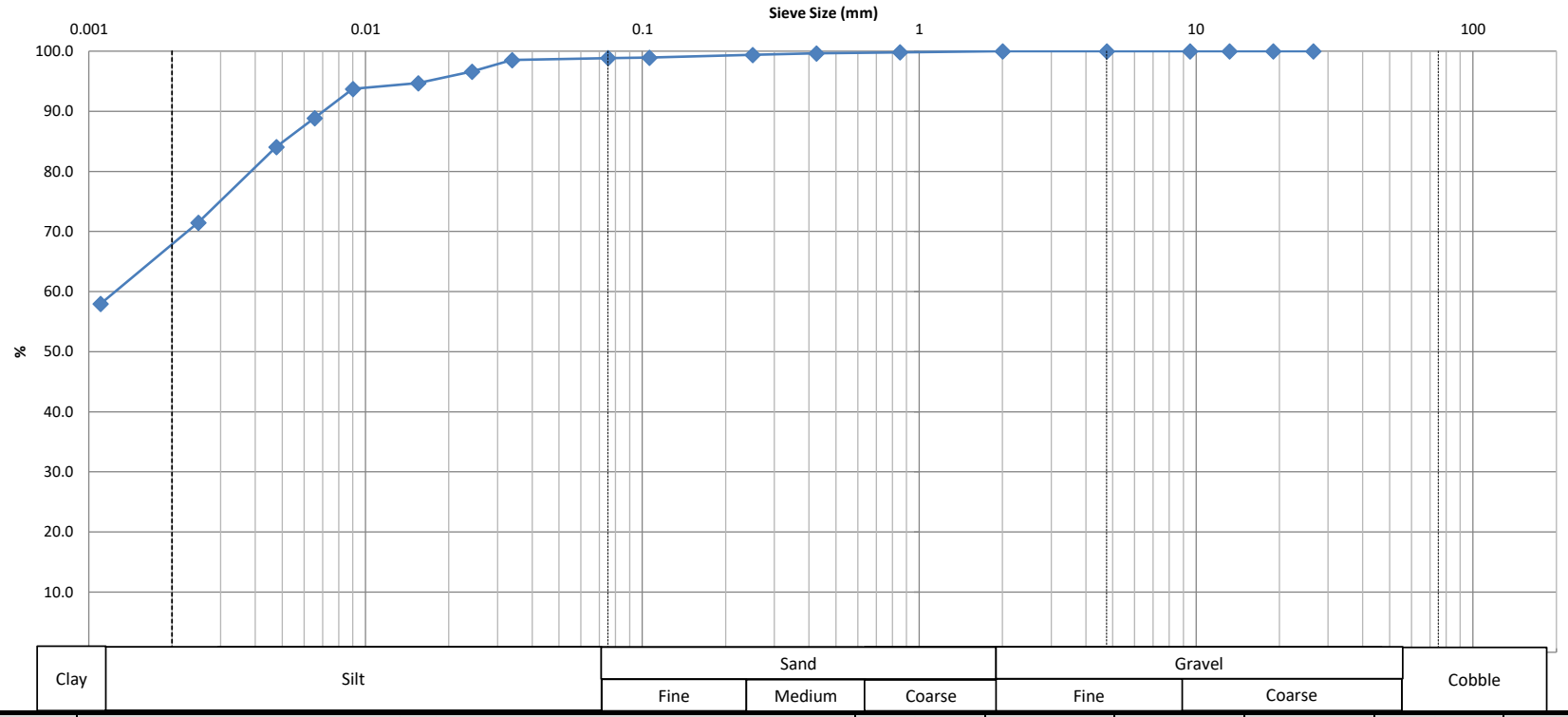
SIEVE ANALYSIS **ASTM C136**

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO:	PG 5354
CONTRACT NO.:		BH OR TP No.:	BH5 SS4	LAB NO:	17096
PROJECT:	715 Mikinak Rd.			DATE RECEIVED:	22-Jun-20
				DATE TESTED:	24-Jun-20
DATE SAMPLED:	15-Jun-20			DATE REPORTED:	29-Jun-20
SAMPLED BY:	Luke Lopers			TESTED BY:	DB



Identification	Soil Classification					MC(%)	LL	PL	PI	Cc	Cu
						29.1					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	1.1		30.4		68.5	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Ottawa Community Housing	DEPTH:	-	FILE NO.:	PG 5354
PROJECT:	715 Mikinak Rd.	BH OR TP No.:	BH5 SS4	DATE SAMPLED	15-Jun-20
LAB No. :	17096	TESTED BY:	DB	DATE RECEIVED	22-Jun-20
SAMPLED BY:	Luke Lopers	DATE REPT'D:	29-Jun-20	DATE TESTED:	24-Jun-20

SAMPLE INFORMATION

SAMPLE MASS	SPECIFIC GRAVITY
107.3	2.700

INITIAL WEIGHT	50.00	**HYGROSCOPIC MOISTURE**		
WEIGHT CORRECTED	46.58	TARE WEIGHT	50.00	ACTUAL WEIGHT
WT. AFTER WASH BACK SIEVE	0.57	AIR DRY	150.00	100.00
SOLUTION CONCENTRATION	40 g/L	OVEN DRY	143.15	93.15
		CORRECTED	0.932	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
26.5		0.0	**100.0**
19	**0**	0.0	**100.0**
13.2	**0.0**	0.0	**100.0**
9.5	**0.0**	0.0	**100.0**
4.75	**0.0**	0.0	**100.0**
2.0	**0.0**	0.0	**100.0**
Pan	**107.3**		
0.850	**0.09**	0.2	**99.8**
0.425	**0.17**	0.3	**99.7**
0.250	**0.31**	0.6	**99.4**
0.106	**0.53**	1.1	**98.9**
0.075	**0.57**	1.1	**98.9**
Pan	**0.57**		
SIEVE CHECK 0.0	MAX = 0.3%		

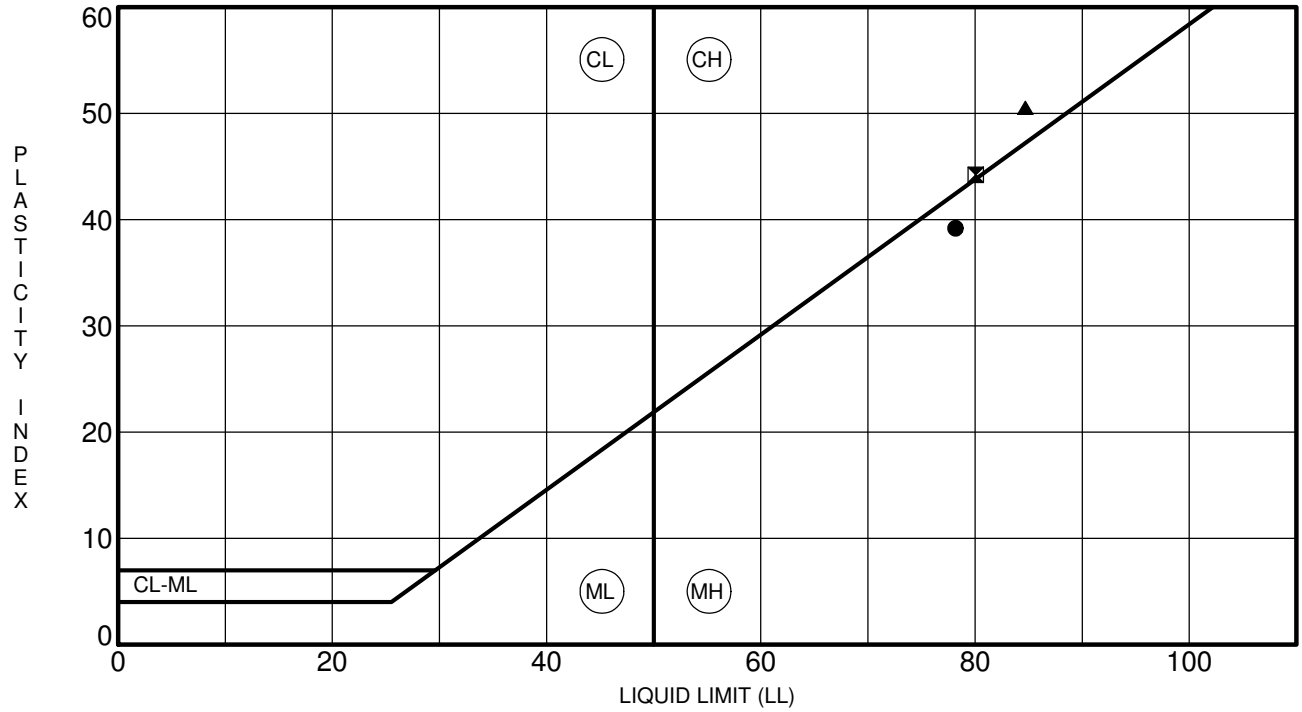
HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:42	56.0	5.0	23.0	0.0338	98.6	**98.6**
2	8:43	55.0	5.0	23.0	0.0242	96.6	**96.6**
5	8:46	54.0	5.0	23.0	0.0155	94.7	**94.7**
15	8:56	53.5	5.0	23.0	0.0090	93.7	**93.7**
30	9:11	51.0	5.0	23.0	0.0065	88.9	**88.9**
60	9:41	48.5	5.0	23.0	0.0048	84.1	**84.1**
250	12:51	42.0	5.0	23.0	0.0025	71.5	**71.5**
1440	8:41	35.0	5.0	23.0	0.0011	58.0	**58.0**

COMMENTS:

Moisture = 29.1%

REVIEWED BY:	C. Beadow	Joe Forsyth, P. Eng.



Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 4-20**	**SS 3**	**78**	**39**	**39**		**MH - Inorganic silts of high plasticity**
⧓	**BH 5-20**	**SS 3**	**80**	**36**	**44**		**CH - Inorganic clays of high plasticity**
▲	**BH 8-20**	**SS3**	**85**	**34**	**51**		**CH - Inorganic clays of high plasticity**

CLIENT

PROJECT **Geotechnical Investigation - Proposed Residential Building - 715 Mikinak Road**

FILE NO. **PG5354**

DATE **16 Jun 20**

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 - 1991 ARIAL PHOTOGRAPH

DRAWING PG5354-1 - TEST HOLE LOCATION PLAN

DRAWING PG5354-2 - PERMISSIBLE GRADE RAISE AREAS

DRAWING PG5354-3 - TREE PLANTING SETBACK RECOMMENDATIONS

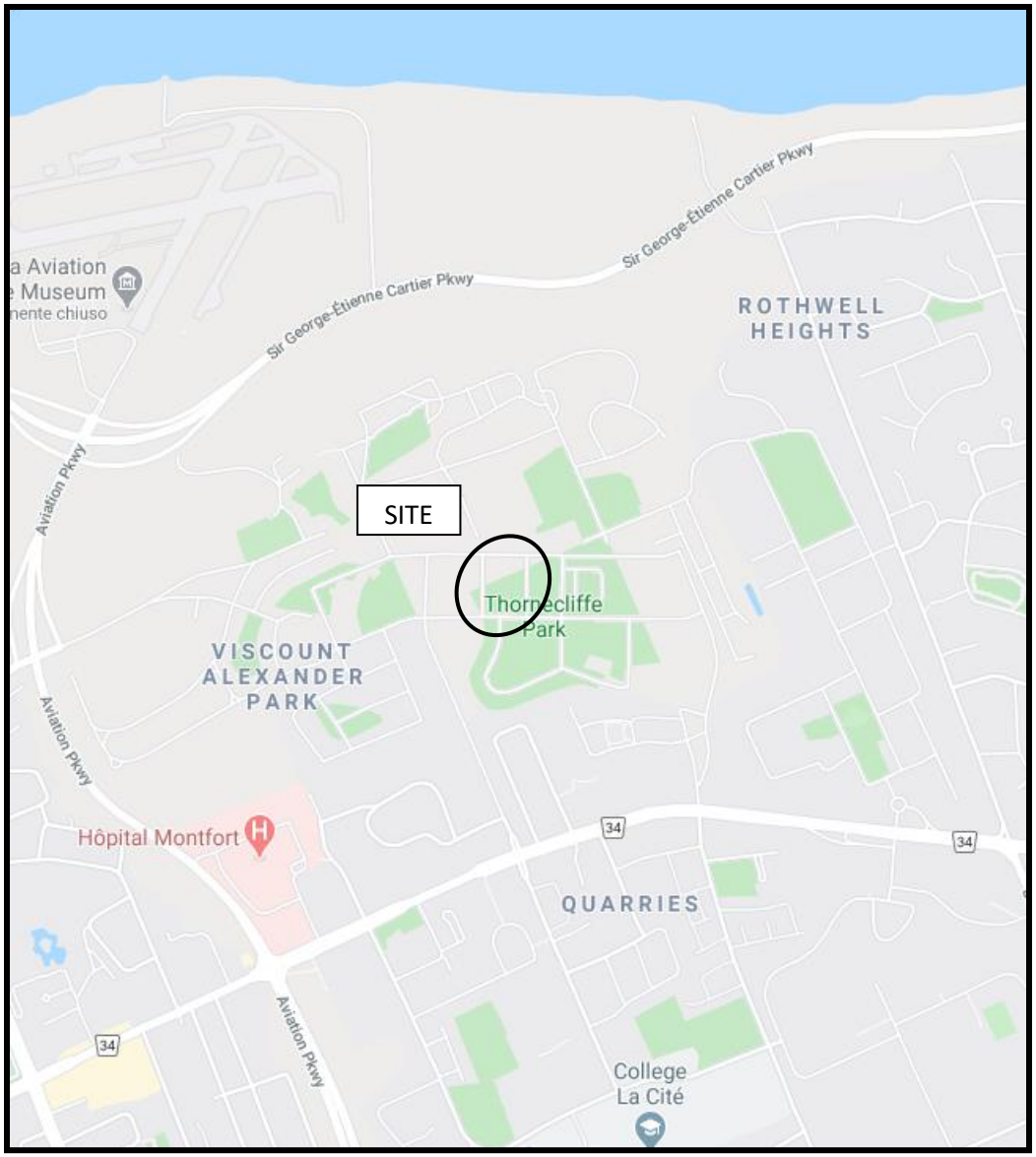


FIGURE 1

KEY PLAN

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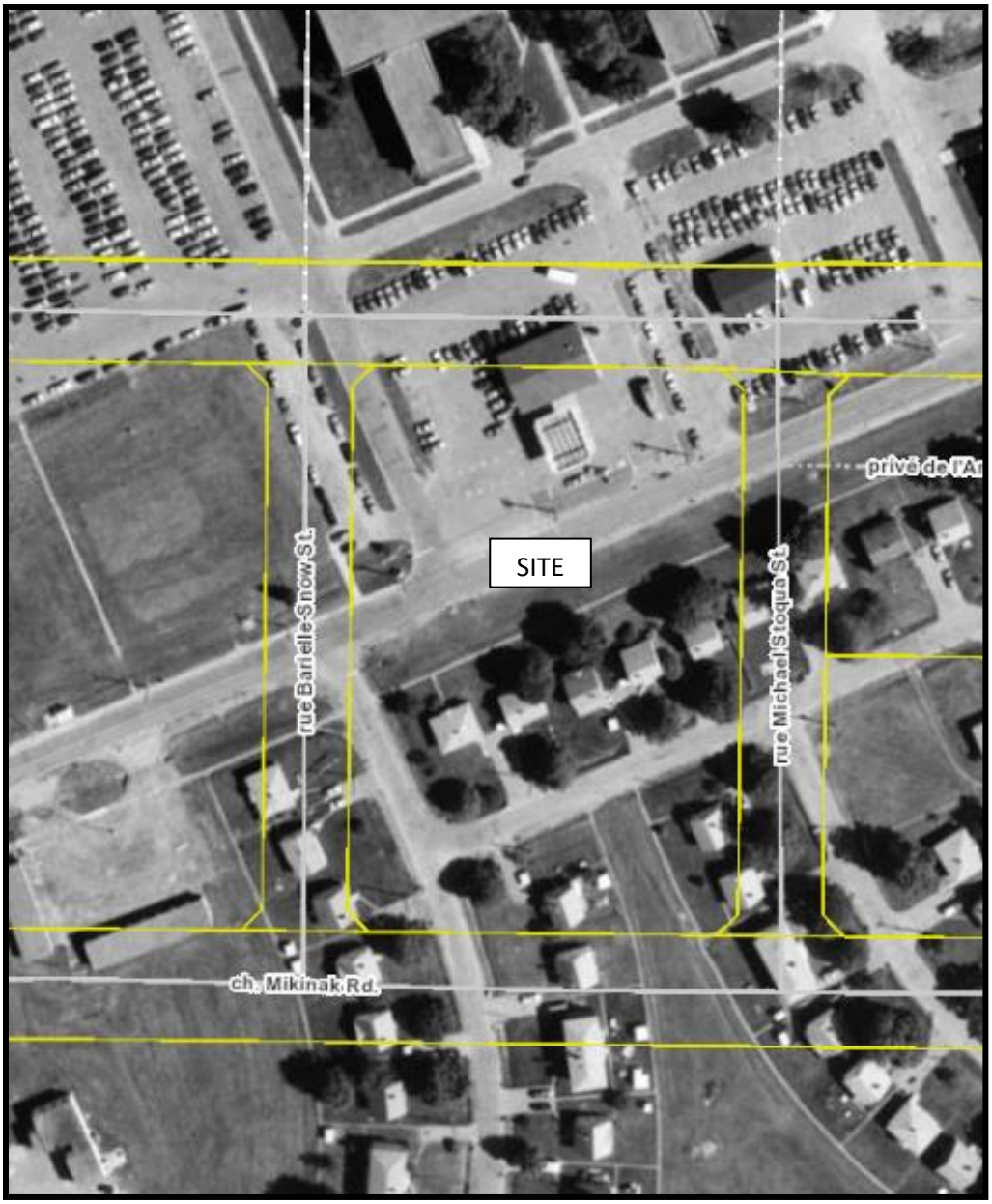

FIGURE 2

1991 ARIAL PHOTOGRAPH

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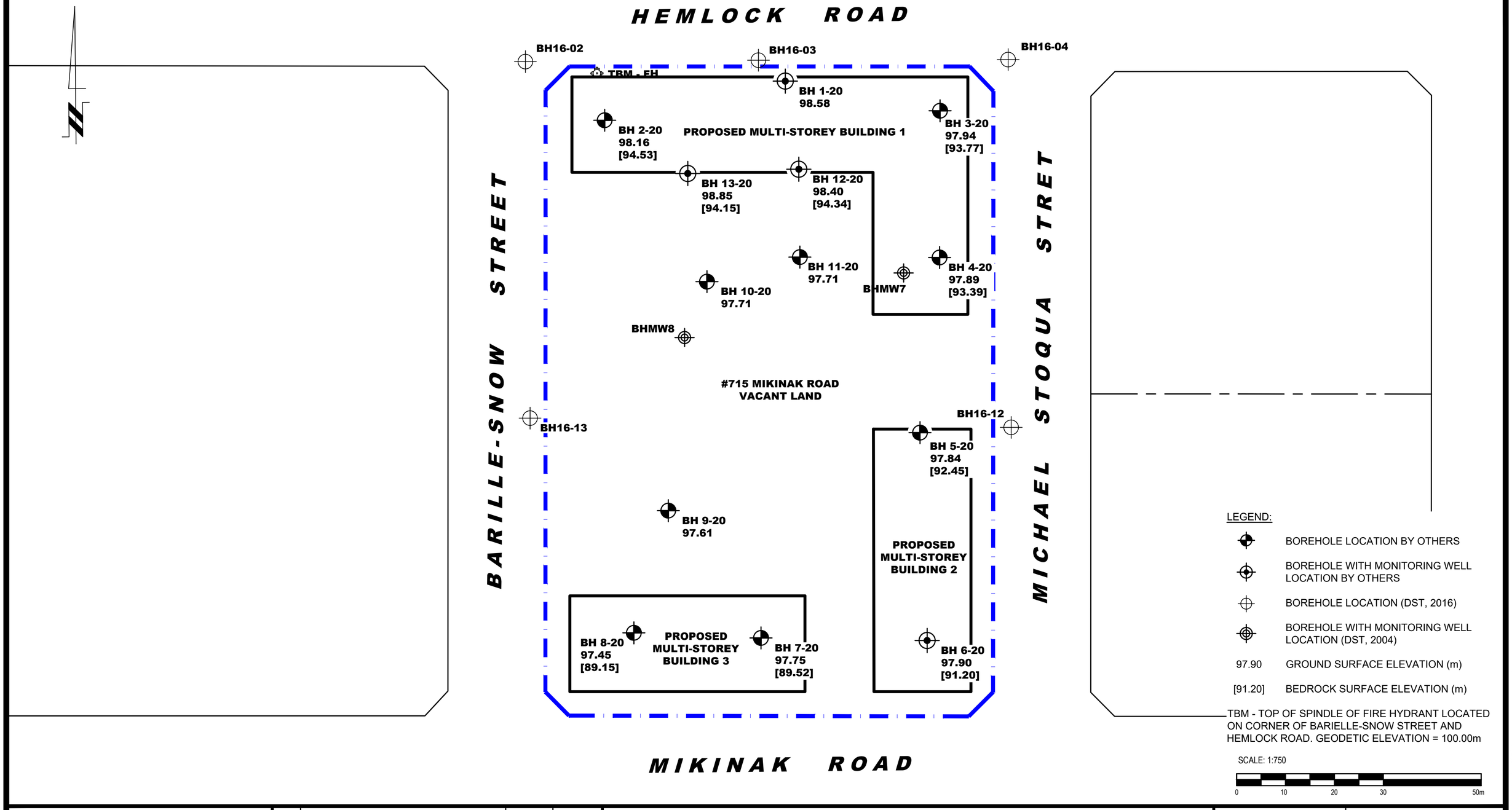

LEGEND:

- BOREHOLE LOCATION BY OTHERS
- BOREHOLE WITH MONITORING WELL LOCATION BY OTHERS
- BOREHOLE LOCATION (DST, 2016)
- BOREHOLE WITH MONITORING WELL LOCATION (DST, 2004)
- 97.90 GROUND SURFACE ELEVATION (m)
- [91.20] BEDROCK SURFACE ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT LOCATED ON CORNER OF BARIELLE-SNOW STREET AND HEMLOCK ROAD. GEODETIC ELEVATION = 100.00m

SCALE: 1:750

0 10 20 30 50m

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NO.	REVISIONS	DATE	INITIAL

OTTAWA COMMUNITY HOUSING

GEOTECHNICAL INVESTIGATION
715 MIKINAK ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750	Date: 07/2020
Drawn by: NFRV	Report No.: PG5354-1
Checked by: JV	Dwg. No.: PG5354-1
Approved by: DJG	Revision No.:

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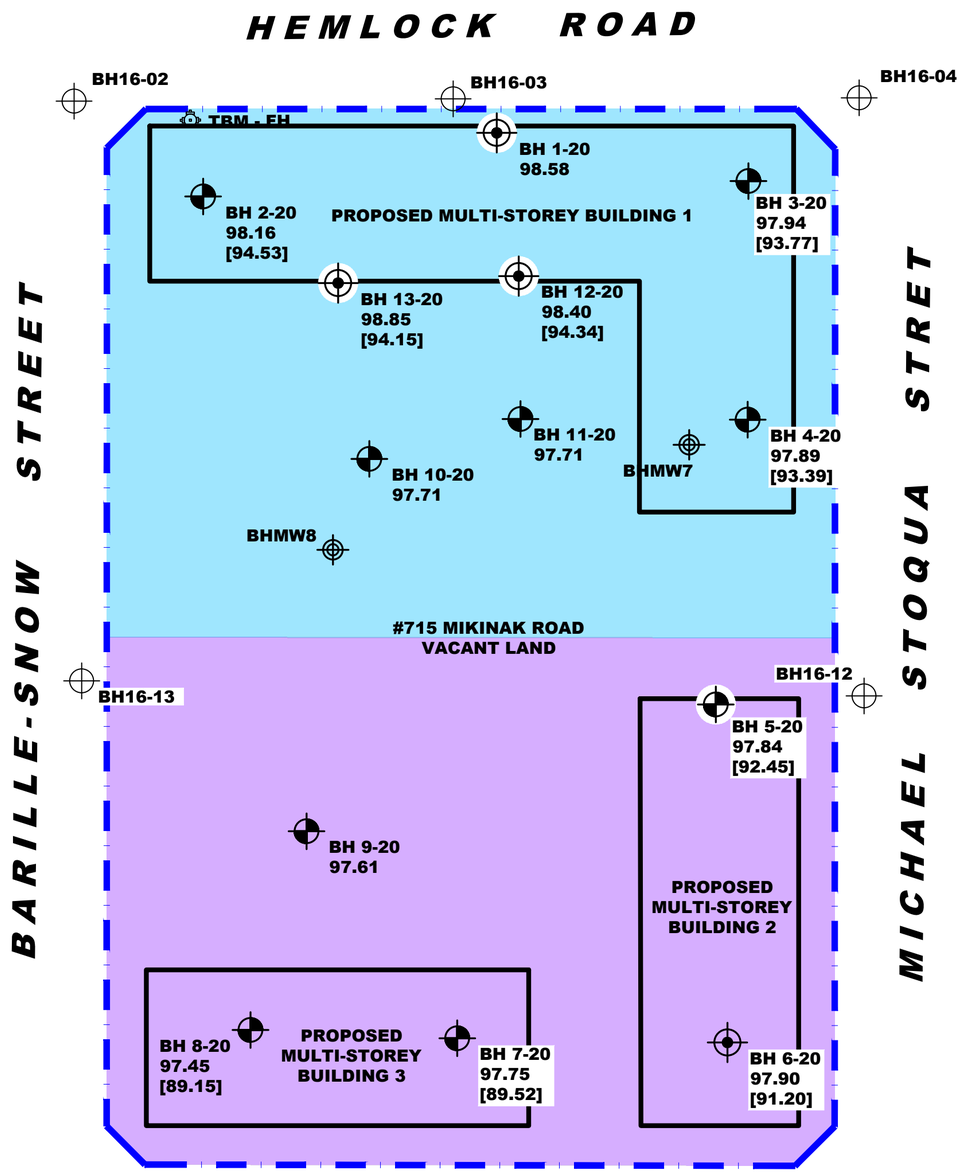

LEGEND:

- BOREHOLE LOCATION BY OTHERS
- BOREHOLE WITH MONITORING WELL LOCATION BY OTHERS
- BOREHOLE LOCATION (DST, 2016)
- BOREHOLE WITH MONITORING WELL LOCATION (DST, 2004)
- 97.90 GROUND SURFACE ELEVATION (m)
- [91.20] BEDROCK SURFACE ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT LOCATED ON CORNER OF BARIELLE-SNOW STREET AND HEMLOCK ROAD. GEODETIC ELEVATION = 100.00m

- AREAS WHERE GRADE RAISES UP TO 1.5m IS PERMITTED
- AREAS WHERE GRADE RAISES UP TO 2.0m IS PERMITTED

SCALE: 1:750

0 10 20 30 50m

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Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL

OTTAWA COMMUNITY HOUSING

GEOTECHNICAL INVESTIGATION
715 MIKINAK ROAD

OTTAWA, ONTARIO

Title:

PERMISSIBLE GRADE RAISE PLAN

Scale: 1:750	Date: 07/2020
Drawn by: NFRV	Report No.: PG5354-1
Checked by: JV	Dwg. No.: PG5354-2
Approved by: DJG	Revision No.:

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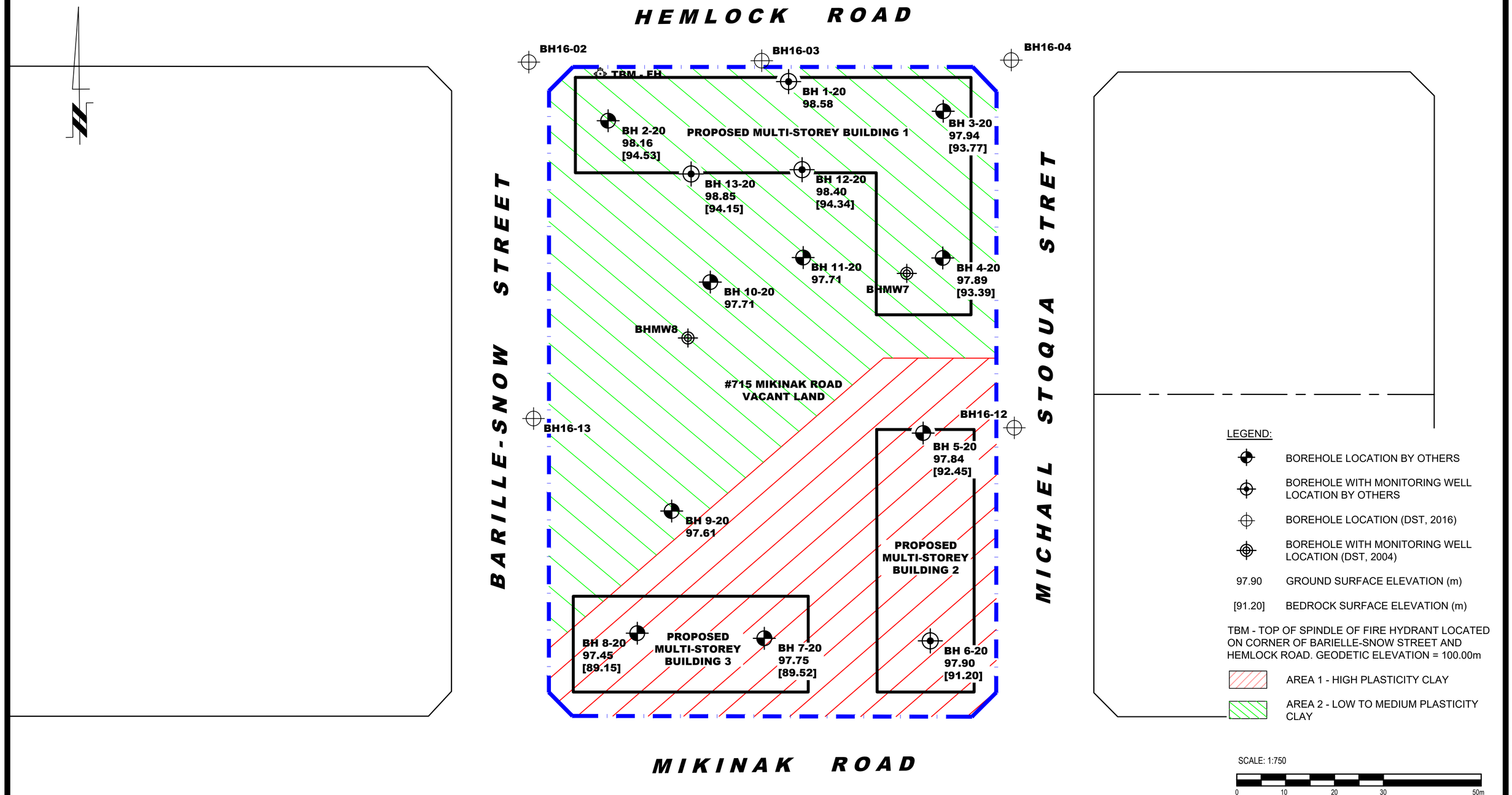

LEGEND:

- BOREHOLE LOCATION BY OTHERS
- BOREHOLE WITH MONITORING WELL LOCATION BY OTHERS
- BOREHOLE LOCATION (DST, 2016)
- BOREHOLE WITH MONITORING WELL LOCATION (DST, 2004)
- 97.90 GROUND SURFACE ELEVATION (m)
- [91.20] BEDROCK SURFACE ELEVATION (m)

TBM - TOP OF SPINDLE OF FIRE HYDRANT LOCATED ON CORNER OF BARIELLE-SNOW STREET AND HEMLOCK ROAD. GEODETIC ELEVATION = 100.00m

- AREA 1 - HIGH PLASTICITY CLAY
- AREA 2 - LOW TO MEDIUM PLASTICITY CLAY

SCALE: 1:750

0 10 20 30 50m

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Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL

OTTAWA COMMUNITY HOUSING

GEOTECHNICAL INVESTIGATION
715 MIKINAK ROAD

OTTAWA, ONTARIO

Title:
TREE PLANTING SETBACK RECOMMENDATIONS

Scale: 1:750	Date: 07/2020
Drawn by: NFRV	Report No.: PG5354-1
Checked by: JV	Dwg. No.: PG5354-3
Approved by: DJG	Revision No.:

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